IFM-GEOMAR REPORT

IFM-GEOMAR
Leibniz-Institut für Meereswissenschaften
an der Universität Kiel

# FS Sonne
# Fahrtbericht / Cruise Report SO201-1b

**KALMAR**
**K**urile-Kamchatka and **AL**eutian **MAR**ginal Sea-Island Arc Systems:
Geodynamic and Climate Interaction in Space and Time

Yokohama, Japan - Tomakomai, Japan
10.06. - 06.07.2009


Berichte aus dem Leibniz-Institut
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## SUMMARY

R/V SONNE cruise SO201 Leg 1b was one of three marine expeditions carried out within the framework of the German-Russian KALMAR Project, which is funded by German Ministry of Education and Research (BMBF). The expedition goals were to sample in-situ volcanic and other magmatic rocks from (1) the northern part of the Hawaii-Emperor Seamount Chain, (2) western Aleutian Arc, (3) Bowers Ridge, and (4) ocean floor and fracture zones between Emperor Chain and western Aleutian trench. Major questions addressed by SO201 Leg 1b include the early history of the Hawaii Hotspot, the origin and extend of recent volcanism in the Western Aleutian Arc, the origin of the Bowers Ridge, and the age and composition of the oceanic crust of the NW Pacific. With this approach SO201 Leg 1b will contribute to the main objective of KALMAR, to better understand the geosystem Kurile-Kamchatka and Aleutian-Arc.

SO201 Leg 1b started in Yokohama/Japan on June 9th, 2009 and ended in Tomakomai, Japan on July 6th, 2009. Complementing 3,406 nm bathymetric and sediment-echo-sounding profiling, a total of 45 dredges and one TV grab were carried out during 13.5 working days on this cruise. Of these deployments, 35 recovered magmatic rocks, 13 recovered volcaniclastic rocks, 8 recovered sedimentary rock, and 15 included Mn-Fe oxide encrustations (without dropstones).

Dredging at the northern Emperor Seamount Chain yielded volcanic rocks from the previously unsampled Suizei and Tenji Seamounts and contributed to fill the ~700 km long sampling gap in the northern Emperor Chain. Sampling at the Stalemate Fracture zone, the Emperor Trough, and the fossil Kula-Pacific spreading center provided a wide spectrum of magmatic rocks representing a cross section through the ocean crust. Various young and fresh basalts, andesites, and dacites, recovered from 15 volcanic cones in the Ingenstrem Depression (western Aleutian arc), will provide a much improved basis for understanding compositional variability of the volcanism in this area and throughout the Aleutian arc. The discovery of young volcanism west of the Aleutian island Attu indicates that the Aleutians are one continuous magmatic arc extending from the Alaska Peninsula on the east to Piip Seamount on the west. Dredging at Bowers Ridge and associated seamounts yielded for the first time a collection of magmatic rocks from the ridge basement which may provide new and important information on the geological history of Bowers Ridge and the Bering Sea.



## ZUSAMMENFASSUNG

Die FS SONNE-Reise SO201 Leg 1b war eine von drei marinen Expeditionen, die im Rahmen des BMBF-geförderten deutsch-russischen Verbundvorhabens KALMAR durchgeführt wurden. Die Expedition hatte die Beprobung magmatischer Gesteine zum Ziel (1) im nördlichen Teil der Hawaii-Emperor-Seamountkette, (2) am westlichen Aleuten-Inselbogen, (3) am Bowersrücken in der Beringsee und (4) von der Ozeankruste zwischen den Emperor Seamounts und den Aleuten-Tiefseegraben. Durch die Analyse dieser Proben sollen u.a. Fragen nach der frühen Geschichte des Hawaii-Hotspot, dem Ursprung und dem Ausmaß des rezenten Vulkanismus im westlichen Aleuten-Inselbogen, dem Ursprung des Bowersrücken und dem Alter sowie der Zusammensetzung der Ozeankruste im Nordwest-Pazifik beantwortet werden. Damit will SO201 Leg 1b zu dem übergeordneten Ziel von KALMAR, einem besseren Verständnis des Geosystems Kurilen-Kamtschaka-Aleutenbogen, beitragen.

SO201 Leg 1b begann am 9. Juni 2009 in Yokohama (Japan) und endete am 6. Juli 2009 in Tomakomai (Japan). Insgesamt wurden in gut 13 Tagen 45 Dredge-züge und ein TV-Greifereinsatz durchgeführt. Achtunddreißig der Geräteeinsätze erbrachten magmatische Gesteine, 13 Vulkaniklastika, 8 sedimentäre Gesteine und 15 Mn-Fe-Oxide (ohne „Dropstones“).

Mit den Dredgezügen an den Emperor Seamounts konnten vulkanische Gesteine der bisher unbeprobten Seamounts Suizei und Tenji beprobt und so dazu beigetragen werden, eine ca. 700 km lange Beprobungslücke in den nördlichen Emperorkette zu schließen. Von der Stalemate Störungszone, dem Emperor Trog und dem fossilen Kula-Pazifik-Spreizungszentrum wurde ein weites Spektrum an magmatischen Gesteinen gewonnen, die quasi einen Querschnitt durch die Ozeankruste repräsentieren. Basalte, Andesite und Dazite, die an 15 Vulkankegeln in der Ingenstrem Depression (westlicher Aleutenbogen) gedredgt wurden, werden es erlauben, die kompositionelle Variabilität des Vulkanismus in diesem Gebiet zu charakterisieren. Die Entdeckung von jungem Vulkanismus westlich der Aleuteninsel Attu bedeutet, dass der Aleuteninselbogen höchstwahrscheinlich auf seiner gesamten Länge durchgehend aktiv ist, was eine große Bedeutung für Modelle zur Entwicklung des Beringsee-Kamtschatka-Aleutenbogensystems hat. Am Bowersrücken konnte erstmals eine Kollektion basaltischer und andesitischer Laven gewonnen werden, die uns Informationen über den Ursprung des Bowersrücken und die geologische Geschichte der Beringsee liefern wird.

## 1. ACKNOWLEDGEMENTS

We would especially like to thank Captain Mallon and the crew of the R/V SONNE. Their hard work, high level of experience, willingness to help, and the pleasant working atmosphere on board contributed directly to the success of the SO201 Leg 1b cruise.

We are very grateful to Gene Yogodzinski, Christoph Gaedicke, Stefan Lagade, and Scott White for providing multi-beam data, multi channel seismic data, and a variety invaluable background information for the preparation of the SO201 Leg 1b cruise, all of which contributed to a thorough achievement of the cruise objectives.

We thank the Government of the United States of America for granting permission to work within their territorial waters.

The SO201 Leg 1b KALMAR project is funded by the “Bundesministerium für Bildung und Forschung” (BMBF) project award to Prof. Wolf-Christian Dullo (head project, ship’s time) and Prof. Kaj Hoernle (sub-project 3). S. Silantiev’s and A. Novoselov’s funding was provided by the Russian Foundation for Basic Research (grant no. 09-05-00008a).

# 2. PARTICIPANTS

## 2.1. Ship's Crew

| | | | |
|---|---|---|---|
| Mallon, Lutz | Master | Guzman-Navarrete, Werner | Chief Engin. |
| Korte, Detlef | Chief Mate | Thomsen, Sascha | 2nd Engineer |
| Schmitz, Olaf | 2nd Mate | Hermesmeyer, Dieter | 2nd Engineer |
| Göbel, Jens | 2nd Mate | Zebrowski, Dariusz | Electrician |
| Leppin, Jörg | Chief Electrician | Rosemeyer, Rainer | Fitter |
| Ehmer, Andreas | Systems Manager | Zeitz, Holger | Motorman |
| Borchert, Wolfgang | Systems Manager | Krawczak, Ryszard | Motorman |
| Walther, Anke | Surgeon | Grübe, Gerlinde | Chief Steward |
| Wieden, Wilhelm | Chief Cook | Steep, Maik | 2nd Steward |
| Ganagaraj, Antony | 2nd Cook | Peplow, Michael | Apprentice |
| Schrapel, Andreas | Boatswain | Eidam, Oliver | Apprentice |
| Kraft, Jürgen | A.B. | Stängl, Günther | A.B. |
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| Bierstedt, Torsten | A.B. | Eibel, Markus | A.B. |

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| | |
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| | |
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| Gaedike, Christoph | BGR (Germany) |
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| Silantiev, Sergej | Vernadsky Inst. (Russia) |
| Yogodzinski, Gene | Univ. South Carolina (U.S.A.) |

## 2.4. Shipboard Scientific Party *(in alphabetical order)*

| | | |
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| Krasheninnikov, Stepan | Student | Moscow State Univ. |
| Kuvikas, Olga | Student | Bering State Univ. |
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| Portnyagin, Maxim | Geologist | IFM-GEOMAR |
| Silantiev, Sergey | Geologist | Vernadsky Inst. |
| Turka, Joshua | Student | Univ. South Carolina |
| van den Bogaard, Christel | Geologist | IFM-GEOMAR |
| Wanke, Maren | Student | CAU Kiel/IFM-GEOMAR |
| Werner, Reinhard (Chief Scientist) | Geologist | IFM-GEOMAR |
| Yogodzinski, Gene | Geologist | Univ. South Carolina |

*The SO201 Leg 1b Shipboard Scientific Party.*

### 2.5. Institutions

| | |
|---|---|
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## 3. MAJOR OBJECTIVES AND BACKGROUND OF SO201 LEG 1B KALMAR

*(M. Portnyagin, G. Yogodzinski, R. Werner, F. Hauff, K. Hoernle)*

Zhe R/V SONNE cruise SO201 Leg1b (http://kalmar.ifm-geomar.de/?Marine_expeditions:SO201_Leg_1b) is one of three marine expeditions carried out within the framework of the German-Russian KALMAR project (***K***urile-Kamchatka and ***AL***eutian ***MAR***ginal Sea-Island Arc Systems: Geodynamic and Climate Interaction in Space and Time) that is funded by German ministry of Education and Research (BMBF). SO201 Leg 1b KALMAR comprises investigations of volcanic and tectonic structures and dredging of magmatic rocks in the Northwest Pacific and Bering Sea, and in areas adjacent to the Kamchatka-Aleutian junction (Fig. 3.1.).

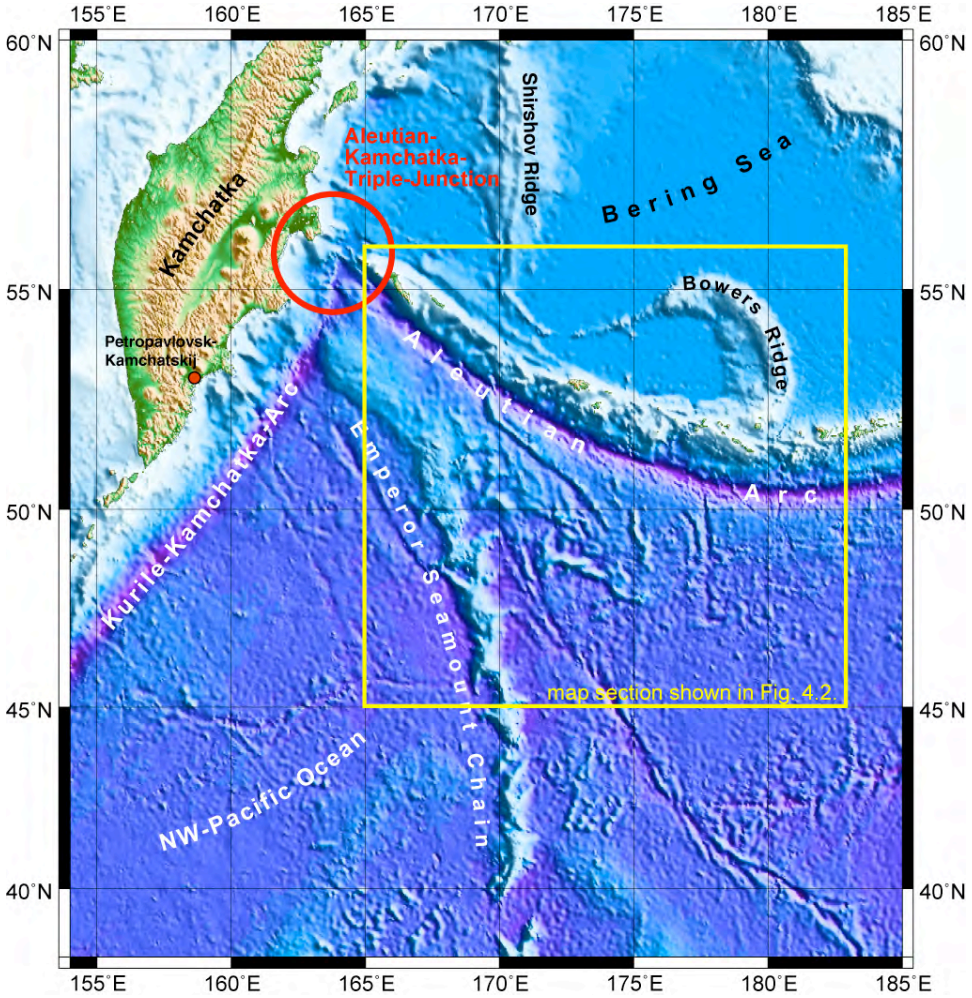


**Fig. 3.1.:** *Overview map of the Kamchatka-Aleutian Arc system.*

The geological studies carried out on R/V SONNE cruise SO201 Leg 1b targeted four major regions: (1) northern part of the Emperor Seamount Chain, (2) western Aleutian Arc, (3) Bowers Ridge, and (4) oceanic floor and fracture zones between Emperor Chain and Aleutian trench. Most of the areas selected for recovering of in-situ magmatic rocks had not been previously sampled. The interpretation of their origin was largely based on bathymetric and geophysical analysis and thus remained hypothetical. Geological, volcanological, petrological, geochemical and geochronological analyses subsequent to the cruise aim to provide principle information on:

(1) the origin, age and composition of the Hawaiian hotspot volcanism during the Late Cretaceous to Early Cenozoic time;
(2) the origin of recent volcanism in the Western Aleutian Arc, in a setting transitional from subduction to strike-slip fault tectonic regime;

(3) the origin of Bowers Ridge in the Bering Sea;
(4) the age and composition of oceanic crust formed at fossil Kula-Pacific and Pacific-Farallon spreading centers during the late Cretaceous to Cenozoic time;
(5) the composition of oceanic crust subducting beneath the Western Aleutian Arc and Kamchatka and its bearing on the composition modern arc volcanism.

The integration of these results with existing data as well as with the data obtained during on-land investigations within the KALMAR project will contribute substantially to the main objective of KALMAR, which is to better understand the geosystem Kurile-Kamtchatka and Aleutian Arc.

### 3.1. NORTHERN EMPEROR SEAMOUNTS

The Hawaiian-Emperor Seamount Chain, produced during the passage of the Pacific Plate over the Hawaiian hotspot, extends for 5,800 km from the presently most active Hawaiian Island and Loihi Seamount (the present location of the hotspot) northwest to the Detroit (71 - 76 m.y. old) and Meiji (> 81 m.y. old) seamounts (Duncan and Keller 2004), seaward of the Kamchatka-Aleutian arc junction (Fig. 3.1.). Despite the extensive data set on the modern Hawaiian plume magmatism, geochemical and age data are still scarce for the submarine part of the hotspot track. These data, however, are crucial for elucidating the compositional and thermal evolution of the Hawaiian mantle plume and for paleotectonic reconstructions of the Pacific Ocean in the Late Cretaceous-Early Cenozoic.

Presently available information on the age and composition of the northern Emperor Seamounts is based on results of the DSDP and ODP investigations which recovered basement rocks from Meiji, Detroit and Suiko Seamounts (Keller et al. 2000, Duncan and Keller 2004, Regelous et al. 2003, Huang et al. 2004, Frey et al. 2005). These data have substantially changed previous views on the compositional range of the Hawaiian plume magmas and were used to demonstrate significant southward motion of the hotspot during the Late Cretaceous. Reliable age data were obtained for Detroit (76 Ma at ODP Site 1203, 81 Ma at ODP Site 884) and Suiko Seamount (61 Ma at ODP Site 433). An important result from geochemical investigations of the Meiji and Detroit Seamounts was the discovery of rocks with relatively depleted trace element and isotopic compositions, which were interpreted to result from the location of the Hawaiian plume on young and thus thin oceanic lithosphere in the late Cretaceous (Huang et al. 2005, Keller et al. 2000, Regelous et al. 2003). The models proposed to explain the MORB-like composition of the Late-Cretaceous Hawaiian rocks favored either entrainment of the depleted upper mantle by an upwelling mantle plume near an oceanic ridge (Keller et al. 2000) or involvement of a depleted plume component due to enhanced melting beneath thin lithosphere (Huang et al. 2005, Regelous et al. 2003).

Investigations during the SO201 Leg 1b have been targeted to sample the Hanzei, Suizei and Tenji Seamounts (Fig. 3.2.) located along a chain length of ~700 km between Detroit and Suiko Seamounts. Geochemical and age data on these previously unsampled seamounts will provide critical data needed to understand the evolution of the Hawaiian hotspot for the period from ~75 to 60 Ma.

### 3.2. RECENT VOLCANISM IN THE WESTERN ALEUTIAN ARC

Two areas within the Aleutian arc were selected for investigation during leg SO201 Leg 1b of the RV Sonne. These areas were (1) the Ingenstrem Depression, and (2) the area from Attu Island westward to the international border (hereafter called ‘the area west of Attu’) (Fig. 3.2.).

The Ingenstrem Depression is a structural basin ~60 km in length by 10-15 km wide, lying along the crest of the arc just west of Buldir Island, the westernmost emergent volcano in the Aleutians. Mapping accomplished in 2005 under the U.S.-funded Western Aleutian Volcano Expedition (WAVE) revealed the seafloor in the Ingenstrem Depression to be littered with more than 100 small volcanic cones and associated lava flows. Spatial analysis of the map data indicate that total volume of young volcanic rock present in the Ingenstrem Depression to be approximately 10 cubic kilometers, similar to the total volume of small, emergent volcanoes in the Aleutians, such as Little Sitkin and Buldir. The objective of SO201 Leg 1b investigations in the Ingenstrem Depression was to improve sampling of young volcanic rocks, with the aim of delineating the full range of geochemical compositions that are present. Post-cruise

geochemical studies of these samples will provide data to be used to test ideas about the genesis of subduction-related magmas in the Aleutians and worldwide.

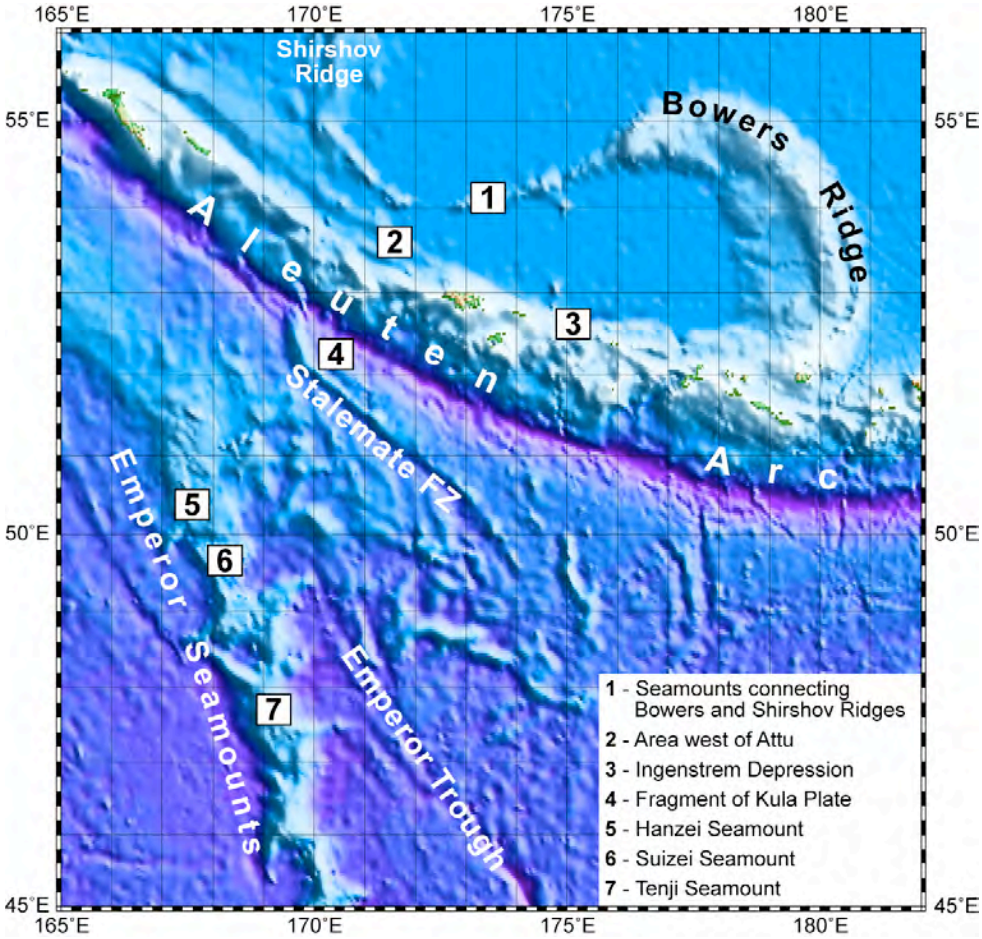


**Fig. 3.2.:** *Key locations for SO201 Leg 1b KALMAR.*

The objective of leg SO201 Leg 1b in the area west of Attu was to search for young volcanic structures on the seafloor and (if they are found) to sample them by dredging. Mapping in 2005 in the area west of Attu was concentrated at Kresta Ridge, where there is a complex pattern of intersecting strike-slip faults, similar to those which are known to host recent volcanic activity in other areas. Extensive mapping at Kresta Ridge in 2005 failed to reveal signs of active volcanism on the seafloor. Consequently, mapping on SO201 Leg 1b was concentrated north of Kresta Ridge, in a ~25 km-wide and northwest-trending swath, beginning at approximately the northern extent of the 2005 map area (~172° 30' E).

New geologic and geochemical investigations in the Western Aleutian Arc carried on under SO 201 KALMAR project were aimed to test a working hypothesis that an active volcanism is present throughout the western Aleutians, indicating that the Aleutians define one magmatic arc that is continuous from the tip of the Alaska Peninsula on the east to Piip Seamount on the west. Subsequent geochemical investigations are expected to illustrate a systematic change of compositions of primitive arc rocks along the Aleutian Arc, from predominantly basaltic in the east to andesitic in the west, which were interpreted to reflect decreasing subducting sediment flux and increasing contribution of slab melts to the composition of the arc magmas from east to west along the Aleutians (Yogodzinski et al. 1995; Kelemen et al. 2003). These investigations will also aim at testing our working hypothesis that andesitic compositions of primary melts in the Western Aleutian Arc reflect eclogitic or pyroxenitic rather than peridotitic sources in the mantle wedge.

### 3.3. BOWERS RIDGE

The Bowers Ridge is a large, arcuate submarine ridge that extends north and west from the Aleutian Ridge (Fig. 3.2.) and separates the abyssal Aleutian and Bowers basins in the Bering

Sea. Submerged sectors of the summit of Bowers Ridge as deep as 1000 m, are wave-truncated platforms of former islands. The summit platform of the eastern end of Bowers Ridge abuts and merges with the wave-flattened summit platform of the Aleutian Ridge. The northern side of Bowers Ridge is flanked by prominent trench structure filled with a 10 km thick sequence of sediments. The geologic and geophysical data indicate an island arc origin of Bowers Ridge (e.g. Cooper et al. 1981, Scholl 2007).

Data on age and composition of Bowers Ridge basement, however, are absent at present. This makes it impossible to include the Bowers Ridge in geodynamic models for the evolution of the north Pacific and Aleutian-Bering Sea area. Only an andesitic breccia was recovered in 1970 by the Scripps Institution of Oceanography from the north side of Bowers Ridge. This rock appeared too altered to be dated by the K-Ar technique. The mechanism and timing of formation of Bowers Ridge within the confined area of the Bering Sea thus remains unclear. Depending on its age of formation, the Bowers Ridge could have been formed in the north Pacific and thus would be exotic to the Bering Sea Basin. If the igneous basement of this ridge is of Cretaceous age and exhibits ocean island basalt (OIB) geochemical characteristics, then its origin as a part of the NW extension of the Emperor Chain can also be hypothesized (Steinberger and Gaina 2007). If volcanic activity at Bowers Ridge ceased in the Eocene, then it could have been formed in-place within the Bering Sea forced by the large land-mass extrusion in Alaska toward Beringian margin (Scholl 2007) or by some other mechanism.

Objectives of SO201 Leg 1b were to map and dredge basement rocks of Bowers Ridge at its northern flank, where some basement rocks were recovered by dredging in the 1970's, and also at the western extension of the ridge and on elongate seamounts connecting the Bowers and Shirshov Ridges (Fig. 3.2.). Subsequent geochemical investigations and Ar-Ar rock dating will be aimed at elucidating the origin of Bowers and Shirshov Ridges and their place during the evolution of Bering Sea.

### 3.4. OCEANIC FLOOR AND FRACTURE ZONES BETWEEN EMPEROR RIDGE AND ALEUTIAN TRENCH

A part of the Pacific Ocean floor north of the Emperor Seamount Chain and south of the Aleutian Trench comprises several prominent submarine structures (seamounts, fracture zones, fossil rifts) formed during late Cretaceous and Eocene. The major objective of SO201 Leg 1b in this area was multi-beam survey and dredging of magmatic rocks at Stalemate Fracture Zone and fossil Kula-Pacific spreading center (Fig. 3.2.). Reconnaissance mapping and sampling of the adjacent ocean floor comprising numerous seamounts on Cretaceous (?) ocean floor between Emperor Trough (Fig. 3.2.) and Aleutian Trench was also included in the scientific program.

The preservation of a small fragment of the originally hypothetical Kula Plate and fossil Kula-Pacific Rift in the area bordered by the Aleutian Trench in the north and Stalemate Fracture Zone in the south was first described by Lonsdale (1988). Magnetic anomalies indicate that the crust was formed at 50 to approximately 40 Ma, when the Kula-Pacific Rift became inactive. The Stalemate Ridge bordering the oceanic crust was interpreted to be a transverse ridge (Lonsdale 1988) formed by flexural uplift of oceanic lithosphere along transform fault (e.g. Bonatti 1978, Bonatti et al. 2005). Although the offset along the Stalemate Fracture Zone is unknown, rocks cropping out at the northern flank of the ridge are more deeply submerged presumably older than adjacent ocean floor formed at the Kula-Pacific Rift and could have been formed during Cretaceous. Aforementioned prominent geologic structures in the NW Pacific have never been sampled and thus were targeted for dredging during SO201 Leg 1b. Reconnaissance sampling is also planned for the Emperor Trough (Cretaceous Farallon-Pacific Spreading Center) and at several large seamounts on Cretaceous oceanic floor that lies between the Emperor Trough and Stalemate Fracture Zone.

Subsequent geochemical investigations and dating will be aimed at reconstructing the composition and conditions of magma generation at the Kula-Pacific spreading center through Cretaceous (?) to Eocene time. These data will have important implications for the origin of depleted component contributing to the Cretaceous Hawaiian plume magmas. They will also help to reconstruct the history of paleo-Pacific spreading centers, and will provide direct information on the composition of oceanic crust being subducted beneath Western Aleutian Arc.

## 4. CRUISE NARRATIVE

*(R. Werner, G. Yogodzinski, C.v.d. Bogaard, F. Hauff)*

The starting point of the SO201 Leg 1b cruise funded by the German Ministry of Education and Research (BMBF) was port of Yokohama near Tokyo, Japan (Fig. 4.1.). In the morning of Wednesday, June 10th, the SO201 Leg 1b scientific party boarded RV SONNE. Despite the numerous duties in the port, the master and crew of the research vessel enabled the visit of a class of children from the German school in Tokyo (Fig. 4.2.). Students ages 8 to 10 years were fascinated by the opportunity to visit the vessel and showed great interest in life aboard the ship and in its scientific work.

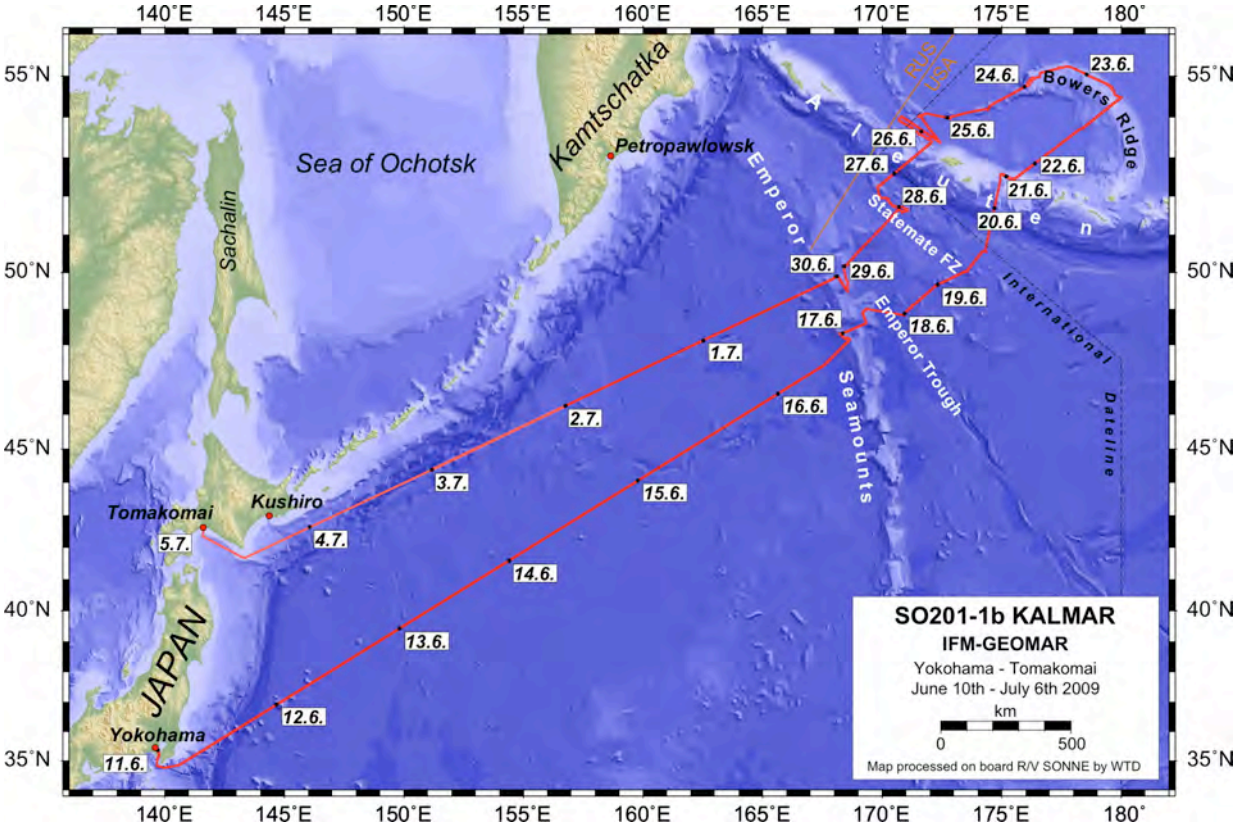


**Fig. 4.1.:** *Cruise track for SO201 Leg 1b (map processed onboard RV SONNE by WTD).*

Soon after leaving Japanese waters, recording of bathymetric and sediment-echosound data were begun. The scientists used the 5.5-day transit to the working area to unload their equipment and prepare the laboratories on board the ship. They also used the transit time for scientific presentations and discussions about the targeted research areas. On Tuesday, June 16th at 9:00 pm, RV SONNE arrived at Emperor Seamount Chain in the area south of Tenji Seamount. After mapping the area, this part of the Emperor Seamount Chain was first successfully sampled in the early hours on Wednesday morning. Dredging at two ridges, which extend from Tenji Seamount to the northwest, yielded lavas and volcaniclastic breccias.

On the morning of June 18th the RV SONNE reached approximately 120 km east of Tenji Seamount to our next target, the Emperor Trough. This feature represents a NNW-striking fracture zone in the ocean crust. The part of the Emperor Trough selected for study is characterized by a ~10 km wide graben, which reaches maximum water depths of more than 6,000 meters. The trough has steep flanks with as much as 1,000 meters of relief. Along the western flank of this structure we carried out what will be the deepest dredge on this cruise, which recovered lavas out of up to 6,000 meters water depth.


**Fig. 4.2.:** *In Yokohama RV SONNE was visited by a class from the German School in Tokyo.*

From the Emperor Trough we sailed to the northeast, toward the Aleutian Arc. Bathymetric maps based on satellite altimetry ("predicted bathymetry") reveal more than 30 seamounts, each up to more than 3,000 meters high, in the area between the northern Emperor Seamounts and the Aleutian Arc. We mapped portions of and sampled three of these seamounts. The westernmost seamount has a guyot-like morphology, with steep flanks and an plateau at the top. Guyots are ocean island volcanoes that became inactive, were eroded down to sea level and then slowly submerged to deep-ocean depths. Two dredge hauls carried out at the southeastern slope of this seamount, just below the plateau edge, recovered lava fragments. The two other studied seamounts are located ~100 and 180 km to the northeast on younger ocean crust, north of the Stalemate fracture zone. These seamounts are ~2,500 m high, ridge-like structures, which are elongate in a south-east to north-west direction. Dolerites and volcaniclastics were the dominant rock types dredged at this location.

**Fig. 4.3.:** *A chain bag dredge before and after a successful dredge haul.*

At noon of June 21st we arrived at the western Aleutian Arc. In this area our studies focused on the Ingenstrem Depression, a ~60 km long and 10 – 15 km wide basin between Attu and Buldir islands. Mapping during the U.S. WAVE expedition with *R/V Thompson* in 2005 revealed that this area is marked by numerous small and apparently very young volcanic cones. Lavas dredged from these cones during the WAVE-Expedition have an unusual chemical composition indicating that they may provide key information on the generation of island arc magmas. Detailed sampling was carried out in the Ingenstrem Depression during SO201 Leg1b. To sample the wide variability expected in lavas of this area, dredges were taken from locations along much of the length of the depression from morphologically different volcanic structures. In total, we sampled 15 volcanoes in water depth of 500 – 1,500 meters in only 39 hours. This was possible due to the huge effort from the crew and scientists. The dredges yielded porphyritic basalts, andesites and dacites (Figs 4.3., 4.4.). Moreover, basalts

from one dredge contained olivine-rich mantle xenoliths as well as xenoliths of metamorphic rock, apparently from the deep crust beneath the location.

After finishing our work in the Ingenstrem Depression in the early morning of June 22nd, the RV SONNE sailed to the Bowers Ridge. This distinctly arcuate ridge, which is up to 15 km wide, rises from water depths of ~3,900 m to nearly sea level. Despite its large size and importance for the understanding of the Bering Sea-Kamchatka-Aleutian system, the origin of the Bowers Ridge is still largely unknown. Prior to our cruise, rock samples from the ridge, which could provide detailed information on its composition and age, did not exist. Seismic profiles collected in the 1970's, reveal a thick blanket of sediment, especially on the flanks of the ridge, making dredge-sampling of the basement of Bowers Ridge difficult. Our reconnaissance mapping along the northeastern and northern slopes of the ridge revealed a morphology characteristic of thick sediment accumulation. As expected, our first dredge haul along the northern flank of Bowers Ridge recovered solidified sediment. Further to the northwest, we successfully dredged a collection of magmatic rocks, presumably from the ridge basement, from four locations along the upper slope of the ridge. We expect these samples to provide new and important information on the geological history of Bowers Ridge.

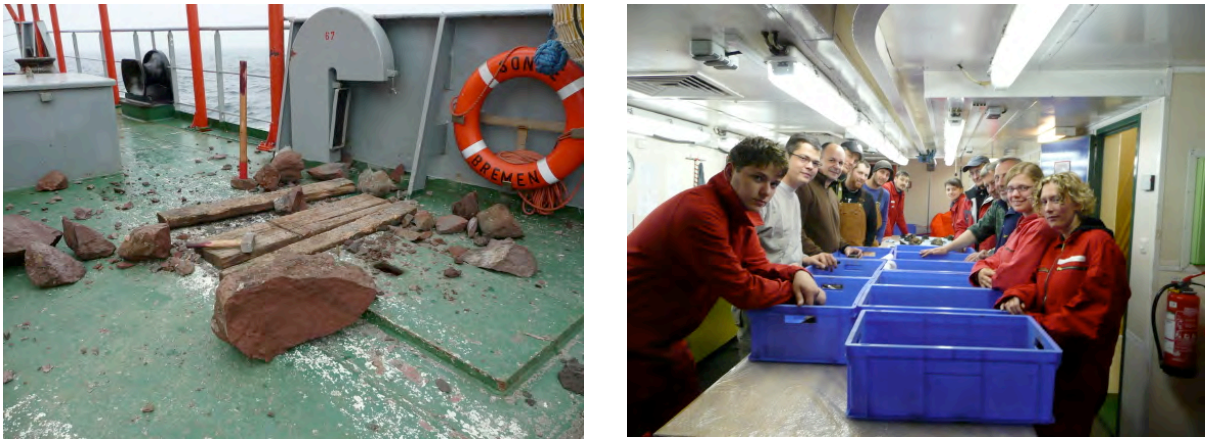


**Fig. 4.4.:** *The first step of rock preparation: Crushing of large blocks on deck (to the right). The second step: Classification and further preparation in the labs of RV SONNE (to the left).*

In the morning of June 24th, RV SONNE departed Bowers Ridge and began mapping and sampling a seamount chain which seems to connect the western end of the Bowers Ridge with the southern part of the Shirshov Ridge, which is located in Russian waters. Mapping revealed that the two easternmost of these seamounts were actually 2,000 m high, ENE-striking ridge-like structures, which are morphologically connected to the Bowers Ridge. Dredges of these structures yielded a large number pillow lava fragments, some with fresh, glassy rims. Approximately 40 nm further to the west, the R/V SONNE reached another ~2,000 m high seamount which appears unconnected with the Bowers Ridge and more closely resembles a tilted crustal block than a volcano. One dredge on this structure recovered sedimentary rocks and a wide spectrum of magmatic rocks being most likely ice-rafted material ("dropstones").

In the night of June 25th/26th we arrived again at the Aleutian Arc, this time in the area west of the ~900 km$^2$ Attu Island - home to approximately 30 U.S. Coast Guard personnel. Prior to SO201 Leg 1b, mapping in the area west of Attu revealed no evidence of active sea floor volcanism, indicating that the island arc might be inactive for a length of more than 200 km here, and possibly all the way to Piip Seamount, the furthest west active volcano known in the Aleutian system, which located in Russian territory near Medny Island. To test this hypothesis, we surveyed a ~130 km long and ~30 km wide strip of the ocean floor in a previously unmapped area in the northern part of the arc. This mapping revealed 4 small cones, each less than a few hundred meters high and with basal diameters of less than 2 km. This mapping also revealed a much larger volcano with multiple satellites and other flank features, in more than 3,000 m water depth. Dredge hauls at two of the small cones and at the large volcano recovered fresh andesites and dacites. As a result of this work, SO201 Leg 1b has proven for the first time that sea floor volcanism is present in the area between Attu Island and Piip Seamount. This means that active volcanism is probably present continuously along the entire

length of the Aleutian system. This observation will have important implications for our understanding of island arc magma genesis, and geological models for the evolution of the Bering Sea-Kamchatka-Aleutian Arc system.


**Fig. 4.5.:** *To the left: Sampling around the clock.... To the right: View of the port of Tomakomai upon arrival of RV SONNE at the end of expedition SO201 Leg 1b.*

On the morning of June 27th, RV SONNE left the Aleutians and sailed to the Stalemate Fracture Zone, which begins south of the Aleutian arc, approximately at the American-Russian border, and extends ~400 km to the southeast. Between the Aleutian arc and the Stalemate Fracture Zone lies the last remains of the Kula Plate and the fossil Kula-Pacific Ridge, which have not yet been subducted into the Aleutian trench. Multi-beam mapping revealed that the northern margin of the Stalemate Fracture Zone is bordered by up to ~2,000 m high ridges which strike parallel to the fracture zone. Sampling at 3 of these ridges yielded mainly partially serpentinzied ultramafic rocks and highly deformed fault breccias, indicating a tectonic origin for the ridges. One dredge carried out at the fossil spreading center, which is clearly marked by a shallow summit graben structure at the crest of the ridge, recovered hundreds of pillow fragments, many with fresh glassy rims. The successful sampling of crustal rocks at the Stalemate fracture zone will provide us new insights in the composition of the material which is being subducted beneath Kamchatka and the Aleutians.

After finishing the work at the Stalemate Fracture Zone in the evening of June 28th, the RV SONNE sailed again to the Emperor Seamount Chain. Whereas sampling at Hanzei Seamount failed to return *in situ* magmatic rocks, dredging at Suizei Seamount yielded abundant lavas and volcanic breccias. Combined with the rock samples recovered further south at the beginning of this cruise, these sample will help to fill the large gap in the sampling record from the shield phase of the northern Emperor Seamounts. After deploying a TV-grab on a small cone between Hanzei und Suizei Seamounts, the R/V SONNE left the SO201 Leg 1b working area in the morning of June 30th and began her 5-day transit to Tomakomai, Japan.

On the evening of July 1st, we celebrated the successful end of the expedition and the 50th birthday of a crew member with a festive party. When approaching the Russian exclusive economic zone off the Kurile Islands on July 1st at 11:30 pm, recording of bathymetric and sediment-echosound data were stopped, marking the end of the scientific work of SO201 Leg 1b. The scientists spent the last days at sea packing and cleaning up the laboratories. On the morning of Sunday, July 5th at 8:00 am SO201 Leg 1b ended at a berth of the port of Tomakomai (Fig. 4.5.).

Complementing 3.406 nm bathymetric and sediment-echosounding profiling, a total of 45 dredges and one TV grab were carried out in an average water depth of 2,600 m during 13.5 working days on SO201 Leg 1b. No dredges were lost or damaged. Of these deployments, 35 recovered magmatic rocks, 13 volcaniclastics, 8 sedimentary rock, and 15 Mn-Fe oxides (without dropstones). Only one dredge returned empty.

# 5. BATHYMETRY AND ROCK SAMPLING

*(F. Hauff, R. Werner, G. Yogodzinski, M. Portnyagin, S. Silantiev)*

## 5.1. METHODS

### 5.1.1. Bathymetry

***Data Acquisition***

Since June 2001 the R/V SONNE has been equipped with a SIMRAD EM120 multi-beam echo sounder system (Kongsberg) for continuous mapping of the seafloor. The SIMRAD EM120 system consists of several units. A transmitter/receiver transducer array is fixed in a mills cross below the keel of the vessel. A preamplifier unit contains the preamplifiers for the received signals. The transceiver unit contains the transmitter and receiver electronics and processors for beam-forming and control of all parameters with respect to gain, ping rate and transmit angles. The system has serial interfaces for vessel motion sensors, such as roll, pitch and heave, external clock and vessel position. The system also includes a SUN-workstation as an operator station. The operator station processes the collected data, applying all corrections, displays the results and logs the data to internal or external disks. The EM120 system has an interface to a sound speed sensor, which is installed near by the transducers.

The SIMRAD EM120 system uses a frequency of about 12 KHz with a whole angular coverage sector of up to 150° (75° per port-/starboard side). When one ping is sent, the transmitting signal is formed into 191 beams by the transducer unit through the hydrophones. The beam spacing can be defined in equidistant or equiangular modes or in a mix of both. The ping-rate depends on the water depth and the runtime of the signal through the water column. The variation of angular coverage sector and beam pointing angles was set automatically. This optimized the number of usable beams.

During a survey the transmitter fan is split into individual sectors with independent active steering according to vessel roll, pitch and yaw. This forces all soundings on a line perpendicular to the survey line and enables a continuous sampling with a complete coverage. Pitch and roll movements within ±10 degrees are automatically compensated by the software. Thus, the SIMRAD EM120 system can map the seafloor with a swath width about up to six times the water depth. The geometric resolution depends on the water depth and the used angular coverage sector and is less than 10 m at depths of 2,000 - 3,000 m.

The accuracy of the depth data obtained from the system is usually critically dependent upon weather conditions and the use of a correct sound speed profile. During SO201-1b sound profiles have been used recorded on SO201-1a in the working area, ensuring the use of the correct sound velocity on this cruise.

***Data Processing***

The collected data were processed onboard with the EM120 coverage software. The post-processing was done on two other workstations by the accessory Neptune software. The Neptune software converted the raw data in 9 different files which contains information about position, status, depth, sound velocity and other parameters and are stored in a SIMRAD binary format.

The data cleaning procedure was accomplished by the Neptune software. The first step was to assign the correct navigational positions to the data without map projections. The second step was the depth corrections, for which a depth threshold was defined to eliminate erratic data points. In the third part of post-processing statistical corrections were applied. Therefore, a multitude of statistical functions are available in a so called BinStat window where the data are treated by calculating grid cells with an operator-chosen range in x and y direction. Each kind of treatment is stored as rule and has an undo option. For the calculation the three outermost beams (1 - 3 and 188 - 191) were not considered. Also a noise factor, filtering and a standard deviation were applied to the calculated grid. All this work was done by the system operators of RV SONNE. After the post-processing the data have been exported in an ASCII x,y,z file format with header information and it was transferred to another workstation where assembling, girding and contouring with the GMT software (Wessel and Smith 1995) were done.

All maps presented in this report are created by W. Borchert and A. Ehmer (RF Forschungsschiffahrt GmbH, scientific and technical department [WTD]) onboard RV SONNE (except of Figs. 3.1., 3.2., 5.8., and 5.15.).

### 5.1.2. Rock Sampling

Rock sampling on SO201 Leg 1b was carried out using chain bag dredges and, at one station using a TV guided grab. Chain bag dredges are similar to large steel buckets with a chain bag attached to their bottom and steel teeth at their openings, which are dragged along the ocean floor by the ship or the ship's winch. The TV-grab consists essentially of a set of steel jaws with a video camera in the center, which transmits pictures of the ocean floor. Suitable objects for sampling can be identified on a monitor and sampled from the ocean floor by closing the hydraulic jaws by remote control around the objects and then heave then on board.

***Selection of Dredge Sites***

Sites for detailed SIMRAD EM120 mapping and dredging were chosen on the basis of a number of existing datasets. These include:

1. Predicted bathymetry, derived from gravity data and ship depth soundings (Smith and Sandwell 1997), as well as GEBCO data sets.
2. Swath bathymetry data and maps, provided by Gene Yogodzinski, Christoph Gaedicke, Stefan Lagade, and Scott White.
3. Multi-channel seismic profiles provided by Christoph Gaedicke.
4. Published monographs and papers (see, for example, chapter 3.).

***Shipboard Procedure***

Once onboard, a selection of the rocks recovered by the dredge were cleaned in fresh water and cut using a rock saw. The rocks were then examined with a hand lens and microscope, and grouped according to all aspects of their lithology, including the primary mineralogy and degree of alteration/weathering, and/or the presence of manganese encrustations. The immediate aim of these observations is to determine whether material suitable for geochemistry and radiometric age dating had been recovered. Suitable samples have an unweathered and unaltered groundmass, empty vesicles, glassy rims (ideally), and fresh phenocryst minerals. If suitable samples are present, the ship moves to the next station. If they are not, then the importance of obtaining samples from the station is weighed against considerations of the available time. In general, a second, nearby dredge is necessary in only very few cases.

Fresh blocks of representative samples were then cut for thin section and microprobe preparation, geochemistry. Additional trimming of the sample is sometimes necessary to remove manganese crusts and alteration products and/or to extract fresh glass in cases when it is present. Each of these sub-samples, together with any remaining bulk sample, was described, labeled, and finally sealed in plastic bags for transportation to IFM-GEOMAR or cooperating institutions.

***Shore Based Analyses***

Magmatic rocks sampled by the RV SONNE from the ocean floor will be analyzed using a variety of different geochemical methods. The ages of whole rocks and minerals will be determined by $^{40}Ar/^{39}Ar$ laser dating. Major element geochemistry by X-ray fluorescence (XRF) and electron microprobe (EMP) will constrain magma chamber processes within the crust, and also yield information on the average depth of melting, temperature and source composition to a first approximation. Phenocryst assemblages and compositions are used to quantify magma evolution, e.g. differentiation, accumulation and wall rock assimilation. Petrologic studies of the volcanic rocks also help to constrain the conditions under which the melts formed (e.g., melting depths and temperatures). Further analytical efforts concentrate on methods that constrain deep seated mantle processes. For example, trace element data by inductively coupled plasma mass spectrometry (ICP-MS) may help to define the degree of mantle melting and to characterize the chemical composition of the source. Long-lived radiogenic isotopic ratios by Thermal Ionization Mass Spectrometry (TIMS) and Multi-Collector ICP-MS such as $^{87}Sr/^{86}Sr$, $^{143}Nd/^{144}Nd$, $^{206}Pb/^{204}Pb$, $^{207}Pb/^{204}Pb$, $^{208}Pb/^{204}Pb$, and $^{187}Hf/^{188}Hf$ are independent of

the melting process and reflect the long term evolution of a source region and thus serve as tracers to identify mantle and recycled crust sources. Additionally, morphological studies and volcanological analyses of the dredged rocks will be used to constrain eruption processes, eruption environment and evolution of the volcanoes. Through integration of the various geochemical parameters, the morphological and volcanological data, and the age data the origin and evolution of the sampled structures can be reconstructed.

Non-magmatic rocks and Mn-Fe oxides yielded by dredging are transferred to co-operating specialists for further shore based analyses.

### 5.2. SAMPLING REPORT AND PRELIMINARY RESULTS

This section gives background information and short summaries of the features sampled and/or mapped on SO201 Leg 1b and on the rocks obtained by dredging. Some preliminary conclusions based on the results of sampling and mapping on SO201 Leg 1b are summarized in chapter 5.2.5.. Refer to Appendix I and II for exact latitude, longitude, and depth of dredge sites and detailed rock descriptions. Distances between seamounts are given between the seamount tops and are approximate only; dimensions and heights are preliminary and are included only to give a rough idea of dimensions of morphological features.

#### 5.2.1. Emperor Seamounts (DR 1 - 3, DR 42 – 45, and TVG 46)

The Emperor Seamounts were sampled between 48°10'N and 50°10'N at the stations DR 1 through DR 3 and DR 42 through TVG 46, the final station of the cruise. The volcanic structures in this area lie at the old end of the Hawaii-Emperor seamount chain and are presumed to have formed ~60 – 80 m.y. ago above the Hawaiian Hotspot. Prior to SO201 Leg 1b, single channel bathymetric maps of the Hanzei, Suizei and Tenji guyots were published by Londsdale et al. (1993). In addition the results of a multi-beam survey carried out during the precursor cruise (SO201 Leg 1a) were also available to us. Principle questions to be addressed by hard-rock sampling concern the age and composition of the shield stage volcanism at each of these guyots. In particular the longevity and spatial distribution of distinct Hawaiian Plume components shall be quantified. An improved characterization of the input into the Kamchatka-Aleutian subduction zone will also be obtained.

Stations DR 1 to DR 3 were carried out between 48°10´N to 49°00´N and targeted two prominent ridges that branch off Tenji Seamount toward the NW (DR 1) and NNW (DR 2 and DR 3, Fig. 5.1.). These branching ridges were both sampled in part, to test the idea that they may have originated as different rift zones, perhaps analogous to the two parallel trends in the present-day Hawaiian volcanic system. At DR 1 the NNE facing slope was dredged from 3,030 to 2,375 meters below sea level (mbsl), below the flat topped ridge crest. A relatively large (70 x 40 x 30 cm), freshly broken Mn encrusted breccia containing decimeter-size angular clasts of variably altered aphyric to slightly ol-cpx-plag phyric sheet lava were recovered, together with manganese crusts and a heterolithological assemblage of rounded to angular dropstones (including plutonic rocks). The basalt clasts of the breccia all have a similar phenocryst mineralogy of altered olivine (1%, 2 mm), fresh clinopyroxene (5%, < 4 mm), fresh plagioclase (1%, < 2 mm) in a groundmass ranges from moderately to strongly altered. The monolithological character of the breccia together with its angular and freshly broken character and thick Mn encrustations (10–15 cm) are taken as evidence that *in situ* talus of the ridge was sampled. DR 2 aimed for the eastern ridge south of Tenji between 3,720 and 3,375 mbsl along the east facing slope. A few rocks of massive sheet lava, basaltic breccias and manganese crusts were obtained. The sheet lava ranges from essentially aphyric to ol-cpx phyric with up to 20% altered olivine (< 5 mm) that contains spinel. The groundmass alteration of these lavas ranges from moderate to strong. The breccia contains strongly altered, rounded to subrounded, up to 3-4cm sized basalt clasts with 5-10% altered olivine. DR 3 carried out ~20 nm north of DR 2 also sampled the same east facing slope between 4,400 to 3,997 mbsl but obtained only a few tuffaceous rocks which are most likely dropstones. A three centimeter oxidized alteration halo in sample DR 3-1 indicates an extended exposure time to seafloor weathering despite the very minor maganese crust.

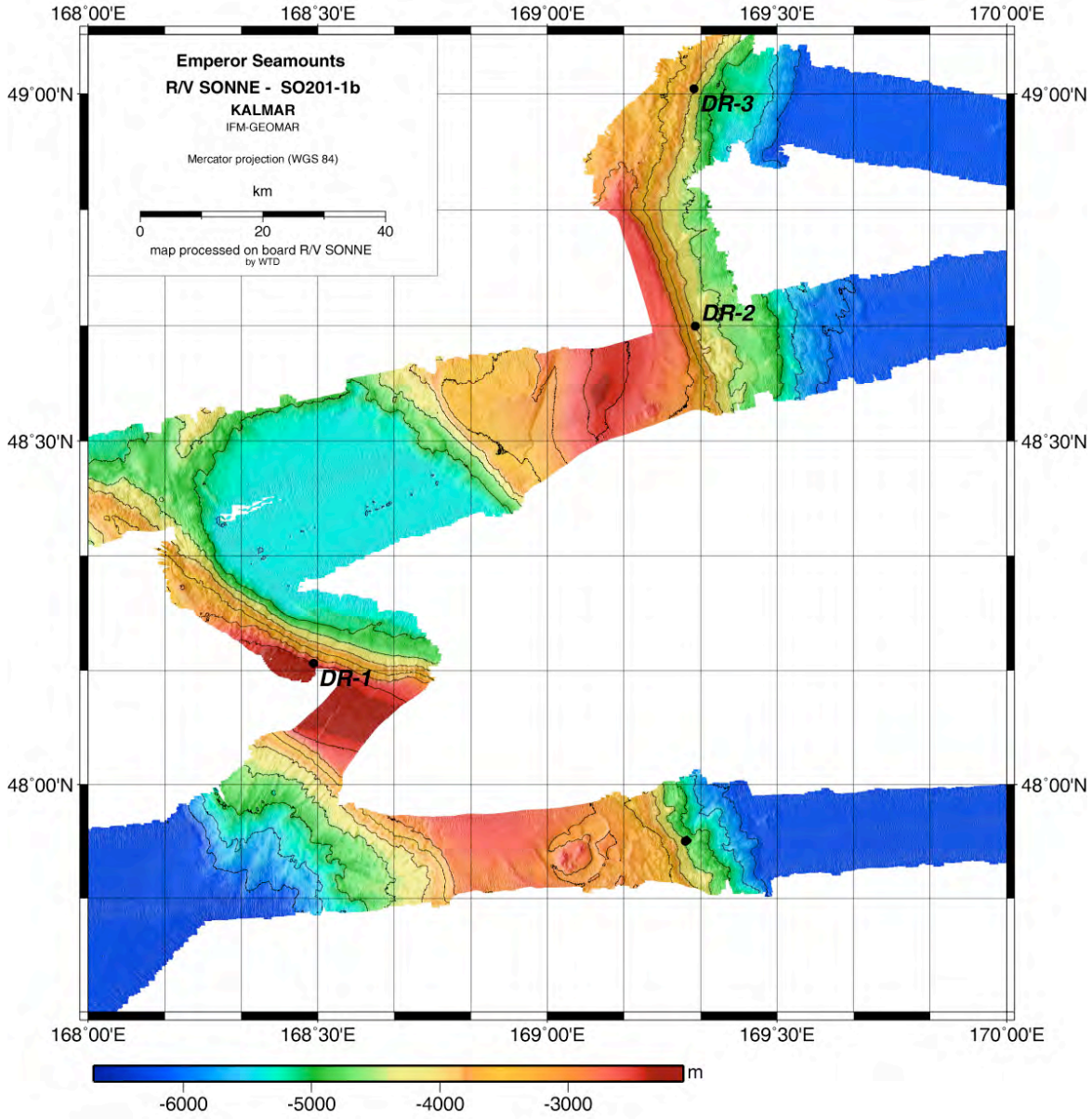


**Fig. 5.1.:** *Dredge sites DR 1 – 3 at two ridges south of Tenji Seamount. This map is based on SO201 Leg 1a (provided by C. Gaedicke) and Leg 1b multi-beam data.*

The last five stations of SO201 Leg 1b (DR 42 to TVG 46) were dedicated to sampling Hanzei and Suzei seamounts between 50°10´N and 49°30´N in the northern section of our Emperor Seamounts array (Fig. 5.2.). DR 42 and DR 43 were carried out ~4 nm apart, along the east facing slope of Hanzei from 3,615 to 3,311 mbsl, and 4,014 to 3,527 mbsl, respectively. While DR 42 only recovered a large bloc of manganese crust and a few dropstones, DR 43 provided two rocks of possible *in situ* origin. A diabase with a fresh well crystallized plag-pyx groundmass together with a fine grained, dark brown tuff. The *in situ* origin of both rocks is, however not absolutely certain and further investigations need to be treated with caution. Suizei guyot was sampled at DR 44 (3,137 to 2,671 m b.s.l.) and DR 45 (4,870 to 4,266 m b.s.l.) again along the east facing margin below the plateau edges. DR 44 returned a full dredge of volcaniclastic breccias, hylaoclastistes and variably altered olivine-phyric (up to 25%, <2 mm, sometimes still fresh) basalts with minor amounts of fresh plagioclase (<1%). Notably the breccias contain strongly altered olivine-phyric basalt clasts similar to basalt fragments. The hyaloclastites are mostly made up of strongly altered glass fragments but some lapilli appear to have fresh glass cores preserved. DR 45 has been

carried out in an area where the plateau region is covered by numerous post-erosional cones (Londsdale et al. 1993). The dredge returned variably altered plagioclase (10%, <1 mm) and pyroxene (5 - 10%, <1 mm) phyric basalts along with coarse to fine grained, greenish-grey sandstones. TVG 46 has been carried out in the top region of a small cone that is located in the valley between Suizei and Hanzei guyots. The survey revealed that the cone is covered by soft sediment that contains small manganese nodules and grayish volcaniclastics of unknown origin. Since the cones are not covered by talus from the nearby guyots their emplacement occurred sometime after erosion and subsidence of the seamounts, possibly together with the late stage volcanism manifested in the southern plateau half of Suizei.

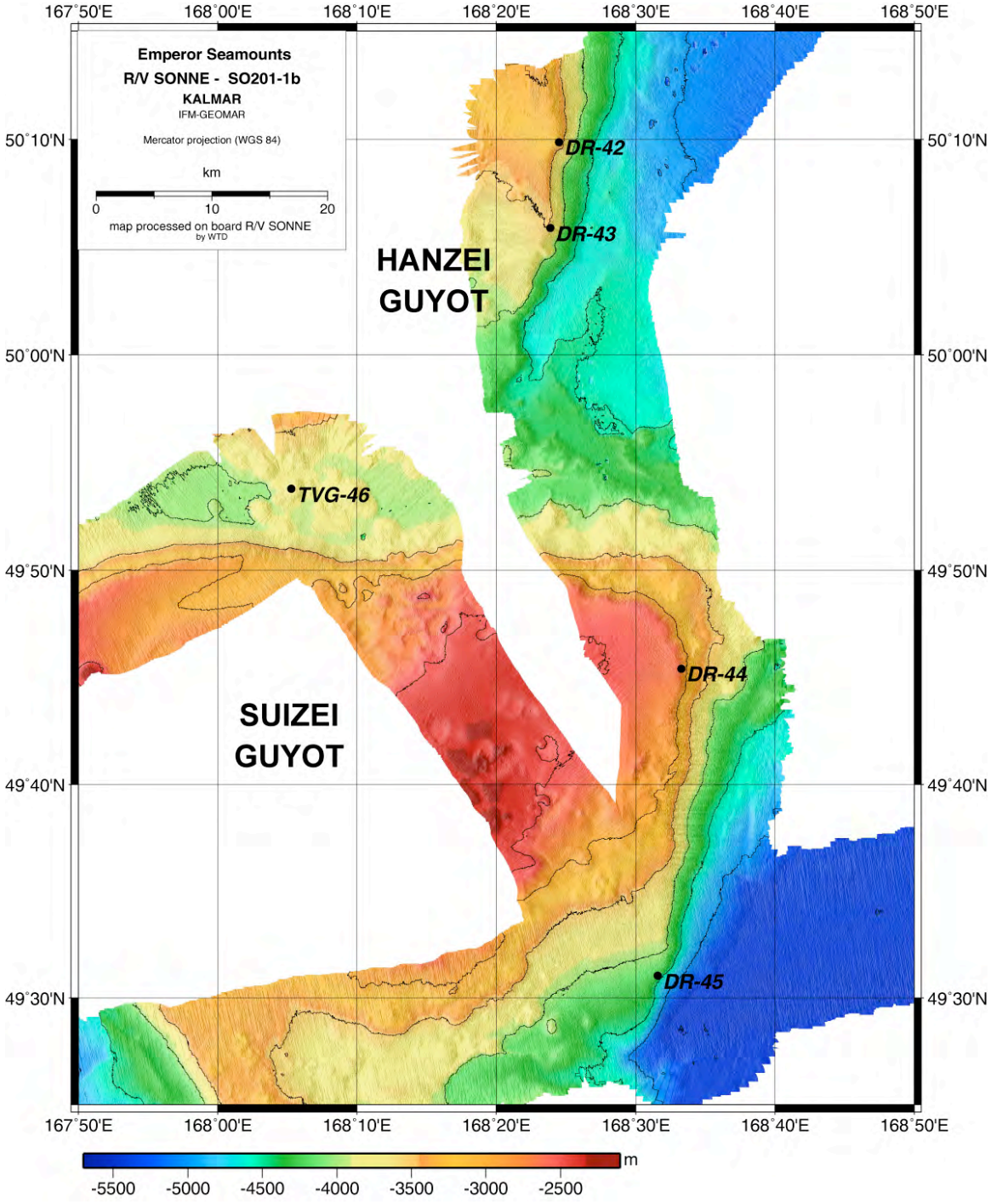


**Fig. 5.2.:** *Dredge sites DR 42 and 43 at Hanzei Guyot, DR 44 and 45 at Suizei Guyot, and TVG 46 in a valley between these guyots. This map is based on SO201 Leg 1a (courtesy C. Gaedicke) and Leg 1b multi-beam data.*

### 5.2.2. Seamounts and Fracture Zones between Emperor Chain and Aleutian trench (DR 4 - 8 and DR 37 - 41)

***Emperor Trough (DR 4)***

The Emperor Trough, located ~110 km east of the Emperor Seamounts, is a NNW - SSE trending structural deep that reaches maximum water depths of more than 6,000 mbsl. The origin of the structure as a fracture zone or failed rift is unclear. DR 4 was conducted from 5,961 to 5,010 mbsl along the east facing slope of the Emperor Trough at 48°52´N (Fig. 5.3.) and yielded plag-pyx phyric basalts with 6-8% plagioclase, 1–5 mm in size and 2-4%, 1–3 mm sized pyroxene. The groundmass is for the most part strongly oxidized to brownish red but relatively fresh grey parts are also preserved. The basalts are cut by numerous cracks filled with manganese. The maganese crusts in this dredge appear to be made up of two generations of manganese layers that are separated by a thin yellowish-brown and brecciated layer. Some maganese crusts contain very strongly altered rounded basalt clasts that are similar to the plag-pyx phyric basalts. Single samples of fairly fresh, aphyric lava (DR 4-9) and ol-hbl phyric lava (DR 4-10) have been also sampled but an *in situ* origin is questionable. In summary, a single dredge along the western side wall of the Emperor Through delivered plag-pyx-phyric lava that will allow age determinations and petrological-geochemical studies. Together with available paleomagentic data, the age dating and geochemistry will help to better constrain the origin of this structure.

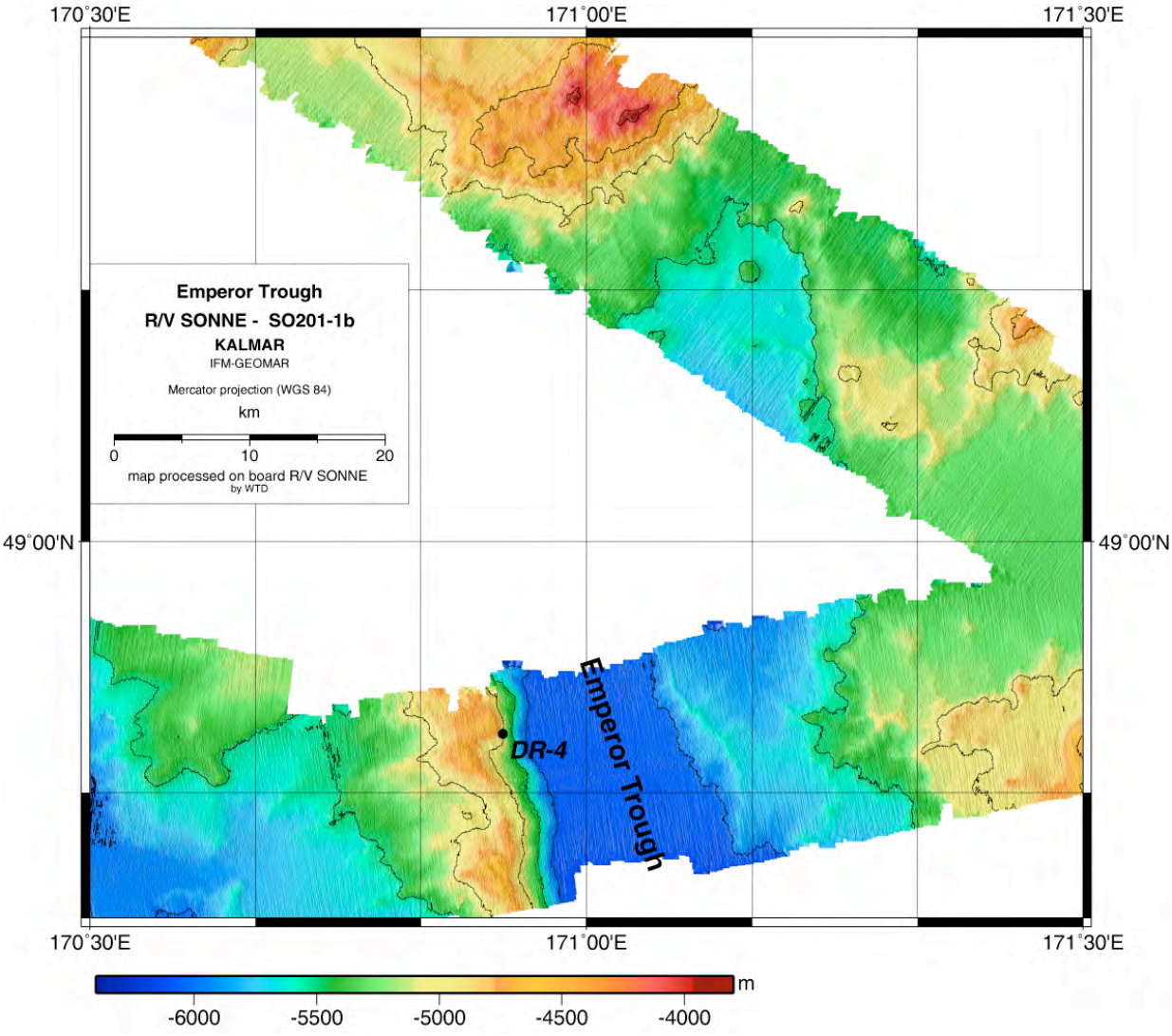


**Fig. 5.3.:** *Dredge site DR 4 at the western slope of the Emperor Trough. This map is based on SO201 Leg 1a (courtesy C. Gaedicke) and Leg 1b multi-beam data.*

***Seamounts (DR 5, DR 6, and DR 8)***

The oceanic crust between the Emperor Seamounts and the Aleutians in principle consists of two age domains, separated by the Stalemate Fracture Zone (see below). The ocean floor on both sides of the fracture zone is covered by numerous seamounts of unknown origin and age. Several possibilities arise for their origin and include (1) a possible relation to volcanism forming the Emperor Seamounts, (2) off-axis volcanism or (3) diffuse intra-plate magmatism. Due to time constraints only two seamounts could be sampled. The first location is a circular shaped seamount on the older ocean crust at 49°40´N, 172°15´E that rises from ~5,500 to 3,300 mbsl with a base diameter of roughly 20 km. The top region seems to be made up of a relatively flat plateau, however it is unclear whether the structure is a true guyot or just part of broader elevated region that stretches further to the NW. DR 5 and DR 6 were carried along the SE flank of the seamount in ~3,900 to 3,250 m water depths beneath the plateau edge (Fig. 5.4.). Both dredges recovered only a few rocks, most of them were identified as dropstones based on roundness and exotic petrography. Several manganese-encrusted (1.5 cm thick) pebbles of a plag-ol phyric lava occur in both dredges. Plagioclase appears quite fresh and makes up 5 - 10% with up to 5 mm long laths while altered olivine is <1 mm and occurs in minor amounts (1%). The groundmass alteration ranges from moderate to strongly altered. At DR 5 an aphyric variation of this lava with a single feldspar phenocrysts has been also sampled.

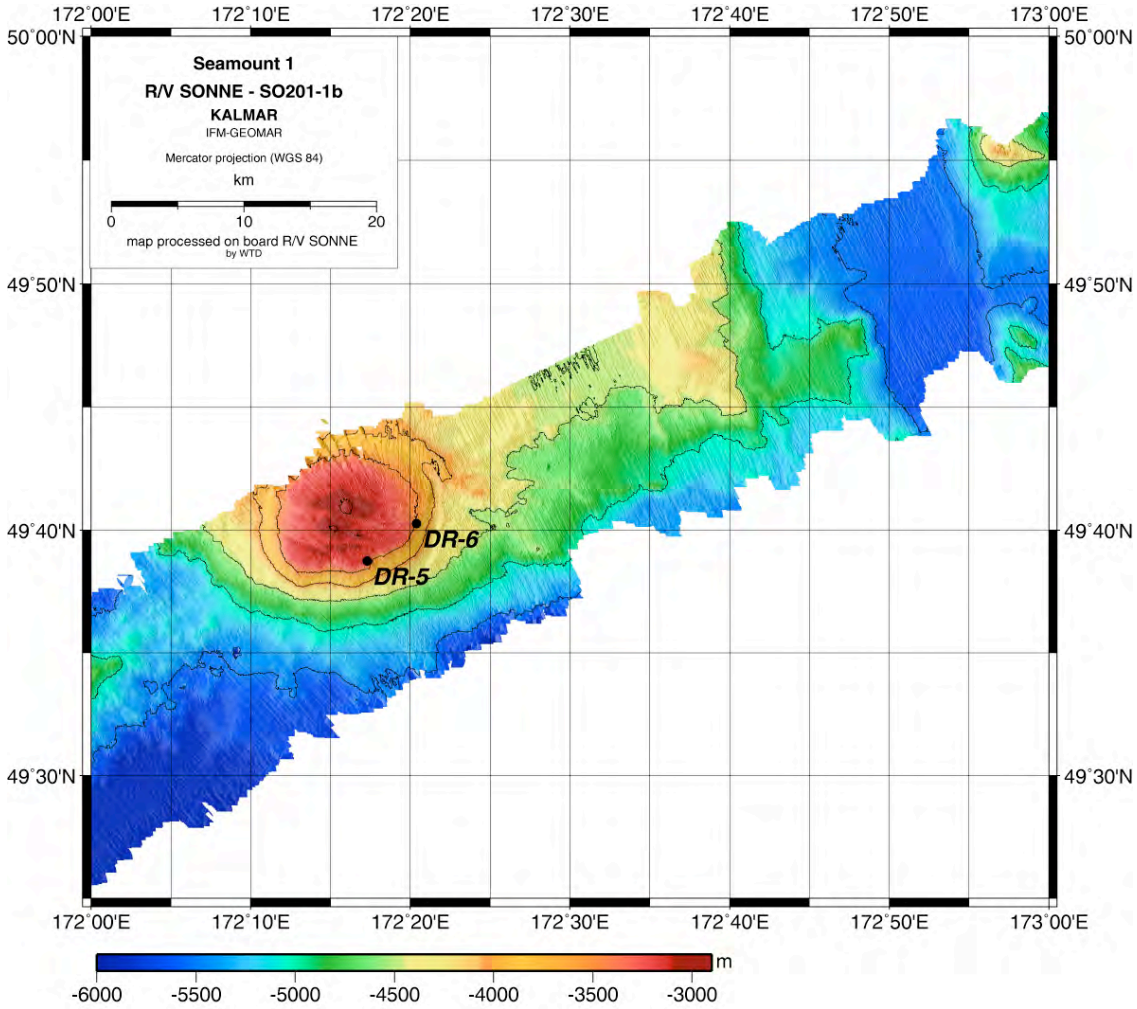


**Fig. 5.4.:** *Dredge sites DR 5 and DR 6 at a guyot-like seamount in the area between the Emperor Seamounts and the Stalemate Fracture Zone.*

Closer to the Aleutian trench a NNW-SSE elongated ridge (>>20 x ~10 km) has been sampled as representative of seamounts on the younger Pacific Plate (Fig. 5.5.). Remarkably this ridge strikes parallel to the chain of ridges bordering the NE-margin of the Stalemate

Fracture Zone (see below). DR 8 is located on the east facing flank near the southern tip of the ridge in 3,514 to 3,134 m water depths. Only a few rocks were recovered including a fragile lava breccia (DR 8-3) that has a similar ol-pyx-plag-hbl mineralogy as a massive porphyritic lava sample (DR 8-1). This is taken as a hint that the latter sample may indeed originate from this structure. Still the occurrence of hornblende - if confirmed by thin section microscopy - is somewhat unexpected for an intraoceanic volcanic setting. Sample DR 8-2 is an aphyric tuff; the origins of which remain unclear. In summary, the reconaissance sampling of two seamounts on older and younger Pacific crust has delivered limited *in situ* sample material which still may provide first insights into the timing of their formation. More sampling, however, is required to fully understand the complex magmatic history in this area.

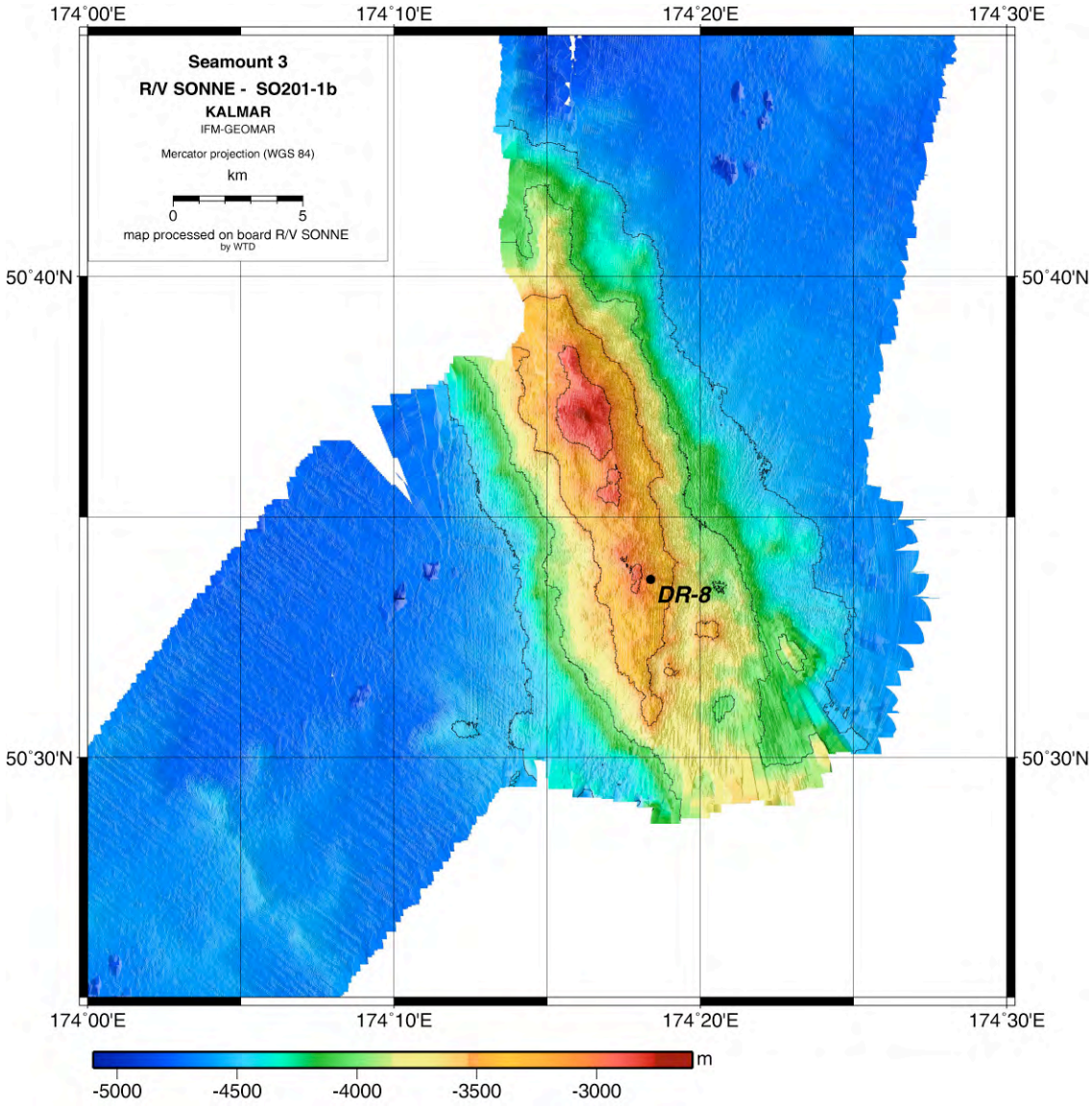


**Fig. 5.5.:** *Dredge site DR 8 at a ridge between the Stalemate Fracture Zone and the Aleutian.*

***Stalemate Fracture Zone (DR 7 and DR 37- 41)***

The Stalemate Fracture Zone is a prominent NW-SE trending bathymetric anomaly that places younger, and less deeply submerged ocean crust immediately south of the Aleutian trench against older and more deeply submerged ocean crust that stretches to the southwest, all the way to the Emperor Seamount chain. The younger Pacific Plate crust contains the fossil spreading axis of the Kula-Pacific plates as suggested by paleomagnetic and seafloor morphology (Lonsdale, 1988). Since it is this part of ocean crust that is presently subducting beneath the western Aleutian arc, its chemical composition may have a strong influence on the composition of the arc lavas. A detailed chemical characterization of the subducted crust was therefore the prime target of our sampling strategy along the Stalemate Fracture Zone.

Our first attempt was carried out at a NW-SE elongated ridge that is part of the Stalemate Fracture Zone separating 5,500 m deep ocean floor in the south-west against 4,800 m deep ocean floor to the north-east (Fig. 5.6.). The dredge haul DR 7 sampled the NE-facing flank beneath the steep sided peak from 3,340 to 2,780 mbsl and provided a full dredge composed of mainly dolerite, minor basalts and plagiogranites as well as occasional gabbros. The dolerites are aphyric with a groundmass ranging from fine to coarse grained that is composed of 30%, 1-4 mm sized fresh feldspar and 10-20%, 1–2 mm sized fresh pyroxene. Overall the groundmass appears relatively fresh with low temperature alteration halos occurring in some samples. A single piece of a coarse grained ol-pyx phyric basalt has been sampled as DR 8-7 but the relation to the dolerites which make up most of the dredge are unclear. Several pieces of angular plagiogranite fragments have been sampled (DR 8-10, -11, and -18X). They are made up of plagioclase, hornblende, pyroxene, and quartz and are cut by epidote bearing veins. The occurrence of plutonic rocks requires an additional vertical component of crustal motion along this fault zone.

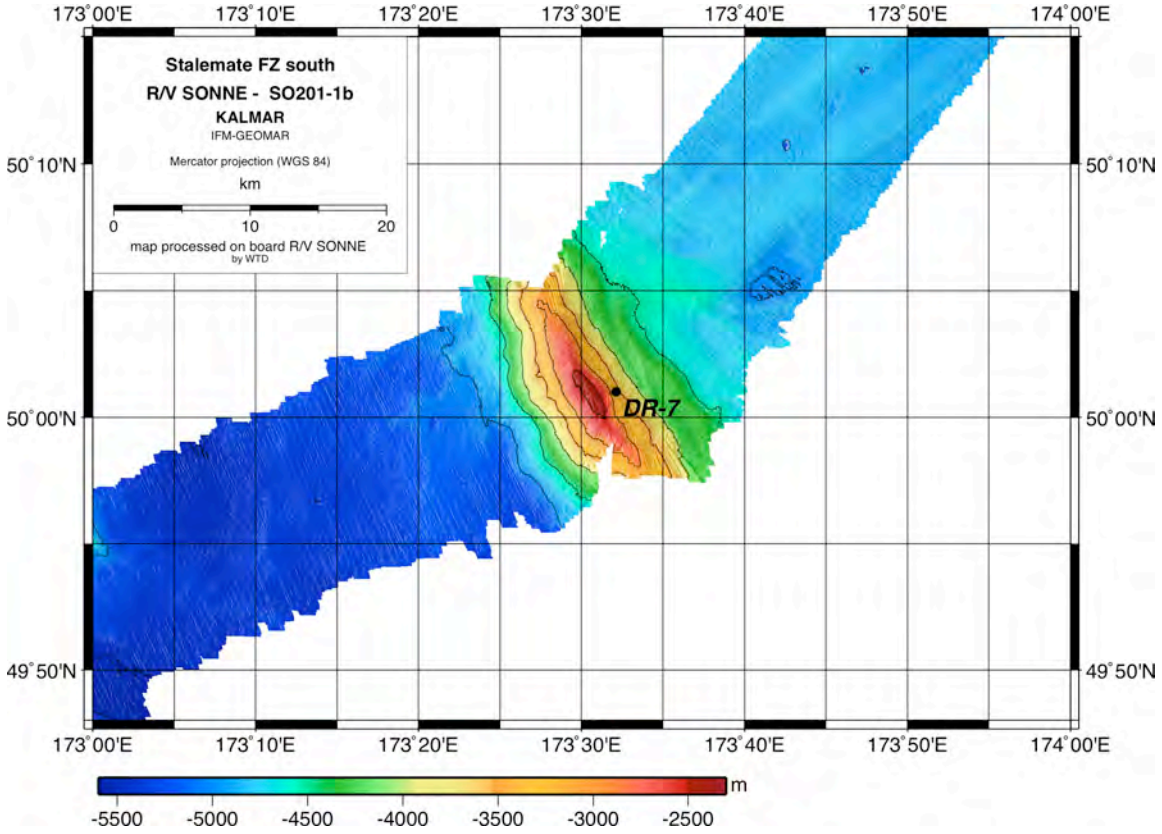


**Fig. 5.6.:** *Dredge site DR 7 at ridge in the southern part of the Stalemate Fracture Zone.*

The second sampling attempt of the Stalemate Fracture Zone was conducted at DR 37, DR 38 and DR 40 at the NW termination of the structure. Here the fault zone is again characterized by NNW-SSE or NW-SE trending ridges that have the steeper slopes facing NE which is the opposite of that in the predicted bathymetry. Still the ridges are segmented by NNW-SSE trending valleys which may represent secondary faults. NE of the Stalemate Fracture Zone the fossil Kula-Pacific spreading center has been mapped at 51°40'N and 171°00'E (Fig. 5.7.). DR 37 was carried out just N of the characteristic bend where the Stalemate fracture zones turns into a NNW-SSE trend as it approaches the Aleutian trench. The dredge track sampled the E facing slope from 4,360 to 3,995 mbsl and recovered highly altered, serpentinized ultramafic rocks (dunites, harburguites and lherzolites), testifying to significant vertical uplift along the fault that probably also enhanced deep fluid migration. Station DR 38 located approx 50 km southeast of DR 37 sampled the northern slope along the NW tip of a NW-SE trending ridge from 4,263 to 3,979 mbsl. An unusually large (111 x 52 x 48cm) tectonized, greenish bloc of plagioclase phyric basalt was recovered in this dredge. Numerous veins filled with calcite-chlorite-actinolite dissect the block and in places larger

areas are filled with a pale green, fine grained matrix composed of tremolite-calcite-serpentine-chlorite (DR 38-8). Some clasts of the bloc are covered with a breccia that may represent fault gauge. The vast majority of this brittle deformed bloc is non vesicular plagioclase phyric basalt (DR 38-1A) with 5-10% up to 5 mm large plagioclase phenocrysts. The matrix is green and the presence of chlorite and actinolite suggests metamorphism under greenschist facies conditions. An aphyric lithological subfacies has been sampled from the same bloc in sample DR 38-1B. Besides the tectonized plagioclase-phyric basalt, individual fragments of aphyric basalt, ol-px phyric basalt (ol 15-20%; cpx 5-10%) and dolerite were also sampled from this dredge. The greenish grey matrix in most of these samples indicates similar metamorphism as observed in sample DR 38-1. DR 39, conducted 25 km southeast of DR 38 at the third elongated ridge (Fig. 5.7.), was abandoned before the dredge was lowered in the water because current conditions became increasingly difficult when the site was approached. Therefore DR 40 was chosen as an alternate of the same structure on the opposite NE facing slope. The dredge haul was carried out between 3,668 and 3,064 mbsl and recovered a well filled dredge that comprised massive plag-cpx/ol-porphyric rocks of probable subvolcanic origin along with fine-to-coarse grained mostly aphyric basalt fragments. Minor lithologies include coarse grained plutonic rocks (leuco gabbros?) and breccias with basaltic and gabbroic clasts. The fossil Kula-Pacific spreading center was sampled along the SE wall between 4,334 and 4,070 mbsl. The dredge returned almost full with pillow lava fragments with chilled margins that contained in many cases well preserved fresh glass. The pillow lava is nearly aphyric with occasional plagioclase phenocrysts (< 1% and sub-mm in size) and the groundmass is in most case strongly oxidized to brownish grey.

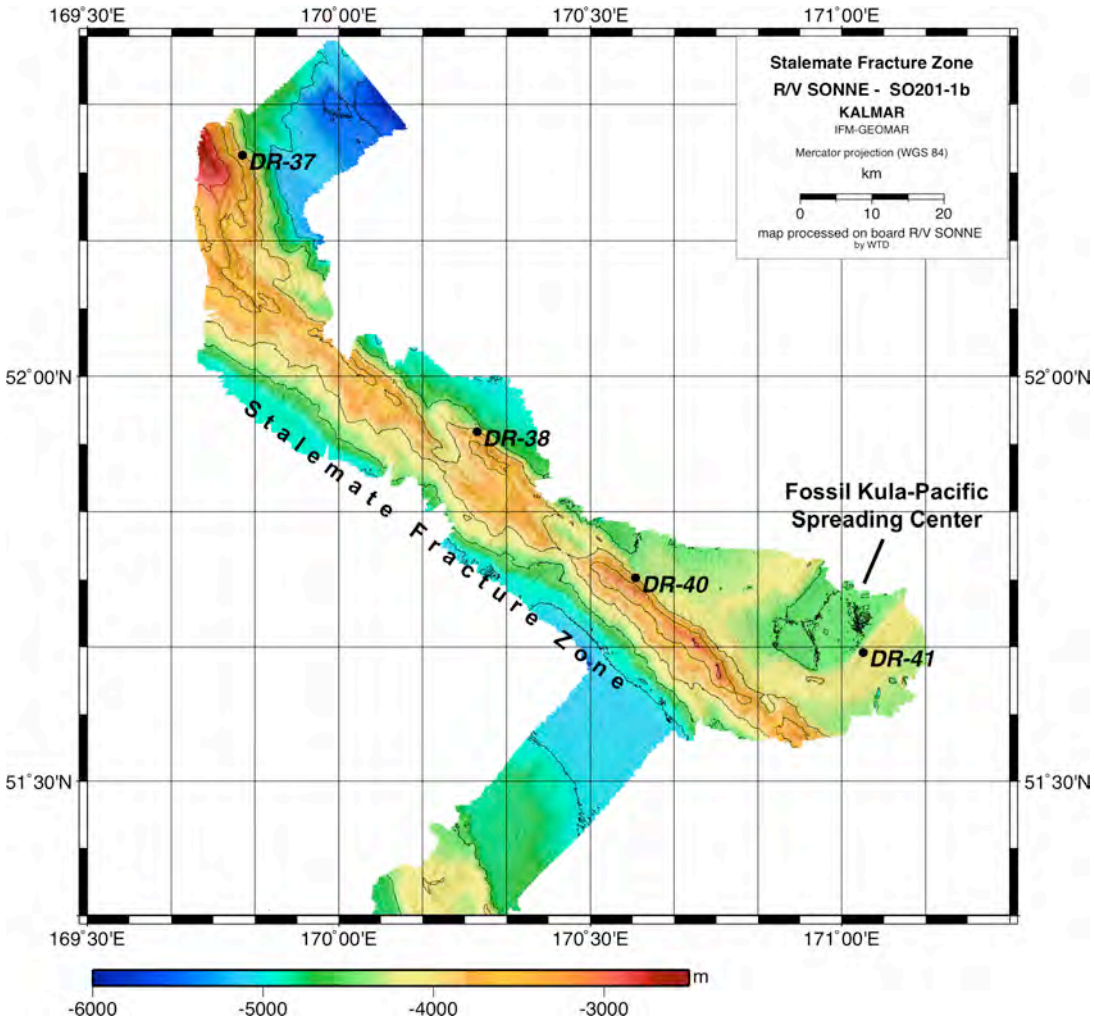


**Fig. 5.7.:** *Dredge sites DR 37 - 40 at ridges in the northern part of the Stalemate Fracture Zone and DR 41 at the fossil Kula-Pacific plate spreading center.*

### 5.2.3. Aleutian Island Arc (DR 9 – 24, DR 33 – 36)

Two areas within the Aleutian arc were selected for investigation during SO201 Leg 1b of the R/V SONNE. These areas were (1) the Ingenstrem Depression, and (2) the area from Attu Island westward to the international border (hereafter the area 'west of Attu').

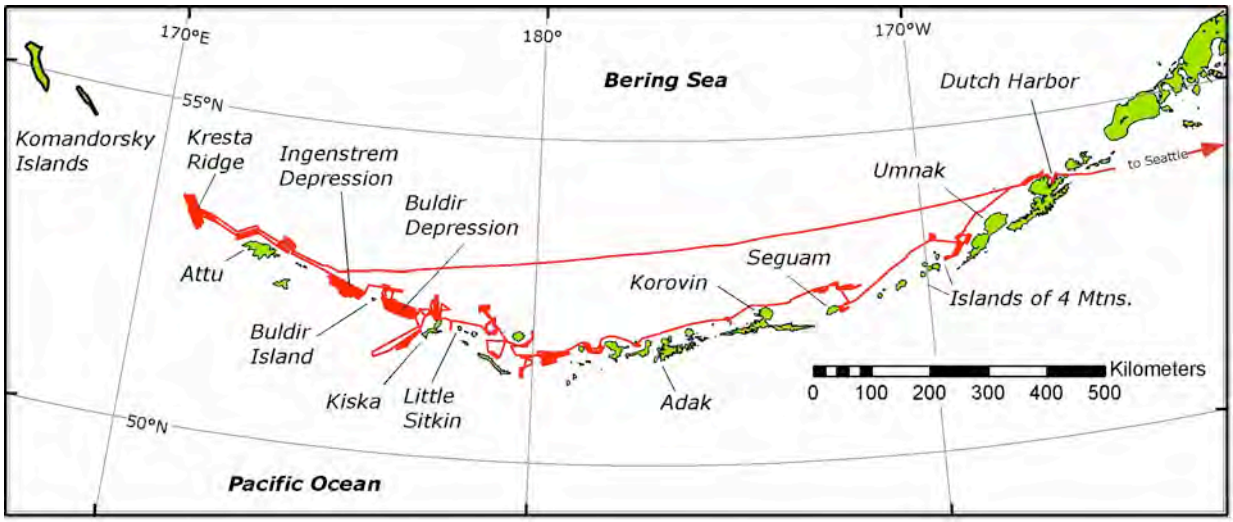


**Fig. 5.8.:** *Overview map of the Aleutian island arc. The red line marks the ship's track of the WAVE cruise by R/V THOMPSON.*

***Ingenstrem Depression (DR 9 through DR 24)***

The Ingenstrem Depression is a structural basin ~60 km in length by 10-15 km wide, lying along the crest of the arc just west of Buldir Island, the westernmost emergent volcano in the Aleutians. Mapping by R/V THOMPSON accomplished in 2005 under the U.S.-funded Western Aleutian Volcano Expedition (WAVE, Fig. 5.8.) revealed the sea-floor in the Ingenstrem Depression to be littered with more than 100 small volcanic cones and associated lava flows. Spatial analysis of the map data indicate that total volume of young volcanic rock present in the Ingenstrem Depression to be approximately 10 $km^3$, similar to the total volume of small, emergent volcanoes in the Aleutians, such as Little Sitkin and Buldir.

The objective of SO201 Leg 1b investigations in the Ingenstrem Depression was to improve sampling of young volcanic rocks, with the aim of delineating the full range of geochemical compositions that are present. Toward this goal a total of 15 cones throughout the Ingenstrem Depression were selected based on preexisting maps and sampling (Fig. 5.9.).

DR 9 marks the westernmost cone of the Ingenstrem Depression sampled during SO201 Leg 1b. Cone 1B (numbers given by cruise participants) has been sampled from base to top (1,083 to 880 mbsl) along its southeast slope and revealed a full dredge of very fresh hornblende and plagioclase-phyric andesites with minor olivine. Generally they have a dark grey matrix and 10-20% vesicles. Hornblende can reach up to 1 cm whereas plagioclase is 2–5 mm in size. Varieties with clinopyroxene instead of hornblende have been described for sample DR 9-3 through -8. At site DR 10, cone 1A has been sampled from base to top (1,191 to 980 mbsl) along the eastern slope and returned a full dredge of relatively homogeneous andesites with varying amounts of clinopyroxene (10-20%), plagioclase (10%) and hornblende (10-20%) all several mm to 1 cm sized. Cone 2A has been sampled during DR 11 along its southern flank from base to top (1,242 to 1,058 mbsl). Two lithologies, a dark grey olivine-phyric basalt with 10-15% olivine up to 5 mm and a light grey hornblende-phyric andesite containing 5-15% hornblende up to 1 cm and minor amounts of mm sized plagioclase. All samples are extremely fresh and possess only minor manganese patches. At site DR 12 the SW-NE oval shaped cone 2E has been sampled at its southeast flank from base to top (1,104 to 993 mbsl) and recovered a homogeneous lithology of dark-grey olivine-phyric basalt with ~15%, 3 mm sized fresh olivine. DR13 targeted cone 2C along its southeast flank from mid-slope to the top (1,076–804 mbsl). A quarter full dredge of brownish-grey andesite with

variable amounts (5-10%) of hornblende-pyroxene and possibly olivine all of which are mostly several millimeters in size. Vesicles (5-10%, sub-mm sized) are often concentrated in several millimeter to centimeter thick bands. The lavas of DR 13 appear more evolved than those of the previous stations. The southeast slope of cone 3A has been sampled during DR 14 from 1,512 to 1,325 mbsl This cone is located at deeper water depth along the N facing slope of the ridge where the majority of cones are located. Here massive porphyritic, dark-grey to black lava with up to 20-30% olivine and pyroxene (3 mm) and 10% plagioclase was recovered. A very similar lithology has been recovered during DR 15 at cone 4B from 1,097 to 878 mbsl along its SSE flank. Adjacent to DR 15, cone 4A has been dredged from 1,160 to 1,015 mbsl during DR 16 and recovered very large blocs of olivine-phyric basalt with minor amounts of clinopyroxene and plagioclase (1-5%) and possibly hornblende. Fresh olivine occurs in amounts of 10-20% and is smaller than 5 mm. Station DR 17 marks sampling of cone 5A along the southeast flank from base to top (1,174 to 993 m b.s.l).. Here an ol-plag-phyric basalt was recovered with minor amounts of clinopyroxene. The groundmass varies from dark grey to greenish grey. Overall the phenocrysts are relatively small (few mm). Notably some lava fragments may contain glassy margins. At DR 18 (cone 5B) ol-plag-phyric basalt with 10-15%, <2 mm sized olivine and 10% plagioclase sometimes up to 3 mm has been recovered from the southeast flank (1,128 to 967 mbsl). Notably 0.5–1 cm sized xenoliths of aphyric basalt is observed in some samples (DR 18-1) along with possible quartz inclusions that have sharp boundaries to the matrix. Although macroscopically interaction of the xenolithic material appears limited, rock preparation should carefully avoid such material.

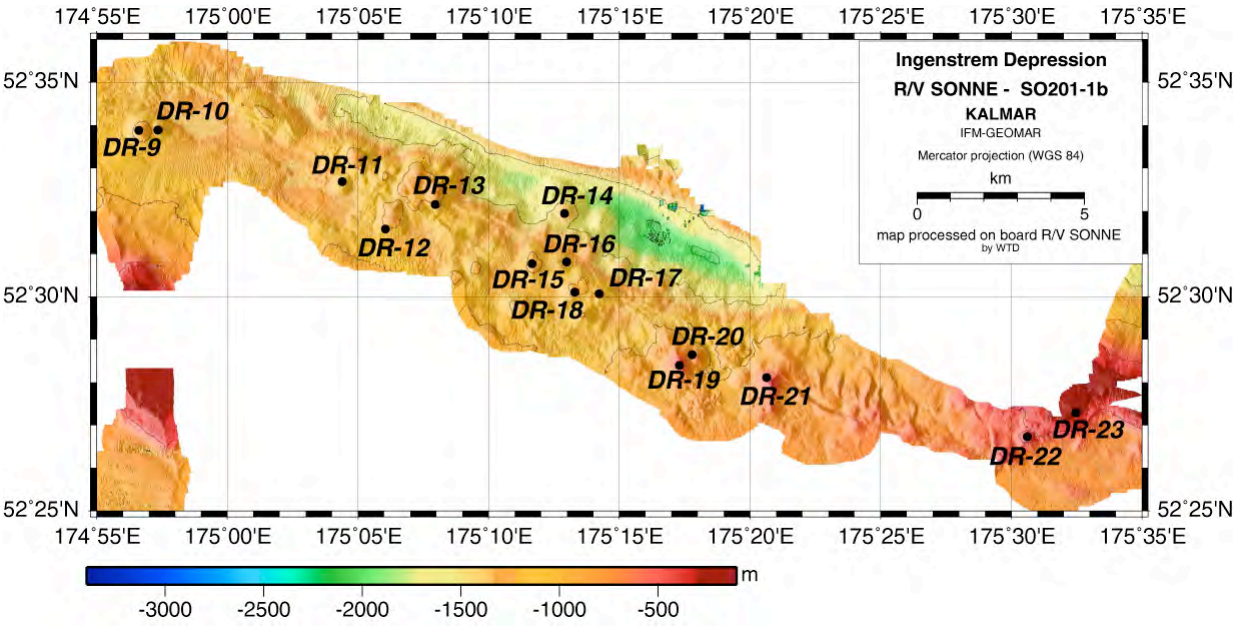


**Fig. 5.9.:** *Dredge sites DR 9 through DR 24 in the Ingenstrem Depression.*

Toward the eastern Ingenstrem Depression the cones become larger and reach shallower water depth of a few 100 m as Buldir Island is approached. DR 19 sampled cone 7A along the upper part of its SE slope from 785 to 558 mbsl. A full dredge of dense olivine-phyric basalt was recovered that notably contains numerous mantle xenoliths ranging from a few cm up to 10 cm. The basalt contains fairly high amounts of fresh olivine (15-30%) and ~3-10% clinopyroxene while plagioclase is restricted to minor amounts of microphenocrysts. The mantle xenoliths consists mostly of olivine (80%) and clinopyroxene-orthopyroxene (20%). A large number of mantle xenoliths has been cut off from the matrix for further investigation. The small cone 7B immediately east of 7A is the location of DR 20 where the east facing slope from base to top (990-795 mbsl) has been dredged. A full dredge with of heterolithogical composition has been recovered. These include light grey to brownish andesites with 15-20% sub-mm sized hornblende and 10-15% plagioclase up to 5 mm. Another lava type is represented by highly olivine-phyric basalt (15-20%, 1–2 mm) with minor amounts of plagioclase (2-3%, <1 mm). Notably these basalts also contain millimeter-sized mantle

xenoliths or in one case reworked basalt clasts. A third lithology of this dredge comprises volcaniclastic rocks with clasts of highly hornblende-phyric andesites and aphyric basalts (DR 20-8, -5). At cone 8B the southeast facing slope has been sampled between 790 and 570 mbsl during DR 21. A full dredge of homogeneous ol-plag-phyric basalt has been recovered. Olivine occurs in constant amounts of ~20% up to 2 mm whereas plagioclase phenocrysts comprise 10-15% and are up to 3 mm in size. Again millimeter- to centimeter-sized ultramafic xenoliths occur in several pieces. In the easternmost Ingenstrem Depression, location DR 22 (cone 9A) and DR 23 (cone 9B) mark the end of the SO201 Leg 1b survey in this area. Both locations are the shallowest dredges of the cruise with 715 to 437 mbsl and 559 to 233 mbsl, respectively, leading to the recovery of higher amounts of biological material such as deep water corals growing on the lava blocs. DR 22 obtained a homogenous load of ol-px-plag-phyric basalt with 10-20% olivine (sub-mm to 5 mm), 5% pyroxene (sub-mm to 2.5 mm) and 2% plagioclase (sub-mm to 2 mm). This variety is more porphyritic than that obtained at DR 21. DR 23 is characterized by two varieties of andesite that differ in the amount of hornblende phenocrysts varying between 10 to 25% and range from a few millimeters up to 1 cm. Minor amounts of pyroxene (1-2%, 1-5 mm) occur in some samples. Several pieces are also strongly rounded (DR 23-7 onwards) indicating that these are reworked clasts from older flows and may originate from the shallowest parts of the structure (<100 m) which may have been exposed to wave erosion during the last sea level low and/or subsided in this tectonically very active area.

***Area west of Attu (DR 33-36)***

The objective of SO201 Leg 1b in the area west of Attu was to search for young volcanic structures on the sea-floor and-if found-to sample them by dredging. Extensive mapping in 2005 in the area west of Attu concentrated at Kresta Ridge (Fig. 5.8.), where there is a complex pattern of intersecting strike-slip faults, similar to those which are known to host recent volcanic activity in other areas. However mapping at Kresta Ridge in 2005 failed to reveal signs of active volcanism on the sea-floor. Consequently, mapping on SO201 Leg 1b was concentrated north of Kresta Ridge, in a ~25 km-wide and northwest-trending swath, beginning at approximately the northern extent of the 2005 map area (~172° 30'E).

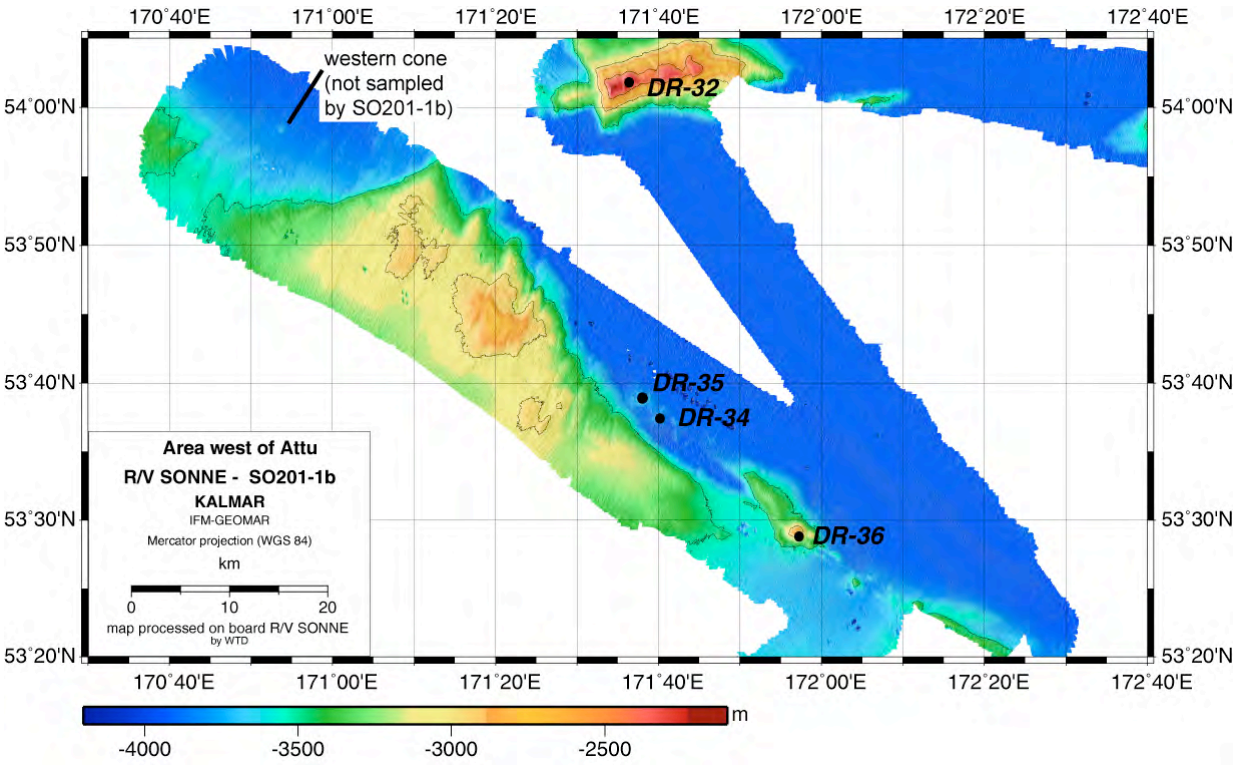


**Fig. 5.10.:** *Dredge sites DR33 – 35 at the newly discovered volcanic cones in the area west of Attu. Also shown on this map is DR 32 at a seamount adjacent to Bowers Ridge (see chapter 5.2.4.).*

This mapping revealed evidence of sea-floor volcanism in three locations, which are, from west-to-east (1) a very small conical feature (<150 m high) at ~170° 53'E, (2) two small cones and related features at 171° 40'E, and (3) a large volcanic structure with satellite vents and flank features at 171° 30'E (Fig. 5.10.). The very small feature, located at the western-most location (~170° 53'E) was not dredged due to time constraints, the small cones (at 171° 40'E) were sampled during DR 33, DR 34 and DR 35 (Fig. 5.10.). All of them are located in more than 3,500 m water depth and thus considerably deeper than the cones of the Ingenstrem Depression. DR 33 (3,778 to 3,457 mbsl) was carried out at the largest cone of the three cones in the area which elevates ~350 m and has a base diameter of ca 1.5 km. A single small piece of dense, aphyric and glassy lava with presumably andesitic to dacitic composition has been obtained. The lava fragment has a small 1 mm thick manganese crust, indicating some residence time. A second more successful attempt on this structure was carried out during DR 35 (3,730 to 3,457 mbsl) which provided fresh hornblende-phyric andesites (10-15% hornblende, several mm-sized) and near aphyric basalt clasts. DR 34 targeted the second largest cone (150 m high, 500 m base diameter) from 3,806 to 3,569 mbsl and obtained a few fairly homogeneous, mostly aphyric and highly vesicular lava clasts. The fresh groundmass is brownish-grey and occasional plagioclase (<4%, <5 mm) and pyroxene (2%, <2 mm) are observed. Notably the clasts possess only minor manganese coating in places, indicating a relatively short exposure time to seawater.

The largest young volcanic structure in this area (171°57'E; 53°28'N) is approximately 4 x 6 km at the base and 1,000 meters high, with a summit elevation of ~2,800 mbsl. The morphology of the seamount clearly indicates that it is a young volcano with multiple satellite vents and other flank features. The total size of the structure approaches that of Little Sitkin or other small emergent volcanoes in the western Aleutians. DR 36 sampled the southeast flank of the main edifice from mid slope to the top (3,187 to 2,829 mbsl) where two large blocs of platy dacites with alternating flow-bands of glassy matrix and pumice were recovered. The groundmass is grayish-brown, nearly aphyric with less than 1% plagioclase, hornblende and pyroxene (?) phenocrysts. Sample DR 36-14 contained a 5 x 1.5 cm sized aphyric basaltic xenolith.

### 5.2.4. Bowers Ridge and Adjacent Seamounts (DR 24 – 32)

***Bowers Ridge (DR 24 – 28)***

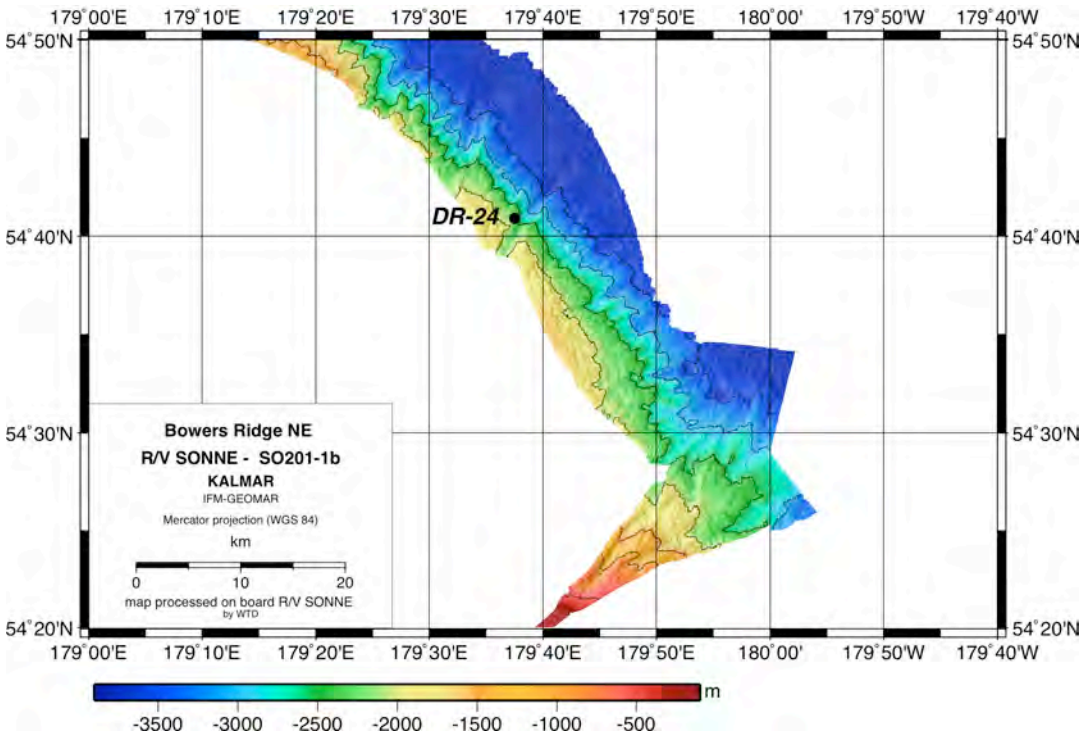


**Fig. 5.11.:** *Dredge site DR 24 at the northeastern slope of Bowers Ridge.*

Bowers Ridge is a sickle-shaped, up to 15 km wide ridge, which rises from water depths of ~3,900 m to nearly sea level. Prior to the SO201 Leg 1b cruise, rock samples from the ridge, which could provide detailed information on its origin, composition and age, did not exist. Accordingly SO 201 Leg 1b aimed to sample the magmatic basement of Bowers Ridge.

The first dredge attempt (DR 24) has been carried out at the east-facing wall of a valley which cuts into the northeastern slope of Bowers Ridge in an area where SO201 Leg 1b reconnaissance mapping revealed a morphology characteristic of thick sediment accumulation (Fig. 5.11.). DR 24 therefore was mainly conducted to verify the nature of the basement in this area. As expected the dredge returned solidified sediments with freshly broken surfaces. Major lithologies are carbonate rocks and marl.

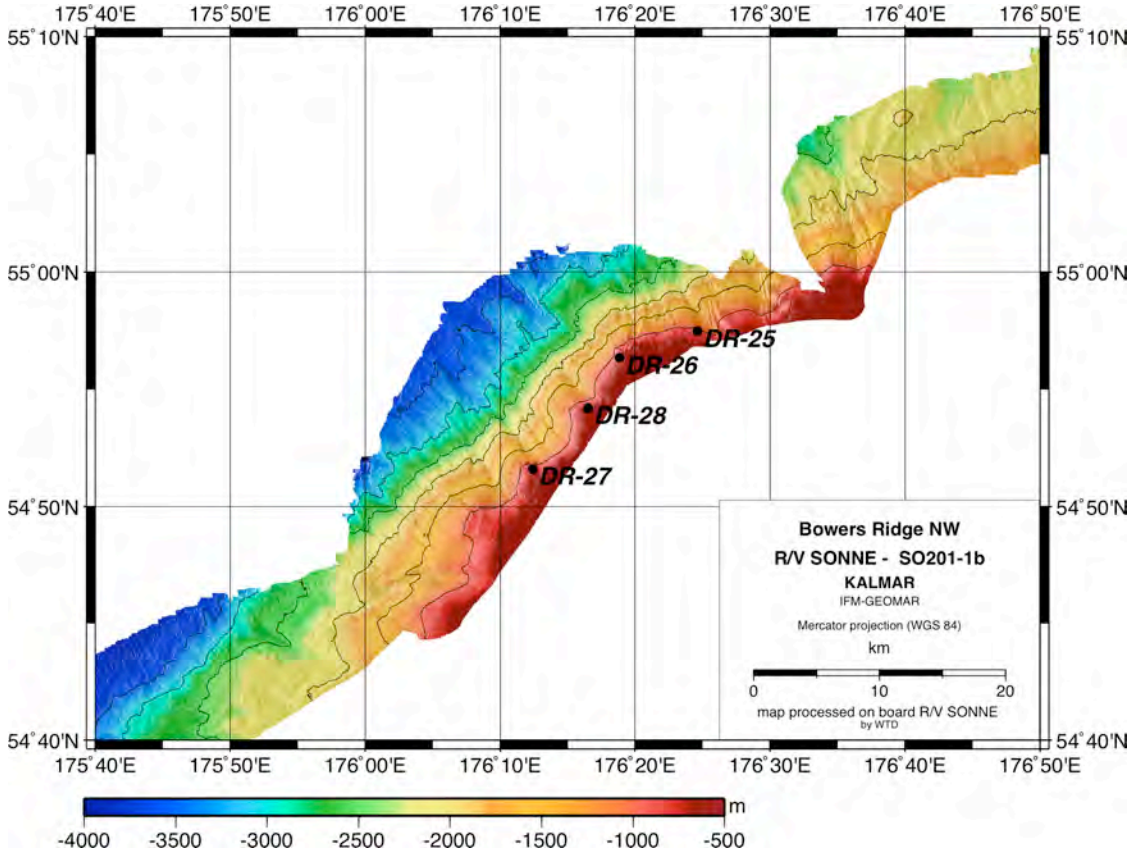


**Fig. 5.12.:** *Dredge site DR 25 to 28 at the upper northwestern slope of Bowers Ridge.*

From dredge site DR24 R/V SONNE sailed along the northeastern and northern slope toward a section of the northwestern slope where dredging in 1970 by the Scripps Institution of Oceanography yielded a piece of volcanic breccia from the Bowers Ridge basement. Here SO201 Leg 1b conducted four dredge hauls (DR 25–28) which sampled a collection of sedimentary and magmatic rocks from the upper slope of the ridge (Fig. 5.12.). Most of these rocks are considered to represent the ridge basement. DR 25 was carried out in small valley just beneath plateau edge from 1,386 to 936 mbsl and returned predominantly slightly vesicular clinopyroxene-phyric basalts (up to 25% cpx, <5 mm) with minor amounts of altered olivine and plagioclase microphenocrysts. Minor lithologies are hbl-plag-cpx-bearing andesites, fine-grained sedimentary rocks, and breccias consisting of various types of clasts, among them are andesites, basalts, altered serpentinites, light aggregates of quartz and feldspar, and shale. DR 26 was made ~4 nm WSW of DR 25 from 1,420 to 749 mbsl at the steepest slope in this area. Just beneath the dredge site a erosion valley develops. This dredge yielded a breccia fragment being similar to those found in DR 25, massive and layered sedimentary rocks, and some pieces of slightly altered hbl-plag-cpx-phyric andesites with up to 15% plagioclase (<3 mm), 10% clinopyroxene (<2 mm), and 6% hornblende (<2 mm). Approximately 6 nm further southwest DR 27 (1,206 to 763 m) recovered moderately to strongly altered lava fragments, highly altered breccias with chunks of vesicular lavas in a

brown matrix, sedimentary rocks, and sponges which are sometimes attached with volcanic rocks. The lavas fragments contain weathered pyroxene (~6%, up to 1 cm in size), plagioclase (~4%, 1 – 2 mm) and altered olivine (~3 %, <2 mm). They resemble the basalts from DR 25 but appear to be more strongly altered. The fourth dredge haul in this area (DR 28; 1,136 to 710 mbsl) was taken ~3 nm northeast of DR27 at the north-facing slope of small valley that cuts the flank of Bowers Ridge up to the plateau edge. Besides sponges DR 28 sampled some large angular blocks of slightly vesicular lava and strongly altered volcanic breccias. The lavas are hbl-plag-cpx-phyric with up 10% hornblende (<8 mm) and up to 5% plagioclase (<2 mm) and minor amounts of clinopyroxene. The majority of the clasts in the breccias show similar phenocryst assemblages (hornblende and plagioclase, each up to 15%) as observed in the lava blocks form the same dredge.

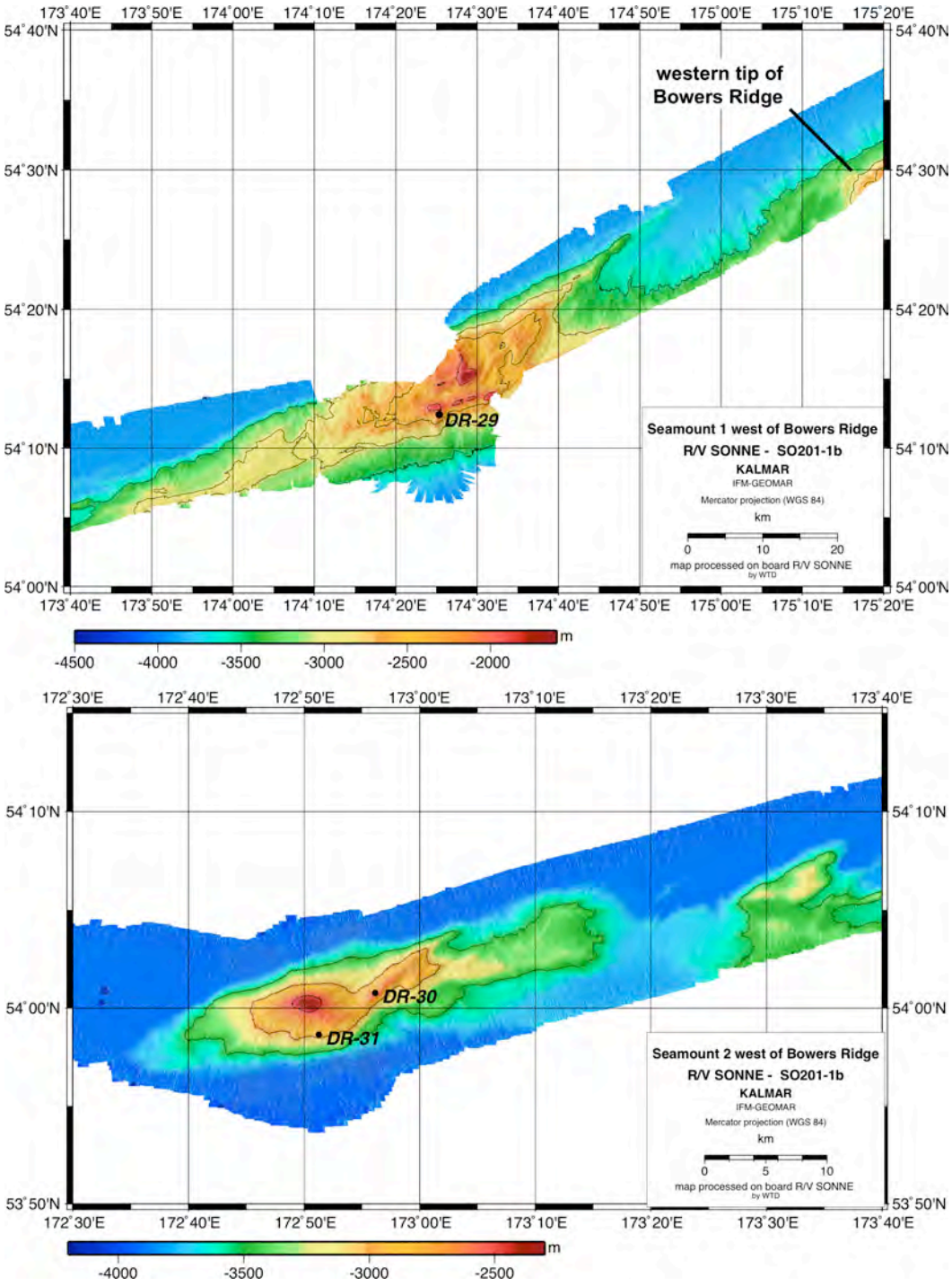


**Fig. 5.13.:** *Dredge site DR 29 to 31 at two ridge-like seamounts extending from Bowers Ridge towards WSW.*

***Seamounts adjacent to Bowers Ridge (DR 29 – 32)***

Bathymetric maps based on satellite altimetry ("predicted bathymetry") reveal several seamounts west of Bowers Ridge. These seamounts form a distinct chain which extends from the western end of Bowers Ridge in WSW-direction. At ~172°50´E the chain bends to the northwest and approaches the southern tip of Shirshov Ridge, which is located in Russian waters (Fig. 3.2.). According to the "predicted bathymetry" this seamount chain seems to connect both ridges, but up till now rock samples and multi-beam bathymetry do not exist from these seamounts and their nature is still unclear. Therefore SO201 Leg 1b was targeted to map and sample the three easternmost seamounts of this chain, which are located in U.S. waters.

SO201 Leg 1b multi-beam mapping revealed that the two seamounts next to Bowers Ridge are situated on a low, broad swell of slightly raised topography which physically connects them with the western tip of the Bowers Ridge. Both are approximately 2,000 m high, ENE-WSW-trending ridge-like features (Fig. 5.13.). DR 29 has been carried out on the upper southern slope of the easternmost seamount from 2,509 to 2,018 mbsl. The dredge recovered a large amount of vesicular olivine-phyric pillows and pillow lavas fragments. Altered olivine (<6 mm) makes up to 15% while plagioclase (<4 mm) and pyroxene (<3 mm) occurs only in minor amounts (<2 %). The groundmass of the lava is moderately altered. Some fragments show chilled glassy margin which appear fresh. Apart from the pillow lavas, DR 29 yielded minor amounts of plag-hbl-bearing doleritic rocks and layered manganese crusts. Two dredge attempts have been made on the second ridge-like seamount, which is located ~20 nm further WSW. DR 30 has been conducted at the southeast-facing flank in 3,107 to 2,527 m water depth beneath the crest of the northern extension of the ridge. Apart from a few volcanic and subvolcanic rocks, being most likely dropstones, this dredges contained a large amount of up to 20 cm thick manganese crusts. A lot of angular fragments of granodiorite-gneissic rocks were found as cemented breccia clasts within the manganese crusts. These rocks consist of up to 80% plagioclase, <10% biotite, <10% amphibole, and up to 10-20% quartz. They are characterized by large variations in textures and color which are typical for plutonic complexes. This may suggest that they are a talus deposit originating from the targeted ridge. To verify the ambiguous results of DR 30 in terms of the *in situ* origin of the plutonic rocks, DR 31 was taken 3 nm southwest of DR 30 at the south-facing slope from 3,236 to 2,895 mbsl beneath the oval-shaped top of the ridge (Fig. 5.13.). However, the dredge returned only a single piece of partially consolidated sediment.

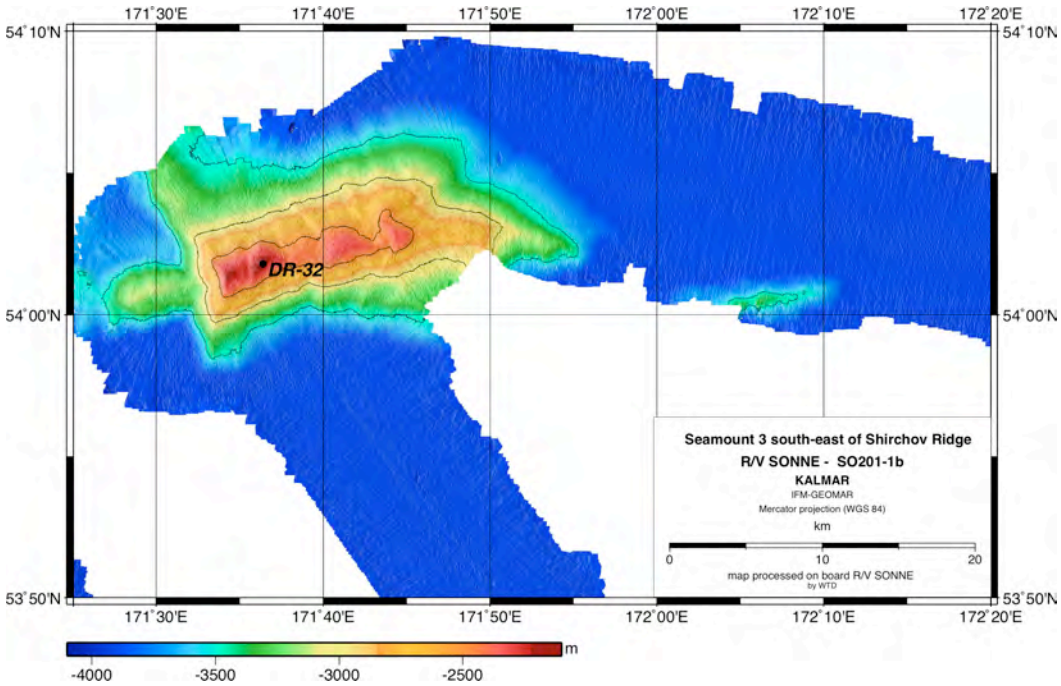


**Fig. 5.14.:** *Dredge site DR 32 at the third seamount west of Bowers Ridge. The plain ocean floor east of this seamount contradicts a morphological connection with Bowers Ridge.*

Subsequently R/V SONNE left the ridge-like seamounts due to time constraints and sailed ~25 nm westward to the third seamount. Multi-beam mapping on the way revealed plain ocean floor, contradicting a direct connection of this seamount with Bowers Ridge. The seamount, which has an elevation ~2,000 m above the abyssal plain, has a roughly rectangular base measuring ~30 x 15 km, and is characterized by steep southern and western and smooth northern and eastern flanks (Fig. 5.14.). Morphologically it resembles more closely a tilted block than a volcano. Unfortunately dredging of the steep flanks proved to be impossible because of the unfavorable wind direction. Instead DR 32 has been carried out on the upper parts of this seamount from 2,383 to 2,895 mbsl (Fig. 5.14.). This dredge returned almost full on deck but contained only a wide spectrum of different volcanic, metamorphic, plutonic, and sedimentary rocks being most likely ice-rafted material ("dropstones").

### 5.2.5. Bathymetry and Hard Rock Sampling Summary

RV SONNE cruise SO201 Leg 1b has achieved its major goals, i.e. bathymetric mapping and the representative hard rock sampling of the basement from selected northern Emperor Seamounts (Suizei, north of Tenji), the western Aleutian Arc (Ingenstrem Depression, west of Attu), the Bowers Ridge and of parts the oceanic crust south of the western Aleutians (Emperor Trough, Stalemate Fracture Zone, Kula-Pacific Spreading Center). Complementing 3.406 nm of multi-beam mapping of the ocean floor, a total of 45 dredges were carried out. Of these deployments, 44 (or 98%) recovered rocks, 37 of them (or 82%) clearly *in situ* magmatic or sedimentary rock (Fig. 5.15.).

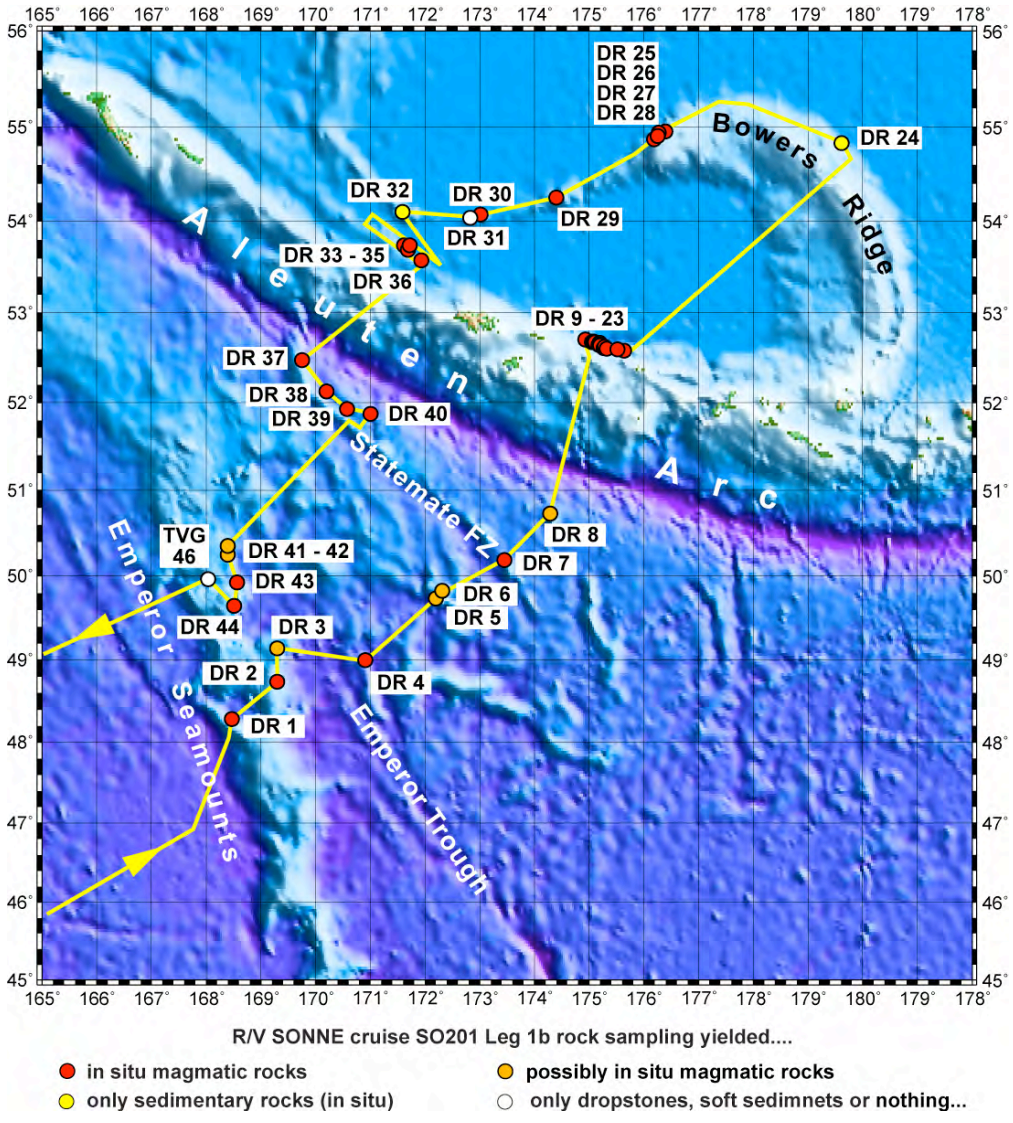


**Fig. 5.14.:** *Overview map of the SO201 Leg 1b sampling sites (yellow line: ship's track).*

As described in detail above, SO201 Leg 1b recovered a broad variety of magmatic rocks from various morphological features in the NW-Pacific and the Bering Sea. The highlights of SO201 Leg 1b rock sampling and multi-beam mapping include:

(1) Filling the sampling gap within the northern part of the Emperor Seamount Chain: *In situ* hard rock sampling of the previously unsampled Hanzei, Suizei, and Tenji Seamounts proved to be difficult since large parts of these structures seem manganese encrusted and the area being littered with dropstones. However, still 4 out of 6 dredges delivered *in situ* magmatic rocks with datable material from Suizei and Tenji Seamounts that also permits further petrological and geochemical investigations. The new samples help to fill the ~700 km long sampling gap between Detroit and Suiko Seamounts and will contribute to an better understanding of the evolution of the Hawaiian plume between ~75 to 60 Ma.

(2) Sampling of the ocean crust of the Pacific and Kula plates: Hard rock sampling along the Stalemate Fracture Zone provided a wide spectrum of volcanic rocks ranging from aphyric pillow lava with fresh glassy margins to plag-cpx-ol-porphyric lavas, dolerites, and gabbros to even serpentinized ultramafic rocks. This rich variation in lithologies represents a good cross section of the ocean crust presently being subducted beneath the Aleutian Arc and thus will allow to better constrain the chemical signal of the down going plate. The combined geochemical and age data set from the Stalemate samples, from the rocks dredged at the previously unsampled Kula-Pacific spreading center, and from the Emperor Trough will provide important informations on magma generation at the Kula-Pacific spreading center and will also contribute to decipher the history of paleo-Pacific spreading centers.

(3) Sampling Lavas of the Ingenstrem Depression: A total of 15 dredge hauls were carried out in the Ingenstrem Depression at small cones in water depths of 200 – 1,500 meters within approximately 39 hours. All dredges recovered moderate-to-heavy loads of angular blocks of fresh volcanic rock. Glacially derived dropstones or samples with more than a fine coating of manganese oxide were essentially absent from these dredges. Shipboard observations indicate that the samples range in composition from olivine basalt to hornblende-bearing andesite and dacite. Some of the olivine basalts contain numerous mantle xenoliths. The volcanic rock samples recovered in these dredges will provide a much more thorough and systematic sampling of small volcanic cones in the Ingenstrem Depression compared to what was collected on the R/V THOMPSON cruise in 2005. The improved sampling will give us a better basis for interpreting previous geochemical data from this location which clearly demonstrates the existence of a high-Sr (‘adakitic’) geochemical series and a low-Sr (‘normal’) geochemical series which each have distinctive isotopic compositions. The isotopic compositions of high-Sr lavas are like those of Piip Volcano, but the processes that relate the high-Sr andesites and dacites of the Ingenstrem Depression to the magnesian andesites at Piip, and the broader importance of the high-Sr end-member to Aleutian magmatism, remain unclear. The samples collected at this location on S201 Leg 1b will play a key roll the effort to solve the geochemical puzzle of the high-Sr geochemical series, which is key to understanding the genesis of Aleutian magmatism.

(4) Discovery of Young Volcanism in the Area West of the Attu Island in the Aleutian Arc: All of the newly discovered volcanic features west of Attu Island in the Aleutians are in water depths of 2,800 - 3,800 meters, and all fall closely on a single volcanic front which connects the westernmost emergent Aleutian volcanoes (Gareloi, Little Sitkin, Kiska and Buldir) with Piip Seamount, which is located north of Medny island, in the Komandorsky area. Dredging of a large cone and two smaller cones recovered a collection of angular blocks of glassy and nearly aphyric andesite and dacite. These results clearly prove that active volcanism is present along much of the length of the Aleutian sea-floor west of Attu Island. This means that the Aleutian volcanoes may be inferred to define one magmatic arc that is continuous from the tip of the Alaska Peninsula on the east to Piip Seamount on the west. Samples collected from the sea-floor volcanoes west of Attu will complement those collected from the Ingenstrem Depression during the R/V THOMPSON cruise in 2005, and will provide a greatly improved basis for understanding the genesis of the distinctive primitive andesite-type of geochemistry at Piip Volcano in the context of ‘normal’ Aleutian arc magmatism which dominates the emergent part of the island arc.

(5) Sampling of the basement of Bowers Ridge: Dredging at the northwestern slope of Bowers Ridge and at associated seamounts yielded for the first time a collection of magmatic rocks from the ridge basement, among them basalts, andesites, and volcaniclastic rocks. The recovered rock types seem to be consistent with an island arc origin for Bowers Ridge as postulated by previous studies (e.g. Cooper et al. 1981, Scholl 2007), contradicting the hypothesis of Steinberger and Gaina (2007) who considered the ridge as a part of the NW-extension of the Emperor Chain. Nevertheless we expect the SO201 Leg 1b samples to provide new and important information on the geological history of Bowers Ridge.

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**APPENDICES:**

I. Sampling Summary

II. Rock Description (dredge station locations and rock sample descriptions)

# *Appendix I (Sampling Summary)*

| Type | Stat. | Location | total volume | Rock summary | on bottom | | off bottom | | depth (m) | | Mag rock | Mn | Sed rock | Volcani-clastics |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | lat °N | long °E | lat °N | long °E | max | min | | | | |
| DR | 1 | Emperor Seamounts South | 1/4 full | lavas, volcaniclastics, Mn crusts, dropsones | 48,182 | 168,501 | 48,177 | 168,409 | 2962 | 2361 | 1 | 1 | 0 | 1 |
| DR | 2 | Emperor Seamounts South | few rocks | lavas, volcaniclastics, Mn crusts | 48,614 | 169,334 | 48,616 | 169,322 | 3720 | 3301 | 0 | 1 | 0 | 1 |
| DR | 3 | Emperor Seamounts South | few rocks | volcaniclastics (most likely dropstones) | 49,002 | 169,332 | 49,007 | 169,319 | 4400 | 3967 | 0 | 0 | 0 | 0 |
| DR | 4 | Emperor Trough | 1/4 full | lavas, Mn crusts, dropsones | 48,863 | 170,942 | 48, 872 | 170,916 | 5971 | 5010 | 1 | 1 | 0 | 0 |
| DR | 5 | Seamount E of Emperor Trough | few rocks | lavas, Mn crusts, dropsones | 49,640 | 172,299 | 49,646 | 172,288 | 3832 | 3259 | 1 | 1 | 0 | 0 |
| DR | 6 | Seamount NE of Emperor Trough | few rocks | lavas, Mn crusts | 49,667 | 172,347 | 49,671 | 172,340 | 3890 | 3455 | 1 | 1 | 0 | 0 |
| DR | 7 | Statemate FZ (Smt on northen margin) | 1/2 full | lavas (dolerite), volcaniclastics, Mn crusts | 50,017 | 173,535 | 50,017 | 173,526 | 3340 | 2803 | 1 | 1 | 0 | 1 |
| DR | 8 | Smt on the Pacific Crust N of Stalemate | few rocks | lavas, volcaniclastics, Mn crusts | 50,558 | 174,316 | 50,562 | 174,306 | 3514 | 3112 | 1 | 1 | 0 | 1 |
| DR | 9 | Ingenstrem Depression Cone 1B | full | lavas | 52,562 | 174,954 | 52,565 | 174,944 | 1083 | 880 | 1 | 0 | 0 | 0 |
| DR | 10 | Ingenstrem Depression Cone 1A | full | lavas | 52,564 | 174,961 | 52,565 | 174,956 | 1191 | 980 | 1 | 0 | 0 | 0 |
| DR | 11 | Ingenstrem Depression Cone 2A | 1/3 full | lavas | 52,538 | 175,077 | 52,545 | 17,073 | 1242 | 1058 | 1 | 0 | 0 | 0 |
| DR | 12 | Ingenstrem Depression Cone 2E | 1/3 full | lavas | 52,543 | 175,103 | 52,860 | 175,101 | 1104 | 993 | 1 | 0 | 0 | 0 |
| DR | 13 | Ingenstrem Depression Cone 2C | 1/4 full | lavas | 52,538 | 175,139 | 52,536 | 175,133 | 1076 | 804 | 1 | 0 | 0 | 0 |
| DR | 14 | Ingenstrem Depression Cone 3A | 1/6 full | lavas | 52,528 | 175,219 | 52,532 | 175,215 | 1512 | 1321 | 1 | 0 | 0 | 0 |
| DR | 15 | Ingenstrem Depression Cone 4B | full | lavas (only large blocks) | 52,506 | 175,198 | 52,513 | 175,194 | 1097 | 878 | 1 | 0 | 0 | 0 |
| DR | 16 | Ingenstrem Depression Cone 4A | 3/4 full | lavas | 52,510 | 175,218 | 52,514 | 175,210 | 1147 | 1015 | 1 | 0 | 0 | 0 |
| DR | 17 | Ingenstrem Depression Cone 5A | 1/4 full | lavas | 52,497 | 175,241 | 52,501 | 175,237 | 1175 | 993 | 1 | 0 | 0 | 0 |
| DR | 18 | Ingenstrem Depression Cone 5B | 1/3 full | lavas | 52,497 | 175,224 | 52,502 | 175,222 | 1128 | 967 | 1 | 0 | 0 | 0 |
| DR | 19 | Ingenstrem Depression Cone 7A | full | lavas (with xenolithes) | 52,467 | 175,293 | 52,473 | 175,288 | 785 | 558 | 1 | 0 | 0 | 0 |
| DR | 20 | Ingenstrem Depression Cone 7B | full | lavas (with xenolithes), volcaniclastics | 52,482 | 175,307 | 52,478 | 175,297 | 990 | 795 | 1 | 0 | 0 | 1 |
| DR | 21 | Ingenstrem Depression Cone 8B | full | lavas | 52,460 | 175,352 | 52,469 | 175,344 | 790 | 570 | 1 | 0 | 0 | 0 |
| DR | 22 | Ingenstrem Depression Cone 9A | few rocks | lavas | 52,439 | 175,666 | 52,446 | 175,510 | 715 | 437 | 1 | 0 | 0 | 0 |
| DR | 23 | Ingenstrem Depression Cone 9B | full | lavas | 52,448 | 175,546 | 52,455 | 175,541 | 559 | 233 | 1 | 0 | 0 | 0 |
| DR | 24 | Bowers Ridge, north-eastern slope | few rocks | sedimentary rocks | 54,681 | 179,635 | 54,682 | 179,624 | 2718 | 2143 | 0 | 0 | 1 | 0 |
| DR | 25 | Bowers Ridge, north-western slope | few rocks | lavas, volcaniclastics, sedimentary rocks | 54,968 | 176,415 | 54,958 | 176,408 | 1326 | 936 | 1 | 0 | 1 | 1 |
| DR | 26 | Bowers Ridge, north-western slope | few rocks | lavas, volcaniclastics, sedimentary rocks | 54,947 | 176,297 | 54,939 | 176,314 | 1420 | 749 | 1 | 0 | 1 | 1 |
| DR | 27 | Bowers Ridge, north-western slope | few rocks | lavas, volcaniclastics, sedimentary rocks, sponges | 54,876 | 176,212 | 54,860 | 176,207 | 1206 | 763 | 1 | 0 | 1 | 1 |
| DR | 28 | Bowers Ridge, north-western slope | few rocks | lavas, volcaniclastics, sponges | 54,912 | 176,276 | 54,903 | 176,275 | 1136 | 710 | 1 | 0 | 1 | 1 |
| DR | 29 | 1. Seamount W of Bowers Ridge | 1/2 full | pillow lavas, Mn crusts | 54,202 | 174,431 | 54,207 | 174,423 | 2509 | 2018 | 1 | 1 | 0 | 0 |
| DR | 30 | 2. Seamount W of Bowers Ridge | 1/2 full | intrusiva (breccia), Mn crusts, dropstones | 54,004 | 172,943 | 54,013 | 172,936 | 3107 | 2527 | 1 | 1 | 0 | 0 |
| DR | 31 | 2. Seamount W of Bowers Ridge | empty | -- | 53,972 | 172,854 | 54,978 | 172,854 | 3236 | 2900 | 0 | 0 | 0 | 0 |
| DR | 32 | Seamount SE of Shirshov Ridge | 3/4 full | breccia, sedimentary rocks, organics, dropstones | 54,038 | 171,615 | 54,030 | 171,607 | 2383 | 2172 | 0 | 0 | 1 | 1 |
| DR | 33 | Cones NW of Attu Island | one rock | lava | 53,652 | 171,643 | 53,648 | 171,635 | 3778 | 3457 | 1 | 0 | 0 | 0 |
| DR | 34 | Cones NW of Attu Island | 1/10 full | lavas | 53,623 | 171,682 | 53,624 | 171,670 | 3806 | 3669 | 1 | 0 | 0 | 0 |
| DR | 35 | Cones NW of Attu Island | few rocks | lavas | 53,649 | 171,645 | 53,649 | 171,634 | 3730 | 3457 | 1 | 0 | 0 | 0 |
| DR | 36 | Cones NW of Attu Island (large cone) | 1/6 full | lavas | 53,476 | 171,966 | 53,480 | 171,954 | 3187 | 2829 | 1 | 0 | 0 | 0 |
| DR | 37 | Stalemate FZ | few rocks | ultramafic rocks, Mn crusts, dropstones | 52,278 | 169,815 | 52,271 | 169,805 | 4360 | 3955 | 1 | 1 | 0 | 0 |
| DR | 38 | Stalemate FZ | 1/10 full | fault breccia, lavas | 51,940 | 170,262 | 51,931 | 170,275 | 4263 | 3974 | 1 | 0 | 0 | 0 |

# *Appendix I (Sampling Summary)*

| Type | Stat. | Location | total volume | Rock summary | on bottom | | off bottom | | depth (m) | | Mag rock | Mn | Sed rock | Volcani-clastics |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | lat °N | long °E | lat °N | long °E | max | min | | | | |
| DR | 39 | Stalemate FZ | | canceled due to strong current | | | | | | | 0 | 0 | 0 | 0 |
| DR | 40 | Statemate FZ | 1/2 full | lavas, intrusiva, breccias | 51,741 | 170,600 | 51,736 | 170,590 | 3668 | 3064 | 1 | 0 | 0 | 1 |
| DR | 41 | Kula-Pacific late spreading center | 3/4 full | pillow lavas, volcaniclastic rocks (hyaloclastite), Mn crusts | 51,668 | 171,043 | 51,660 | 171,042 | 4334 | 4070 | 1 | 1 | 0 | 1 |
| DR | 42 | Emperor Seamounts north (Hanzei) | few rocks | Mn crusts, dropstones | 50,162 | 168,416 | 50,164 | 168,409 | 3615 | 3311 | 0 | 1 | 0 | 0 |
| DR | 43 | Emperor Seamounts north (Hanzei) | 2 rocks | lava, sedimentary rock (dropstones?) | 50,097 | 168,414 | 50,098 | 168,398 | 4014 | 3527 | 1 | 0 | 1 | 0 |
| DR | 44 | Emperor Seamounts north (Suizei) | full | lava, volcaniclastic rocks, chert, Mn crusts | 49,758 | 168,564 | 49,757 | 168,555 | 3117 | 2650 | 1 | 1 | 0 | 1 |
| DR | 45 | Emperor Seamounts north (Suizei) | few rocks | lavas, volcaniclastics, sedimentary rocks | 49,513 | 168,539 | 49,518 | 168,527 | 4870 | 4216 | 1 | 1 | 1 | 0 |
| TVG | 46 | Emp.r. Smts N (cone betw. Hanzei and Suizei) | full | M-crusts, dropstones, soft sediment | 49,898 | 168,093 | 49,896 | 168,088 | 3634 | 3660 | 0 | 1 | 0 | 0 |
| | | | | | | | | | **Total:** | | **38** | **15** | **8** | **13** |

**Dredge Stations (DR): 44**
**TV-grab Stations (TVG): 1**
**EM120 and PARASOUND Surveys: 3,406 nm**

**SO201-1b-DR1**

**Description of Location and Structure: Emperor Ridge, south from Tenji Smt where the smt chain splits into 2 ridges. Location is along W ridge and E slope just beneath the plateau edge.**

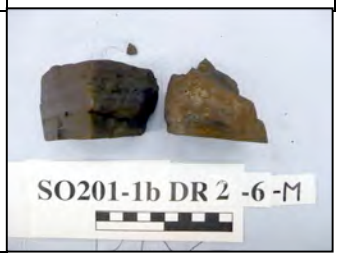
Dredge on bottom UTC 16/06/09 14:30hrs, lat 48°10,91'N, long 168°30,07'E, depth 3030m
Dredge off bottom UTC 16/06/09 19:32hrs, lat 48°10,63'N, long 168°29,36'E, depth 2375m
*total volume: 1/4 full*
*Comments: Very heterogeneous lithology; rounded to angular clasts of plutonics, volcanics, volcanoclastics; 1 breccia with 10-20 cm sized angular clast, numerous dropstopes*

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR1-1 | 1. Rock Type: fragment of breccia cemented by up to 10 cm thick manganese crust. 3 clasts (1A-1C; 10 cm) of massive, dense rock (sheet lava) and numereous clasts of lava breccia. Size of whole piece 70x40x30 cm. | | | | | | | | | | |  |
| DR1-1A | 1. Rock Type: massive, aphyric sheet lava<br>2. Size: 30x20x12 cm<br>3. Shape/Angularity: angular<br>4. Encrustations: no crust<br>5. Vesicularity: dense<br>6. Vesicle Filling: no<br>7. Matrix Color: dark grey<br>8. Primary Minerals: ol ~1%, 2 mm, altered to Fe-Oxides / cpx 5%, <4mm, fresh / plag ≤ 1%, ≥2 mm, fresh<br>9. Secondary Minerals: yes<br>10. Overall Degree of Alteration: moderate<br>11. Comment: | x | x | Groundmass | x | | | | | | |  |
| DR1-1B | 1. Rock Type: massive sheet lava<br>2. Size: 15x10x10 cm<br>3. Shape/Angularity: angular<br>4. Encrustations: no crust<br>5. Vesicularity: dense<br>6. Vesicle Filling: no<br>7. Matrix Color: dark grey<br>8. Primary Minerals: ol < 1%, ≥2 mm, altered / cpx ~7%, ≥5 mm / plag 1%, ≥2 mm<br>9. Secondary Minerals: yes<br>10. Overall Degree of Alteration: moderate<br>11. Comment: Same as 1A | x | x | Groundmass | | | | | | | |  |
| DR1-1C | 1. Rock Type: massive sheet lava<br>2. Size: 10x6x6 cm<br>3. Shape/Angularity: angular<br>7. Matrix Color: dark grey to brownish<br>10. Overall Degree of Alteration: altered<br>11. Comment: same as 1A and 1B | x | | | | | | | | | |  |
| DR1-D | 1. Rock Type: the same as A only strongly altered, with veins filled with carbonate (?)<br>2. Size: 10x4x6 | | | | | | | | | | |  |
| DR1-2 | 1. Rock Type: Breccia, aphyric to phyric, in carbonatized matrix (?), heterogeneous, no sorting, elongated fragments with manganese crust, clast size ≤ 2 cm<br>2. Size: 10x6x6<br>3. Shape/Angularity: angular fragment of manganese crust<br>4. Encrustations: manganese crust<br>5. Vesicularity: no<br>6. Vesicle Filling: no<br>7. Matrix Color: pinkish grey to brown<br>8. Primary Minerals: no<br>9. Secondary Minerals: highly altered<br>10. Overall Degree of Alteration: highly altered | x | | | | | | | | | |  |
| DR1-3M | 1. Rock Type: Manganese crust taken from sample 1, from the upper part of the block, part was exposed to water.<br>2. Size: 25 x 8 x 15 cm | | | | | | | | | x | |  |

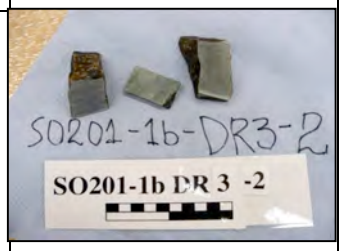
| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR1-4M | 1. Rock Type: piece from different block, breccia like sample 2 with ≤ 6 cm manganese crust<br>2. Size: 10 x 10 x 10 cm | | | | | | | | | x | |  |

**SO201-1b-DR2**
**Description of Location and Structure: Emperor Ridge, Eastern Tenji ridge, upper part of the eastern slope, flank of small canyon**
Dredge on bottom UTC 17/06/09 06:12hrs, lat 48°36,82'N, long 169°20,06'E, depth 3720m
Dredge off bottom UTC 17/06/09 07:37hrs, lat 48°36,98'N, long 169°19,33'E, depth 2375m
*total volume:* few rocks
*Comments:* volcanics, breccia, thick Fe-Mn oxide crusts

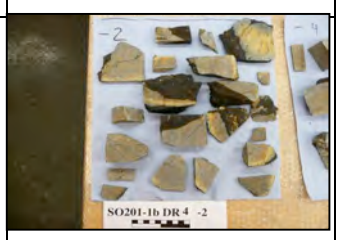
| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR2-1 | 1. Rock Type: sheet lava, massive, somewhat fluidal texture<br>2. Size: 18x10x12<br>3. Shape/Angularity: angular to rounded<br>4. Encrustations: manganese crust <1cm<br>5. Vesicularity: none<br>6. Vesicle Filling: none<br>7. Matrix Color: dark grey<br>8. Primary Minerals: Ol <5 mm/20% with Spinel in inclusions , Cpx<<1%<br>9. Secondary Minerals: hydroxides after olivine, altered g.m.<br>10. Overall Degree of Alteration: moderate to strong | x | x | x | | XRF | | | | | |  |
| DR2-2 | 1. Rock Type: massive lava, aphyric<br>2. Size: 8x6x6<br>3. Shape/Angularity: "bone like", subrouned<br>4. Encrustations: little bit manganese crust, oxidation + carbonate<br>5. Vesicularity: voids filled/ some are not filled: up to 5 mm, 2% vesicularity<br>6. Vesicle Filling: yes/no - white some<br>7. Matrix Color: greyish brown<br>8. Primary Minerals: Ol - microliths<<1% <=0.2 mm<br>9. Secondary Minerals: yes in vesicles<br>10. Overall Degree of Alteration: moderate | x | x | | | XRF | | | | | |  |
| DR2-3 | 1. Rock Type: massive lava , aphyric<br>2. Size: 25x15x10<br>3. Shape/Angularity: angular to rounded<br>4. Encrustations: Mn-Fe crust <= 1 cm<br>5. Vesicularity: 5 %, 1 mm<br>6. Vesicle Filling: none<br>7. Matrix Color: brownish grey<br>8. Primary Minerals: Ol (?) < 1%, small Pl (0.1-0.2mm)<br>9. Secondary Minerals: in vesicles<br>10. Overall Degree of Alteration: moderate to strong<br>11. Comment: Mn encrustations of clasts in breccia and also later incrustations on breccia. | 2x | x | x | | XRF | | | | | |  |
| DR2-4 | 1. Rock Type: Breccia; overall shape angular, contains basalt fragements(?) in a fine grained tuffaceous (?) matrix. Basalts have a brown (oxidized) groundmass.<br>2. Size: 15x10x7cm for the entire sample, clasts are up to 3-4 cm<br>3. Shape/Angularity: Basalt fragments are angular to subrounded<br>4. Encrustations: magnese crust on one side of the sample < 2cm<br>5. Vesicularity: basalt clasts 10-20%<br>7. Matrix Color: greenish - gray, fine grained, probably a tuff, groundmass in basaltic clasts is brown<br>8. Primary Minerals: alterered Ol - 5-10%, up to 1 mm, Pl - ?<br>10. Overall Degree of Alteration: strong and pervasive<br>11. Comment: Basaltic clasts might be analyzed for major elements by XRF. Careful picking is required. | x | | | | | | | | | |  |
| DR2-5 | 1. Rock Type: Mn-crust.<br>2. Size: 15x8x4cm<br>3. Shape/Angularity: triangular | | | | | | | | | x | |  |

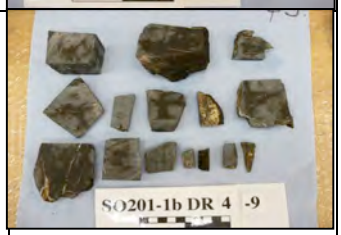
| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR2-6 | 1. Rock Type: Mn-crust.<br>2. Size: 10x6x4cm | | | | | | | | | x | |  |

**SO201-1b-**
**Description of Location and Structure: Eastern Tenji ridge, E, steepest slope in this area, approx. 10nm N of DR2**
Dredge on bottom UTC 17/06/09 14:24hrs, lat 49°00,13'N, long 169°19,91'E, depth 4400m
Dredge off bottom UTC 17/06/09 16:20hrs, lat 49°00,43'N, long 169°19,13'E, depth 3967m
*total volume:* 2 rocks
*Comments:* angular shaped rocks; solidified sediments or aphiric basalts (?) - most likely dropstones

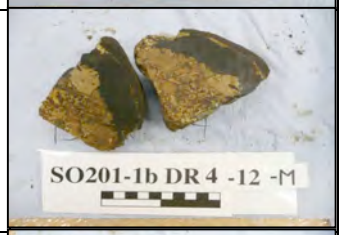
| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR3-1 | 1. Rock Type: volcaniclastic rock, propably tuff<br>2. Size: 8x7x6cm<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: dense<br>6. Vesicle Filling: -<br>7. Matrix Color: fresh core surrounded by 0.5-2cm low-T alteration halo. core = grey to light brown; halo = brown<br>8. Primary Minerals: -<br>9. Secondary Minerals: oxidation halo<br>10. Overall Degree of Alteration: core = rel. fresh; halo = strongly altered<br>11. Comment: flow banding texture suggests soft deformation during desposition. This rock almost certainly represents a dropstone, however the alteration halo indicates that it has been lying on the ocean floor for some time | x | | | | | | | | | |  |
| DR3-2 | 1. Rock Type: probably volcaniclastic, tuff?<br>2. Size: 5x3x2<br>3. Shape/Angularity: angular<br>4. Encrustations: very minor Mn cover<br>5. Vesicularity: dense<br>6. Vesicle Filling: -<br>7. Matrix Color: bluish-grey<br>8. Primary Minerals: no crystals visible, black-grey, angular clasts, 2-3mm in diam.<br>9. Secondary Minerals: very thin veinlets < 0.3mm<br>10. Overall Degree of Alteration:<br>11. Comment: this rock almost certainly is a dropstone. In contrast to sample -1 it does not have an alteration halo, suggesting shorter exposure to seawater. Has been saved for comparison. | x | | | | | | | | | |  |

**SO201-1b-DR4**
**Description of Location and Structure: Emperor Trough. E facing scrap at the flank of a slope failure**
Dredge on bottom UTC 18/06/09 2:26hrs, lat 48°51,79'N, long 170°56,50'E, depth 5961m
Dredge off bottom UTC 18/06/09 07:02hrs, lat 48°52,34'N, long 170°54,94'E, depth 5010m
*total volume: 0.25 full*
*Comments:* Mn encrusted rock fragments, ... Abundant rounded to subangular clasts -> dropstones

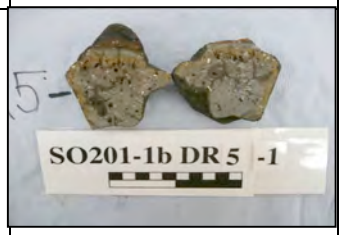
| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR4-1 | 1. Rock Type: porphyric volcanic rock, not clear from texture whether this is indeed lava<br>2. Size: 15x15x10<br>3. Shape/Angularity: subangular<br>4. Encrustations: 2-3 cm Mn-crust<br>5. Vesicularity: not visible, if present then filled with secondary minerals<br>6. Vesicle Filling: yellowish-brown minerals<br>7. Matrix Color: grey... abundant +yellowish orange staining<br>8. Primary Minerals: feldspar 4-6%, 1-3 mm alteredin most cases; pl ?, hbl? 2-3%, 1-2 mm do not appear fresh; ol? <1%, <1mm altered to red iddingsite<br>9. Secondary Minerals: numerous veins filled with Mn, 0.5 mm wide<br>10. Overall Degree of Alteration: strongly altered<br>11. Comment: the rock does not have clear volcanic texture due to the effects of alteration and deformation as is evident from numerous cracks dessectinng the sample | x | x | | | | | | | | |  |
| DR4-2 | 1. Rock Type: similar to sample RD4-1; overall a bit more altered<br>2. Size: 12x12x10<br>3. Shape/Angularity: subangular<br>4. Encrustations: 2-3cm Mn-crust<br>5. Vesicularity: not visible->completely filled with secondary minearal<br>6. Vesicle Filling: -<br>7. Matrix Color: most part brownish-red, very few areas are light gray and appear fresh<br>8. Primary Minerals: fsp 3% 2-3mm altered; px ? 2% 1-2 mm altered<br>9. Secondary Minerals: oxydized groundmass<br>10. Overall Degree of Alteration: very strongly altered<br>11. Comment: overall similar to sample RD4-1; belongs to something like tholeiitic facies | x | x | | | | | | | | |  |

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR4-3 | 1. Rock Type: Fsp-px? phyric volcanic rock<br>2. Size: 8x10x6 cm<br>3. Shape/Angularity: subangular<br>4. Encrustations: 2cm Mn-crust<br>5. Vesicularity: not visible<br>6. Vesicle Filling: -<br>7. Matrix Color: brown; oxydized<br>8. Primary Minerals: 6-8% Fsp upü to 5 mm, some fresh; 4-4% Px? 2-3 mm<br>9. Secondary Minerals: -<br>10. Overall Degree of Alteration: strongly altered but some phenocrysts could be fresh<br>11. Comment: similar to sample 1 and 2 | x | x | | | | | | | | |  |
| DR4-4 | 1. Rock Type: similar to sample 2 but mostly dark phenocrysts<br>2. Size: 12x12x10 cm<br>3. Shape/Angularity: subangular to rounded<br>4. Encrustations: 2 cm Mn-crust<br>5. Vesicularity: dense if present filled with Mn<br>6. Vesicle Filling: -<br>7. Matrix Color: brownish gray<br>8. Primary Minerals: 2-3% px? 1-2 mm altered;<br>9. Secondary Minerals: -<br>10. Overall Degree of Alteration: very strongly altered | x | x | | | | | | | | |  |
| DR4-5 | 1. Rock Type: similar to sample -1 to -4 but more strongly altered and tectonized - check TS for comparison<br>2. Size: 4x5x5cm<br>3. Shape/Angularity: subangular<br>4. Encrustations: 1-2 cm Mn-crust<br>5. Vesicularity: -<br>6. Vesicle Filling: -<br>7. Matrix Color: grey-brownish-green<br>8. Primary Minerals: not preserved and visible<br>9. Secondary Minerals:<br>10. Overall Degree of Alteration: very strong<br>11. Comment: more advanced stage of alteration than previous samples | x | x | | | | | | | | |  |
| DR4-6 | 1. Rock Type: similar to -5) | x | | | | | | | | | |  |
| DR4-7 | 1. Rock Type: similar to -5) | x | | | | | | | | | |  |
| DR4-8 | 1. Rock Type: similar to -5) | x | | | | | | | | | |  |
| DR4-9 | 1. Rock Type: aphyric volcanic rock, most likely basalt<br>2. Size: 8x9x15 cm<br>3. Shape/Angularity: subangular<br>4. Encrustations: less than 1 mm to almost 1 cm Mn-crust<br>5. Vesicularity: slightly vesicular, 1%, 0.5-1 mm<br>6. Vesicle Filling: open<br>7. Matrix Color: dark grey<br>8. Primary Minerals: not visible<br>9. Secondary Minerals: some secondary white veinlets<br>10. Overall Degree of Alteration: minor alteration<br>11. Comment: this is the freshest basalt of the dredge which has Mn-crust indicating that the rocks resided for some time at this location. It could be indeed an in-situ sample though it is unusually fresh compared to sample -1 to -4 | x | x | | | | | | | | |  |

## *Appendix II (Rock Description)*

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR4-10 | 1. Rock Type: moderately 2-10% phyric volcanic rock; basalt<br>2. Size: 10x14x17 cm<br>3. Shape/Angularity: subangular<br>4. Encrustations: encrustations consisting of small clasts and Mn-crusts (up to 2.5 cm thick)<br>5. Vesicularity: non vesicular, dense<br>6. Vesicle Filling: -<br>7. Matrix Color: grey<br>8. Primary Minerals: phenocrysts: - reddish individuals 1-2 mm, equant, probably olivine (altered), replaced with iddingsite ?; - black individuals, prismatic to elongate shape up to 5 mm in size, some visible .. sections indicate probaly hbl ?, seem to be fresh. 60-70% of phenocrysts are olivines, 30-40% - Hbl.<br>9. Secondary Minerals: a few secondary veinlets; iddingsite after ol?<br>10. Overall Degree of Alteration: slightly to moderately altered<br>11. Comment: -fresh minerals can present (hbl?); | x | x | | | | | | | | |  |
| DR4-11M | 1. Rock Type: Mn-crust with basalt clast similar to sample -1 to -4<br>2. Size: 12x14x15 cm<br>3. Shape/Angularity: -<br>4. Encrustations: 2 generations of Mn-crust: outer crust equal to 1-2 cm, and inner crust 1.5-3 cm thick.<br>11. Comment: TS made of basaltic clast | x | | | | | | | | x | |  |
| DR4-12M | 1. Rock Type: Mn-crust with 2 generation<br>2. Size: 8x9x10 cm<br>4. Encrustations: inner crust 1-2.5 cm; outer crust 0.3-1 cm. | | | | | | | | | x | |  |
| DR4-13M | 1. Rock Type: Mn-crust similar to -11M with inclusion of basaltic clast 3-4 cm in diameter<br>2. Size: 17x14x10cm<br>3. Shape/Angularity: inner crust 1.5-2 cm, outer crust 0.5-1 cm.<br>11. Comment: TS made of basaltic clast | x | | | | | | | | x | |  |
| DR4-14C | 1. Rock Type: strongly altered tuff<br>2. Size: 5x9x12 cm<br>3. Shape/Angularity: subangular<br>7. Matrix Color: greenish-grey<br>11. Comment: the rock is likely a drop stone, taken for reference and representative of ca. 7 samples of the same type in the dredge. | x | | | | | | x | | | |  |
| DR4-15 | 1. Rock Type: highly phyric pl-hbl andesite taken from a large block<br>2. Size: 60x50x15 cm<br>3. Shape/Angularity: angular, flat, with plate joining<br>7. Matrix Color: light grey<br>8. Primary Minerals: hbl 10-15% up to 1 cm fresh; plag 20-30 % 0.5-1 cm fresh<br>10. Overall Degree of Alteration: fresh<br>11. Comment: drop-stone taken for reference. | | | | | | | | | | |  |
| DR4-1X | 1. Rock Type: backup of sample -1 | | | | | | x | | | | | |
| DR4-2X | 1. Rock Type: backup of sample -2 | | | | | | x | | | | | |
| DR4-3X | 1. Rock Type: backup of sample -3 | | | | | | x | | | | | |

**SO201-1b-DR5**
**Description of Location and Structure: Seamount on ocean crust E of Emperor Trough. Along S slope of Seamount, small steep nose**
Dredge on b\ UTC 18/06/09 17:40hrs, lat 49°38,42'N, long 172°17,93'E, depth 3832m
Dredge off b\ UTC 18/06/09 19:14hrs, lat 49°38,75'N, long 172°17,28'E, depth 3259m
*total volume:* few rocks
*Comments:* mostly dropstones - granites; a few rocks are covered with Mn crusts -> possibly in situ rocks

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR5-1 | 1. Rock Type: porphyric lava<br>2. Size: 5x5x4<br>3. Shape/Angularity: subangular<br>4. Encrustations: 1.5cm manganese crust<br>5. Vesicularity: 4% open vesicles, 0.5-1mm<br>6. Vesicle Filling: no filling<br>7. Matrix Color: darkgrey<br>8. Primary Minerals: 5% fsp up to 5mm, rel. fresh; <1% altered ol, <0.5mm<br>9. Secondary Minerals: very small redish dots<br>10. Overall Degree of Alteration: slightly to medium altered<br>11. Comment: Mn encrustation suggests inside origin | x | x | | | | | | | | |  |
| DR5-2 | 1. Rock Type: aphyric lava<br>2. Size: 5x5x7<br>3. Shape/Angularity: subangular<br>4. Encrustations: 5mm Mn crust<br>5. Vesicularity: 3% vesicles, 0.3-2mm<br>6. Vesicle Filling: lined with Fe-oxyhydroxide<br>7. Matrix Color: greenish-grey<br>8. Primary Minerals: aphyric for most part, single fsp phenocryst 2mm in diameter, rel. fresh<br>9. Secondary Minerals: medium groundmass oxidation<br>10. Overall Degree of Alteration: medium altered<br>11. Comment: Due to Mn encrustation around entire sample there is some potential that this piece is not a dropstone. | x | x | | | | | | | | |  |
| DR5-3M | 1. Rock Type: Manganese nodule<br>2. Size: 6x4x3<br>3. Shape/Angularity: round<br>4. Encrustations: 1,5cm around yellowish orange core | | | | | | | | | x | | |
| DR5-4M | 1. Rock Type: Manganese crust, 2.5cm thick<br>2. Size: 10x7x3 | | | | | | | | | x | | |

**SO201-1b-DR6**
**Description of Location and Structure: Seamount NE of Emperor Trough. SW facing slope beneath plateau edge, E of DR5**
Dredge on b\ UTC 18/06/09 22:20hrs, lat 49°40,09'N, long 172°20,82'E, depth 3890m
Dredge off b\ UTC 18/06/09 23:18hrs, lat 49°40,27'N, long 172°20,31'E, depth 3455m
*total volume: few rocks*
*Comments:*

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR6-1 | 1. Rock Type: porphyric lava<br>2. Size: 9x5x3<br>3. Shape/Angularity: subangular to rounded<br>4. Encrustations: 5mm Mn crust<br>5. Vesicularity: 20% open vesicles (some filled)<br>6. Vesicle Filling: thin layer of Fe-oxides inside of vesicles and white material<br>7. Matrix Color: brown to grey<br>8. Primary Minerals: fsp up to 5mm, 5-10%; altered ol, 1mm, 1%<br>9. Secondary Minerals: white material in vesicles (carbonate)<br>10. Overall Degree of Alteration: highly altered<br>11. Comment: vesicle zoning (bigger vesicles closer to rim) | x | x | | | | | | | | |  |
| DR6-2M | 1. Rock Type: Mn-"pepple"<br>2. Size: 15x9x8 | | | | | | | | | x | |  |

**SO201-1b-DR7**

**Description of Location and Structure: NW-SE striking ridge close to Stalemate Fracture Zone, upper part of eastern slope near platau**

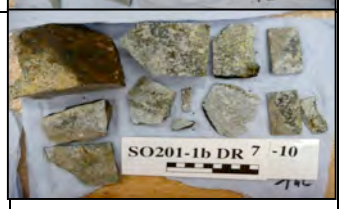
Dredge on b\ UTC 19/06/09 07:00hrs, lat 50°01,00'N, long 173°32,12'E, depth 3340m

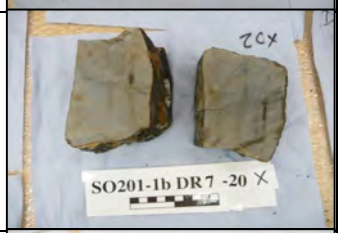
Dredge off b\ UTC 19/06/09 08:12hrs, lat 50°35,00'N, long 174°13,00'E, depth 2780m

*total volume: half full*

*Comments: A lot of angular shaped dolerite blocks, some tuffs, basalts, abundant Fe-Mn crusts*

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR7-1 | 1. Rock Type: coarse grained dolerite; subvolcanic intrusive or thick lava flow<br>2. Size: 30x30x40 original size<br>3. Shape/Angularity: angular<br>4. Encrustations: up to 5mm Mn coating<br>5. Vesicularity: dense<br>6. Vesicle Filling: -<br>7. Matrix Color: light grey<br>8. Primary Minerals: 30% fsp with diffuse crystal shapes, 1-4mm, fresh; 10-20 px?, 1-2mm, fresh<br>9. Secondary Minerals: not visible<br>10. Overall Degree of Alteration: minor alteration, fairly fresh<br>11. Comment: this rock type is the predominant lithology of the dredge showing mainly variations in grain size | x | x | matrix or groundmass fsp | 1X | | | | | |  |
| DR7-2 | 1. Rock Type: similar to sample -1, aphyric<br>2. Size: 50x30x30<br>3. Shape/Angularity: angular<br>4. Encrustations: minor Mn coating<br>5. Vesicularity: < 0.5% filled with redish material (Fe-Oxyhydroxide?)<br>7. Matrix Color: light grey<br>8. Primary Minerals: 20% fsp, 1-3mm, fresh, 30% px, 1-3mm, overall crystals are very fresh<br>10. Overall Degree of Alteration: minor alteration | x | x | | 2X | | | | | |  |
| DR7-3 | 1. Rock Type: fine griained dolerite, appears mafic<br>2. Size: 30x30x30<br>3. Shape/Angularity: subangular<br>4. Encrustations: minor Mn coating<br>5. Vesicularity: dense<br>6. Vesicle Filling:<br>7. Matrix Color: dark grey, aphyric<br>8. Primary Minerals: too fine graine to identify individual crystals, probably consists of fsp-px and possibly ol<br>9. Secondary Minerals: nor visible<br>10. Overall Degree of Alteration: 2-3cm alteration front on one side, fresh inner core | x | x | | 3X | | | | | |  |
| DR7-4 | 1. Rock Type: similar to sample -3<br>2. Size: 30x40x30<br>3. Shape/Angularity: subangular<br>4. Encrustations: minimal Mn coating<br>5. Vesicularity: dense<br>7. Matrix Color: grey to drak grey<br>8. Primary Minerals: see sample 3<br>9. Secondary Minerals: not visible<br>10. Overall Degree of Alteration: moderately altered | x | x | | 4X | | | | | |  |
| DR7-5 | 1. Rock Type: similar to sample -3<br>2. Size: 30x40x30<br>3. Shape/Angularity: subangular<br>4. Encrustations: up to 10mm Mn crust<br>5. Vesicularity: dense<br>7. Matrix Color: grey<br>8. Primary Minerals: Px, Ol<br>9. Secondary Minerals: not visible<br>10. Overall Degree of Alteration: minor alteration | x | x | | 5X | | | | | |  |
| DR7-6 | 1. Rock Type: similar to sample -3<br>2. Size: 22x10x12<br>3. Shape/Angularity: subangular<br>4. Encrustations: sub mm Mn crust<br>5. Vesicularity: none<br>7. Matrix Color: dark grey<br>8. Primary Minerals: Py probably, Matrix is fine grained<br>9. Secondary Minerals: not visible<br>10. Overall Degree of Alteration: minor alteration | x | x | | | | | | | | |  |
| DR7-7 | 1. Rock Type: medium grained dolerite<br>2. Size: 40x50x60<br>3. Shape/Angularity: subrounded<br>4. Encrustations: sub mm Mn crust<br>5. Vesicularity: none<br>7. Matrix Color: dark blueish grey<br>8. Primary Minerals: px possibly fsp<br>9. Secondary Minerals: some qz or cc in pore space<br>10. Overall Degree of Alteration: much of rock severely altered, unaltered core when cut open | x | x | | 7X | | | | | | |  |

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR7-8 | 1. Rock Type: coarse grained basalt; different from prev dolerites<br>2. Size: 24x20x15<br>3. Shape/Angularity: sub rounded<br>4. Encrustations: 1mm Mn crust<br>5. Vesicularity: none<br>7. Matrix Color: drark grey to black<br>8. Primary Minerals: ol px<br>9. Secondary Minerals: not visible<br>10. Overall Degree of Alteration: moderate<br>11. Comment: relation to sample -1 to -7 unclear; insitu origin not clear | x | x | | | | | | | | |  |
| DR7-9 | 1. Rock Type: fine grained tuff or aphyric basaslt?<br>2. Size: 14x7x13<br>3. Shape/Angularity: subrounded<br>4. Encrustations: sub mm Mn crust<br>7. Matrix Color: grey to greenish<br>8. Primary Minerals: plag + hbl<br>10. Overall Degree of Alteration: slightly altered<br>11. Comment: most likely a dropstone | x | x | | | | | | | | |  |
| DR7-10 | 1. Rock Type: coarse grained plutonic rock, plagiogranite?<br>2. Size: 17x13x7<br>3. Shape/Angularity: subangular<br>4. Encrustations: 1-2 mm Mn crust<br>5. Vesicularity: holocrystalline<br>8. Primary Minerals: plag, hbl, possibly qz<br>9. Secondary Minerals: epidite vein<br>10. Overall Degree of Alteration: moderate<br>11. Comment: additional pieces of the same lithology are sampled in the archive half. Insitu origin would require major up lift along the fracture zone | x | x | | | | | | | | |  |
| DR7-11 | 1. Rock Type: similar to sample -10<br>2. Size: 17x10x7 | x | x | | | | | | | | |  |
| DR7-12 | 1. Rock Type: coarse grained diorite or gabbro<br>2. Size: 20x8x9<br>3. Shape/Angularity: subrounded<br>4. Encrustations: 2mm Mn crust<br>5. Vesicularity: holocrystalline<br>8. Primary Minerals: Plag, Px, possibly qz<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fairly fresh | | | | | | | | | | |  |
| DR7-13 | 1. Rock Type: dolerite<br>2. Size: 20x10x5<br>3. Shape/Angularity: rounded<br>4. Encrustations: 1mm Mn crust<br>7. Matrix Color: brownish grey<br>8. Primary Minerals: very fine grained with some large px<br>10. Overall Degree of Alteration: moderate | x | x | | | | | | | | |  |
| DR7-14 | 1. Rock Type: basalt<br>2. Size: 12x7x5<br>3. Shape/Angularity: sub rounded<br>4. Encrustations: 1-2mm Mn crust<br>5. Vesicularity: low<br>6. Vesicle Filling: orange precipitates<br>7. Matrix Color: brownish grey<br>8. Primary Minerals: Px, small plag, olivine<br>9. Secondary Minerals: too fine grained if any<br>10. Overall Degree of Alteration: moderate | x | x | | | | | | | | |  |
| DR7-15M | 1. Rock Type: Manganese crust, 4cm thick<br>11. Comment: multiple layers of gravel in crust | | | | | | | | | | |  |

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR7-16M | 1. Rock Type: Manganese crust, 2cm at thickest<br>11. Comment: multiple layers of gravel in crust | | | | | | | | | | |  |
| DR7-17M | 1. Rock Type: Manganese crust, 4cm at thickest<br>11. Comment: multiple layers of gravel in crust | | | | | | | | | | |  |
| DR7-18X | 1. Rock Type: coarse grained plutonic<br>8. Primary Minerals: plag-hbl-px-qz<br>9. Secondary Minerals: epidote vein<br>11. Comment: similar to sample -11 | | | | | | | | | | |  |
| DR7-19X | 1. Rock Type: fine grained dolerite<br>8. Primary Minerals: px-plag?, fine matrix brownish grey<br>9. Secondary Minerals: slightly altered | | | | | | | | | | |  |
| DR7-20X | 1. Rock Type: very fine grained dolerite<br>8. Primary Minerals: px, fine matrix brownish grey<br>9. Secondary Minerals: small cc vein, thin 1mm Mn crust | | | | | | | | | | |  |
| DR7-21X | 1. Rock Type: medium grained dolerite<br>8. Primary Minerals: px-plag, very dark grey matriix<br>9. Secondary Minerals: sub mm Mn crust | | | | | | | | | | |  |
| DR7-22X | 1. Rock Type: Basalt coarse grained<br>8. Primary Minerals: plag-px low vesicularity, dark matrix | | | | | | | | | | |  |
| DR7-23X | 1. Rock Type: Basalt coarse grained<br>8. Primary Minerals: px, possibly ol, dark matrix, non-vesicular | | | | | | | | | | |  |

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR7-24X | 1. Rock Type: medium grained dolerite<br>8. Primary Minerals: some large px, brownish grey matrix, moderately altered | | | | | | | | | | |  |
| DR7-1X | comment: back up of sample -1 | | | | | | | | | | | |
| DR7-2X | comment: back up of sample -2 | | | | | | | | | | | |
| DR7-3X | comment: back up of sample -3 | | | | | | | | | | | |
| DR7-4X | comment: back up of sample -4 | | | | | | | | | | | |
| DR7-5X | comment: back up of sample -5 | | | | | | | | | | | |

**SO201-1b-DR8**

**Description of Location and Structure: Seamount on the younger Pacific crust about 70 nm NE from DR7. SE slope of the NNW-SSE**

Dredge on b UTC 20/06/09 15:24hrs, lat 50°33,46'N, long 174°18,97'E, depth 3514m

Dredge off b UTC 20/06/09 16:39hrs, lat 50°33,70'N, long 174°18,37'E, depth 3134m

*total volume: few rocks*

*Comments: volcanics, breccia are likely in-situ rocks; Fe-Mn crusts*

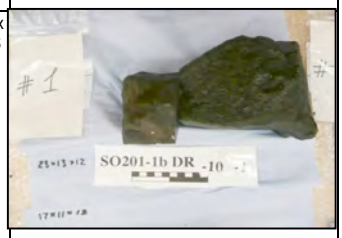
| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR8-1 | 1. Rock Type: volcanic/subvolcanic rock<br>2. Size: 14x14x23 cm<br>3. Shape/Angularity: angular fragment<br>4. Encrustations: is absent<br>5. Vesicularity: no vesicles<br>6. Vesicle Filling: no filling<br>7. Matrix Color: grey-green<br>8. Primary Minerals: Ol (completely altered) 15%, Px5-10%, Hbl (black prismatic) 15%, Pl 15-25%, matrix aphyric (other minerals)<br>9. Secondary Minerals: yellow brown material after Ol (maybe carbonate phase), Iddingsite and Fe-oxide<br>10. Overall Degree of Alteration: moderate altered<br>11. Comment: big amount of well preserved black Hbl, very promising object for Ar/Ar dating | x | | | | | | | | | |  |
| DR8-2 | 1. Rock Type: Tuff (shows some black clasts could be diserupted crystals) aphyric volcanic rock<br>2. Size: 6x8x11<br>3. Shape/Angularity: subangular<br>4. Encrustations: -<br>5. Vesicularity: dense<br>6. Vesicle Filling: -<br>7. Matrix Color: grey<br>8. Primary Minerals: (it is possible) Ol (<2-4mm) in size +Pl (<2-4mm)<br>9. Secondary Minerals: carbonate phase in veins and small cracks<br>10. Overall Degree of Alteration: low degree of alteration | x | | | | | | | | | |  |
| DR8-3 | 1. Rock Type: crystallic-lithoclastic breccia<br>2. Size: 6x9x9<br>3. Shape/Angularity: subangular<br>4. Encrustations: < 3mm<br>5. Vesicularity: clear porous rock, no vesicles<br>6. Vesicle Filling: -<br>7. Matrix Color: individual lithoclasts are characterized by grey-green colour<br>8. Primary Minerals: mineral clasts: pl+hbl (black patches)+px and olivine (altered)<br>9. Secondary Minerals: carbonate phases (Cc?), Chl (?) only in matrix of individual clasts<br>10. Overall Degree of Alteration: low to moderate degree of alteration<br>11. Comment: this lava breccia is of the outer part of lava flow with inner part composed of volcanics represented by sample 1 | x | | | | | | | | | |  |
| DR8-4M | 1. Rock Type: Manganese crust<br>2. Size: 6x6,5x7<br>11. Comment: consists completely of crust, no lithoclasts incorporated, concentric crust | | | | | | | | | | |  |

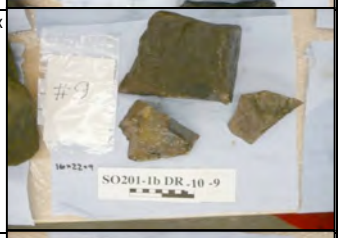
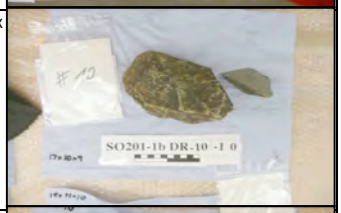
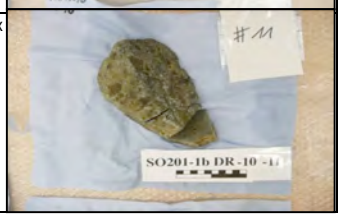
**SO201-1b-DR9**
**Description of Location and Structure: Central Aleutians 50 nm NW from Buldir Isl., Ingenstrem Depression, cone 1B SE slope from base to top.**
Dredge on b UTC 20/06/09 6:47hrs, lat 52°33,69'N, long 174°57,22'E, depth 1083m
Dredge off b UTC 20/06/09 7:40hrs, lat 52°33,88'N, long 174°56,62'E, depth 880m
*total volume: full*
*Comments: Abundant angular to subrounded blocks of volcanics covered with biologic stuff. Fresh rocks.*

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR9-1 | 1. Rock Type: volcanic<br>2. Size: 40x30x30<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: 10% subangular mm-sized vesicles<br>6. Vesicle Filling: no filling<br>7. Matrix Color: dark grey<br>8. Primary Minerals: hbl, plag, small ol<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none<br>11. Comment: megacrystic inclusions of ol+cpx(?) | x | x | | | | | | | | USC: 1x<br>GC+TS |  |
| DR9-2 | 1. Rock Type: volcanic<br>2. Size: 50x20x40<br>3. Shape/Angularity: subangular<br>4. Encrustations: some bio-material on outside<br>5. Vesicularity: 20% angular vesicles<br>6. Vesicle Filling: no filling<br>7. Matrix Color: dark grey<br>8. Primary Minerals: 1cm hbl, plag 2-5mm spongy<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none<br>11. Comment: some hbl hollowed | x | x | | | | | | | | USC: 1x<br>GC+TS |  |
| DR9-3 | 1. Rock Type: volcanic<br>2. Size: 30x25x15<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: 10% angular vesicles<br>6. Vesicle Filling: no filling<br>7. Matrix Color: dark grey<br>8. Primary Minerals: plag 2-4mm, cpx up to 1cm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none | x | x | | | | | | | | USC: 1x<br>GC+TS |  |
| DR9-4 | 1. Rock Type: volcanic<br>2. Size: 22x9x8<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: 15% angular vesicles<br>6. Vesicle Filling: no filling<br>7. Matrix Color: dark grey<br>8. Primary Minerals: plag 2-4mm, cpx up to 1cm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none | x | x | | | | | | | | USC: 1x<br>GC+TS |  |
| DR9-5 | 1. Rock Type: volcanic<br>2. Size: 10x10x18<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: 5% angular vesicles<br>6. Vesicle Filling: no filling<br>7. Matrix Color: dark grey<br>8. Primary Minerals: hbl up to 1cm, cpx 8mm, plag?<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none | x | x | | | | | | | | USC: 1x<br>GC+TS |  |
| DR9-6 | 1. Rock Type: volcanic<br>2. Size: 17x12x9<br>3. Shape/Angularity: subrounded<br>4. Encrustations: none<br>5. Vesicularity: 10% angular vesicles<br>6. Vesicle Filling: no filling<br>7. Matrix Color: dark grey<br>8. Primary Minerals: cpx to 1cm, plag 2-4mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none | x | x | | | | | | | | USC: 1x<br>GC+TS |  |
| DR9-7 | 1. Rock Type: volcanic<br>2. Size: 14x14x9<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: 20-25% angular vesicles<br>6. Vesicle Filling: no filling<br>7. Matrix Color: dark grey<br>8. Primary Minerals: 8mm cpx, 2mm plag<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none | x | x | | | | | | | | USC: 1x<br>GC+TS |  |

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR9-8 | 1. Rock Type: volcanic<br>2. Size: 11x10x9<br>3. Shape/Angularity: subrounded<br>4. Encrustations: none<br>5. Vesicularity: <5%angular (smashed) vesicles<br>6. Vesicle Filling: no filling<br>7. Matrix Color: dark grey<br>8. Primary Minerals: cpx, hbl 3-6mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none<br>11. Comment: one 3mm olivine, might be xenocryst | x | x | | | | | | | | USC: 1x<br>GC+TS |  |
| DR9-9 | 1. Rock Type: volcanic<br>2. Size: 11x11x9<br>3. Shape/Angularity: rounded<br>4. Encrustations: none<br>5. Vesicularity: none<br>6. Vesicle Filling: -<br>7. Matrix Color: greenish-brownish-grey<br>8. Primary Minerals: hbl, one grain 2cm, rest 1-2mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: slight | x | x | | | | | | | | USC: 1x<br>GC+TS |  |
| DR9-10 | 1. Rock Type: volcanic<br>2. Size: 12x9x8<br>3. Shape/Angularity: rounded<br>4. Encrustations: none<br>5. Vesicularity: <1% angular vesicles<br>6. Vesicle Filling: none<br>7. Matrix Color: grey<br>8. Primary Minerals: hbl 2-3mm, plag up to 2cm, 1mm olivine?<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none | x | x | | | | | | | | USC: 1x<br>GC+TS |  |
| DR9-11 | 1. Rock Type: volcanic<br>2. Size: 13x10x7<br>3. Shape/Angularity: subrounded<br>4. Encrustations: none<br>5. Vesicularity: none<br>6. Vesicle Filling: -<br>7. Matrix Color: grey<br>8. Primary Minerals: 2mm hbl, 1cm plag<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none | x | x | | | | | | | | USC: 1x<br>GC+TS |  |
| DR9-12 | 1. Rock Type: volcanic<br>2. Size: 10x7x6<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: none<br>6. Vesicle Filling: -<br>7. Matrix Color: grey<br>8. Primary Minerals: hbl to 3mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none<br>11. Comment: small rounded lithic fragment | x | x | | | | | | | | USC: 1x<br>GC+TS |  |
| DR9-13 | 1. Rock Type: volcanic<br>2. Size: 10x7x6<br>3. Shape/Angularity: subrounded<br>4. Encrustations: none<br>5. Vesicularity: <5%<br>6. Vesicle Filling: none<br>7. Matrix Color: grey<br>8. Primary Minerals: hbl 5mm, plag 2-3mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none<br>11. Comment: flow banding slightly visible | x | x | | | | | | | | USC: 1x<br>GC+TS |  |
| DR9-14 | 1. Rock Type: volcanic<br>2. Size: 11x4x4<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: <1% angular<br>6. Vesicle Filling: none<br>7. Matrix Color: grey<br>8. Primary Minerals: hbl 2-4mm, plag max. 1mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none | x | x | | | | | | | | USC: 1x<br>GC+TS |  |
| DR9-1x | 1. Rock Type: description see no.1 | | | | | | | | | | | |
| DR9-2x | 1. Rock Type: description see no.2 | | | | | | | | | | | |
| DR9-3x | 1. Rock Type: description see no.3 | | | | | | | | | | | |

**SO201-1b-DR10**
**Description of Location and Structure: Central Aleutians 50 nm NW from Buldir Isl., Ingenstrem Depression, cone 1A E slope from base**
Dredge on b\ UTC 20/06/09 9:35hrs, lat 52°33,82'N, long 174°57,66'E, depth 1191m
Dredge off b\ UTC 20/06/09 10:20hrs, lat 52°33,89'N, long 174°57,34'E, depth 980m
*total volume: full*
*Comments: Relatively homogeneous volcanics - andesites (?). Biologic stuff.*

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR10-1 | 1. Rock Type: volcanic<br>2. Size: 23x13x12<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: 15% angular vesicles<br>6. Vesicle Filling: none<br>7. Matrix Color: dark grey<br>8. Primary Minerals: px+plag, 20% 8mm cpx, plag 5mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none<br>11. Comment: hbl? | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR10-2 | 1. Rock Type: volcanic<br>2. Size: 17x11x13<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: 15% angular vesicles<br>6. Vesicle Filling: none<br>7. Matrix Color: dark grey<br>8. Primary Minerals: 8mm cpx + 5mm plag 20%<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none<br>11. Comment: hbl | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR10-3 | 1. Rock Type: volcanic<br>2. Size: 21x11x10<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: 3% angular vesicles<br>6. Vesicle Filling: none<br>7. Matrix Color: dark grey<br>8. Primary Minerals: plag up to 3mm, hbl up to 1cm, total 12%<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR10-4 | 1. Rock Type: volcanic<br>2. Size: 13x12x11<br>3. Shape/Angularity: subrounded<br>4. Encrustations: none<br>5. Vesicularity: 10% angular vesicles<br>6. Vesicle Filling: none<br>7. Matrix Color: dark grey<br>8. Primary Minerals: plag up to 5mm, hbl up to 1cm, total 14%<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR10-5 | 1. Rock Type: volcanic<br>2. Size: 21x15x30<br>3. Shape/Angularity: subrounded<br>4. Encrustations: none<br>5. Vesicularity: 5% angular vesicles<br>6. Vesicle Filling: none<br>7. Matrix Color: dark grey<br>8. Primary Minerals: plag up to 5mm, hbl up to 1cm, cpx up to 1cm, total 20%<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR10-6 | 1. Rock Type: volcanic<br>2. Size: 21x21x18<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: 15% angular vesicles<br>6. Vesicle Filling: none<br>7. Matrix Color: dark grey<br>8. Primary Minerals: plag 30-40% <1.5mm, cpx 10% <4mm, hbl 10% <1cm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR10-7 | 1. Rock Type: volcanic<br>2. Size: 58x44x30<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: none (<1%)<br>6. Vesicle Filling: carb. ?<br>7. Matrix Color: grey<br>8. Primary Minerals: phenocrysts <1%, plag <1%, cpx a few (?), well crystallized groundmass<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none<br>11. Comment: inclusion of altered andesite (?) 2x10mm | x | x | | | | | | | | USC: 1x GC+TS |  |

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR10-8 | 1. Rock Type: volcanic<br>2. Size: 22x15x10<br>3. Shape/Angularity: rounded<br>4. Encrustations: none<br>5. Vesicularity: 1-2%<br>6. Vesicle Filling: none<br>7. Matrix Color: light grey<br>8. Primary Minerals: hbl 20% <3mm, plag <5% <1.5mm<br>9. Secondary Minerals: -<br>10. Overall Degree of Alteration: fresh | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR10-9 | 1. Rock Type: volcanic<br>2. Size: 16x22x9<br>3. Shape/Angularity: subrounded<br>4. Encrustations: -<br>5. Vesicularity: <5% irregular, bands enriched in vesicles up to 15-20%<br>6. Vesicle Filling: none<br>7. Matrix Color: pinkish brown<br>8. Primary Minerals: cpx 30-40% <5mm, plag (?) - microphenocrysts, ol (altered)? 10-15% <3mm<br>9. Secondary Minerals: Fe oxides after ol, alteration in g.m.<br>10. Overall Degree of Alteration: moderate | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR10-10 | 1. Rock Type: volcanic<br>2. Size: 17x10x9<br>3. Shape/Angularity: subrounded<br>4. Encrustations: none<br>5. Vesicularity: none<br>6. Vesicle Filling: -<br>7. Matrix Color: light grey<br>8. Primary Minerals: hbl to 2mm, plag sub mm, total 25%<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR10-11 | 1. Rock Type: volcanic<br>2. Size: 18x11x10<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: <1% angular vesicles<br>6. Vesicle Filling: none<br>7. Matrix Color: grey<br>8. Primary Minerals: hbl 5mm, plag 2mm, total 30%<br>9. Secondary Minerals: some Fe oxides, not much<br>10. Overall Degree of Alteration: low | x | x | | | | | | | | USC: 1x GC+TS |  |

**SO201-1b-DR11**

**Description of Location and Structure: Central Aleutians 50 nm NW from Buldir Isl., Ingenstrem Depression, cone 2A southern flank from base to top.**

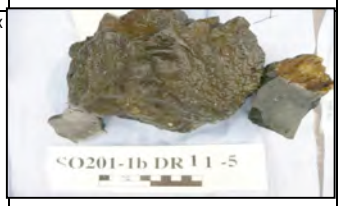
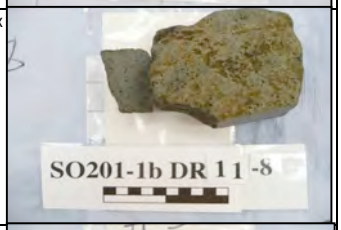
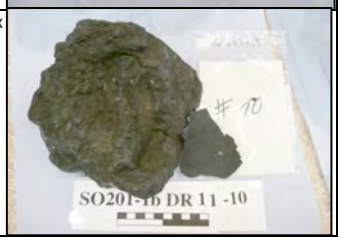
Dredge on b UTC 20/06/09 12:42hrs, lat 52°32,3'N, long 175°04,63'E, depth 1242m

Dredge off b UTC 20/06/09 13:36hrs, lat 52°32,68'N, long 175°04,39'E, depth 1058m

*total volume:* 1/3 full

*Comments:* fresh volcanic rock, no dropstones observed, suggesting that it is young

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR11-1 | 1. Rock Type: basalt<br>2. Size: 20x24x28<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: 10-15% angular vesicles<br>6. Vesicle Filling: none<br>7. Matrix Color: dark grey to black<br>8. Primary Minerals: ol 10% up to 5mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR11-2 | 1. Rock Type: volcanic<br>2. Size: 14x20x39<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: <1% angular vesicles<br>6. Vesicle Filling: none<br>7. Matrix Color: grey<br>8. Primary Minerals: hbl to 2mm, plag to 5mm, 25% total<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none<br>11. Comment: mafic inclusion 6x6 | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR11-3 | 1. Rock Type: basalt<br>2. Size: 25x32x40<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: 5% vesicles, angular to subangular<br>6. Vesicle Filling: none<br>7. Matrix Color: dark grey to black<br>8. Primary Minerals: ol to 5mm 10%<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR11-4 | 1. Rock Type: volcanic<br>2. Size: 10x15x20<br>3. Shape/Angularity: subrounded<br>4. Encrustations: none<br>5. Vesicularity: <1% angular vesicles<br>6. Vesicle Filling: none<br>7. Matrix Color: grey<br>8. Primary Minerals: hbl 15% up to 5mm<br>9. Secondary Minerals: small amount of plag sub mm<br>10. Overall Degree of Alteration: none | x | x | | | | | | | | USC: 1x GC+TS |  |

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR11-5 | 1. Rock Type: basalt<br>2. Size: 20x20x40<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: 5% angular vesicles<br>6. Vesicle Filling: none<br>7. Matrix Color: dark grey to black<br>8. Primary Minerals: ol 2mm 10%<br>9. Secondary Minerals: 2 plag grains, could be xenocrysts<br>10. Overall Degree of Alteration: none | x | x | | | | | | | | USC: 1x<br>GC+TS |  |
| DR11-6 | 1. Rock Type: basalt<br>2. Size: 11x14x15 - came from unmeasured larger clunk<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: 10% angular vesicles<br>6. Vesicle Filling: none<br>7. Matrix Color: dark grey to black<br>8. Primary Minerals: ol up to 4mm 15%<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none | x | x | | | | | | | | USC: 1x<br>GC+TS |  |
| DR11-7 | 1. Rock Type: basalt<br>2. Size: 11x12x15<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: 10% angular vesicles<br>6. Vesicle Filling: none<br>7. Matrix Color: dark grey to black<br>8. Primary Minerals: ol 10% to 3mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none | x | x | | | | | | | | USC: 1x<br>GC+TS |  |
| DR11-8 | 1. Rock Type: volcanic<br>2. Size: 4x11x13<br>3. Shape/Angularity: subrounded<br>4. Encrustations: none<br>5. Vesicularity: <1% angular vesicles<br>6. Vesicle Filling: none<br>7. Matrix Color: grey<br>8. Primary Minerals: hbl up to 4mm, 15%<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none | x | x | | | | | | | | USC: 1x<br>GC+TS |  |
| DR11-9 | 1. Rock Type: volcanic<br>2. Size: 4x9x10<br>3. Shape/Angularity: subrounded<br>4. Encrustations: none<br>5. Vesicularity: <1% angular vesicles<br>6. Vesicle Filling: none<br>7. Matrix Color: grey<br>8. Primary Minerals: hbl up to 2cm, 15%<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none | x | x | | | | | | | | USC: 1x<br>GC+TS |  |
| DR11-10 | 1. Rock Type: basalt<br>2. Size: 14x18x21<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: 20% angular to subangular vesicles<br>6. Vesicle Filling: none<br>7. Matrix Color: dark grey to black<br>8. Primary Minerals: ol to 4mm, 15%<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none<br>11. Comment: 1cm qtz or plag xenocryst | x | x | | | | | | | | USC: 1x<br>GC+TS |  |

**SO201-1b-DR12**

**Description of Location and Structure: Central Aleutians 50 nm NW from Buldir Isl., Ingenstrem Depression, oval SW elongated cone-like structure (Pos. 2E) gentle slopes, SE slope from base to top.**

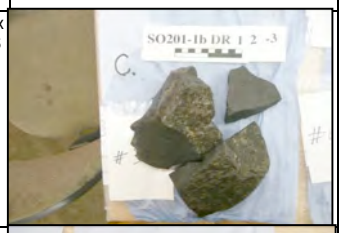
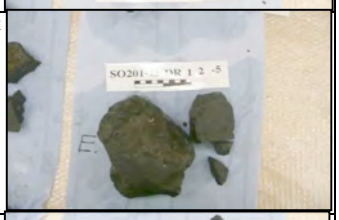
Dredge on b\ UTC 20/06/09 15:16hrs, lat 52°32,55'N, long 175°06,16'E, depth 1104m

Dredge off b\ UTC 20/06/09 15:54hrs, lat 52°31,58'N, long 175°06,05'E, depth 993m

*total volume: 1/3 full*

*Comments: Volcanic; no dropstones*

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR12-1 | 1. Rock Type: basalt<br>2. Size: 27x32x45<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: 10% angular vesicles<br>6. Vesicle Filling: none<br>7. Matrix Color: dark grey to black<br>8. Primary Minerals: olivine up to 2mm, 15%<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none<br>11. Comment: possible plag inclusion, could be ol | x | x | | | | | | | | USC: 1x<br>GC+TS |  |

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR12-2 | 1. Rock Type: basalt<br>2. Size: 20x25x43<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: 15% angular vesicles, larger ones seem squished<br>6. Vesicle Filling: none<br>7. Matrix Color: dark grey to black<br>8. Primary Minerals: ol up to 3mm, 15%<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR12-3 | 1. Rock Type: basalt<br>2. Size: 21x21x48<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: 10% angular vesicles<br>6. Vesicle Filling: none<br>7. Matrix Color: dark grey to black<br>8. Primary Minerals: ol up to 3mm, 15%<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR12-4 | 1. Rock Type: basalt<br>2. Size: 20x21x25<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: 15% angular vesicles, slight alignment<br>6. Vesicle Filling: none<br>7. Matrix Color: dark grey to black<br>8. Primary Minerals: ol up to 5mm (one elongated grain) 15%<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR12-5 | 1. Rock Type: basalt<br>2. Size: 21x23x24<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: 15% angular vesicles<br>6. Vesicle Filling: none<br>7. Matrix Color: dark grey to black<br>8. Primary Minerals: ol up to 3mm, 15%<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR12-6 | 1. Rock Type: basalt<br>2. Size: 13x21x36<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: 10% angular vesicles<br>6. Vesicle Filling: none<br>7. Matrix Color: dark grey to black<br>8. Primary Minerals: ol up to 3mm, 15%<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none | x | x | | | | | | | | USC: 1x GC+TS |  |

**SO201-1b-DR13**

**Description of Location and Structure: Central Aleutians 50 nm NW from Buldir Isl., Ingenstrem Depression, cone 2C SE facing slope from middle to top. Entire structure consists of 2 cones that are connected along the 900 m depth contour.**

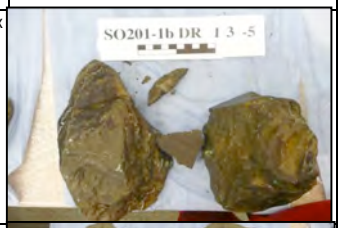
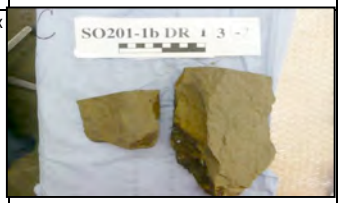
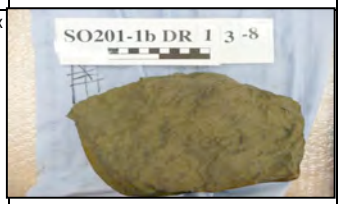
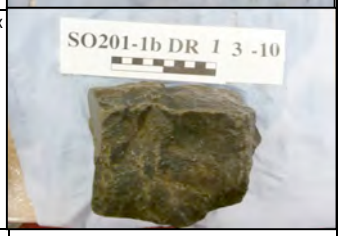
Dredge on b/ UTC 20/06/09 17:56hrs, lat 52°32,28'N, long 175°08,36'E, depth 1076m

Dredge off b/ UTC 20/06/09 18:48hrs, lat 52°32,15'N, long 175°07,95'E, depth 804m

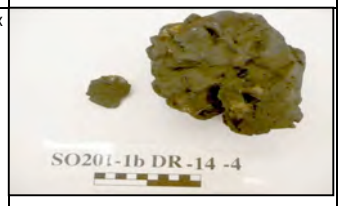
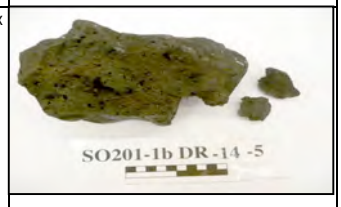
*total volume: 1/4 full*

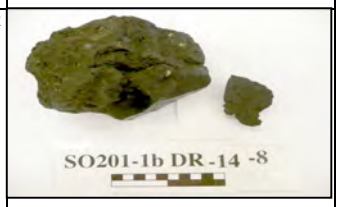
*Comments: fresh volcanic, fresh broken surface, no dropstones*

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR13-1 | 1. Rock Type: volcanic<br>2. Size: 34x22x20<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: 5-10% sub mm vesicles<br>6. Vesicle Filling: none<br>7. Matrix Color: brownish grey<br>8. Primary Minerals: hbl, px or ol, unsure which, grains of all up to 3mm, total 5%<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR13-2 | 1. Rock Type: volcanic<br>2. Size: 32x35x60<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: <5% sub mm vesicles, concentrated in 1cm bands, spaced 2-3cm<br>6. Vesicle Filling: none<br>7. Matrix Color: brownish grey<br>8. Primary Minerals: hbl 3mm, px 2mm, ol? 2-3mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none | x | x | | | | | | | | USC: 1x GC+TS |  |

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR13-3 | 1. Rock Type: volcanic<br>2. Size: 28x24x19<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: <5% sub mm vesicles<br>6. Vesicle Filling: none<br>7. Matrix Color: dark brown grey<br>8. Primary Minerals: few crystals, some px <1mm <5%, hbl mircrophenocrysts<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none<br>11. Comment: small vesicular mafic inclusions with ol; like dredge 11 rocks | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR13-4 | 1. Rock Type: volcanic<br>2. Size: 30x12x23<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: <5% angular vesicles, banded<br>6. Vesicle Filling: none<br>7. Matrix Color: dark brown grey<br>8. Primary Minerals: hbl up to 1cm long, px 5mm, total 3%<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none<br>11. Comment: couple of plag grains, could be xenocrysts, unsure | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR13-5 | 1. Rock Type: volcanic<br>2. Size: 21x13x12<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: <5% angular vesicles<br>6. Vesicle Filling: none<br>7. Matrix Color: dark brown grey<br>8. Primary Minerals: few phenocrysts, 3mm px, ol??, 2% total<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR13-6 | 1. Rock Type: volcanic<br>2. Size: 40x33x22<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: <5% angular vesicles<br>6. Vesicle Filling: none<br>7. Matrix Color: light brown grey<br>8. Primary Minerals: hbl 3mm, px 5mm, total 7%<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR13-7 | 1. Rock Type: volcanic<br>2. Size: 45x42x18<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: 5% angular vesicles, some in 1mm bands<br>6. Vesicle Filling: none<br>7. Matrix Color: light browngrey<br>8. Primary Minerals: thin 5mm hbl, few px 3mm, total 8%<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR13-8 | 1. Rock Type: volcanic<br>2. Size: 21x12x14<br>3. Shape/Angularity: subrounded<br>4. Encrustations: none<br>5. Vesicularity: 10% sub mm angular vesicles, banded<br>6. Vesicle Filling: none<br>7. Matrix Color: medium brown grey<br>8. Primary Minerals: 4% 2mm hbl<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR13-9 | 1. Rock Type: volcanic<br>2. Size: 21x11x10<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: <2% sub mm angular vesicles<br>6. Vesicle Filling: none<br>7. Matrix Color: dark brown grey<br>8. Primary Minerals: px 2mm, hbl (saw 2 or 3) 3mm, total 2%<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR13-10 | 1. Rock Type: volcanic<br>2. Size: 15x12x9<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: <10% angular vesicles<br>6. Vesicle Filling: none<br>7. Matrix Color: medium brown grey<br>8. Primary Minerals: px 8mm, few hbl 5mm, total 3%<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR13-1x | 1. Rock Type: description see no.1 | | | | | | | | | | | |
| DR13-2x | 1. Rock Type: description see no.2 | | | | | | | | | | | |
| DR13-3x | 1. Rock Type: description see no.3 | | | | | | | | | | | |

**SO201-1b-DR14**
**Description of Location and Structure: Central Aleutians 50 nm NW from Buldir Isl., Ingenstrem Depression, small cone 3A on the N slope of the structure dredged in the previous station. SE facing slope at 1500 mbsl.**
Dredge on b. UTC 20/06/09 20:47hrs, lat 52°31,67'N, long 175°13,16'E, depth 1512m
Dredge off b. UTC 20/06/09 21:29hrs, lat 52°31,94'N, long 175°12,90'E, depth 1325m
*total volume: 1/6 full*
*Comments: small piece of fresh volcanics, appear homogeneous lithology, no dropstones*

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR14-1 | 1. Rock Type: porphyric lava, massiv<br>2. Size: 20x10x10<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: 10% vesicles up to 0.5mm<br>6. Vesicle Filling: none<br>7. Matrix Color: black<br>8. Primary Minerals: 20% ol or px up to 3mm, pale green; 10% plag <2mm clear white<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR14-2 | 1. Rock Type: porphyric lava, massiv<br>2. Size: 13x15x15<br>3. Shape/Angularity: spherical to angular<br>4. Encrustations: none<br>5. Vesicularity: 25% vesicles, more dense in the middle(1mm), more open at the rim (up to 1cm)<br>6. Vesicle Filling: none<br>7. Matrix Color: black<br>8. Primary Minerals: 20% ol or cpx up to 3mm, pale green; 10% plag <2mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR14-3 | 1. Rock Type: porphyric lava, massiv<br>2. Size: 13x12x9<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: 30% vesicles up to 3mm, homogenous<br>6. Vesicle Filling: none<br>7. Matrix Color: black<br>8. Primary Minerals: 30% ol/cpx <3mm; 10% plag <2mm; 1 megacryst of ol/cpx (1,5cm)<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR14-4 | 1. Rock Type: porphyric lava, massiv<br>2. Size: 15x12x12<br>3. Shape/Angularity: brain-like shape<br>4. Encrustations: none<br>5. Vesicularity: 25% vesicles, inhomogenous, up to 0.5mm<br>6. Vesicle Filling: none<br>7. Matrix Color: black<br>8. Primary Minerals: 20% OL or CPx <2mm; 10% plag <1mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh<br>11. Comment: some fractures | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR14-5 | 1. Rock Type: porphyric lava, massiv<br>2. Size: 20x12x11<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: 40% vesicles, mostly <5 mm, some up to 2 cm<br>6. Vesicle Filling: open<br>7. Matrix Color: black<br>8. Primary Minerals: 30% Ol or CPx<3mm, 15% Pl<2mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh<br>11. Comment: Vesicles seem to grow together | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR14-6 | 1. Rock Type: porphyric lava, fresh<br>2. Size: 13x13x10<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: 15% vesicles <5mm<br>6. Vesicle Filling: open<br>7. Matrix Color: black<br>8. Primary Minerals: 25% Ol or CPx < 2mm, 10% Pl<1mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR14-7 | 1. Rock Type: porphyric lava, massiv<br>2. Size: 17x12x12<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: 40% vesicles < 1 cm, more open at the rim<br>6. Vesicle Filling: open<br>7. Matrix Color: black<br>8. Primary Minerals: 30% Ol or Cpx < 3mm, 10% Pl < 1mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh | x | x | | | | | | | | USC: 1x GC+TS |  |

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR14-8 | 1. Rock Type: porphyric lava, massiv<br>2. Size: 15x13x9<br>3. Shape/Angularity: subangulars<br>4. Encrustations: none<br>5. Vesicularity: zonation of vesicles, round, up to 1 cm around 50% at the rim, < 2 mm around 10% in the middle<br>6. Vesicle Filling: open<br>7. Matrix Color: black<br>8. Primary Minerals: 30% Ol/CPx < 6 mm, 5-10% Pl < 2 mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh | x | x | | | | | | | | USC: 1x<br>GC+TS |  |
| DR14-9 | 1. Rock Type: porphyric lava, massiv<br>2. Size: 12x10x8<br>3. Shape/Angularity: subangular, rounded<br>4. Encrustations: none<br>5. Vesicularity: round vesicles < 5 mm, biggest at the rim, 40%<br>6. Vesicle Filling: open<br>7. Matrix Color: black<br>8. Primary Minerals: 25% Ol/CPx < 5 mm, 5% Pl < 1 mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh | x | x | | | | | | | | USC: 1x<br>GC+TS |  |

**SO201-1b-DR15**
**Description of Location and Structure: Central Aleutians 50 nm NW from Buldir Isl., Ingenstrem Depression, cone 4B cone SSE facing**
Dredge on b UTC 20/06/09 22:40hrs, lat 52°30,48'N, long 175°11,89'E, depth 1097m
Dredge off b UTC 20/06/09 23:40hrs, lat 52°30,77'N, long 175°11,66'E, depth 878m
*total volume: full*
*Comments: no dropstones, all angular blocks, some column fragments, blocks mostly >10kg*

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR15-1 | 1. Rock Type: porphyric lava<br>2. Size: 40x30x40<br>3. Shape/Angularity: angular<br>4. Encrustations: relatively fresh rocks, some alteration on the outer rim, no mn-crust<br>5. Vesicularity: 20% vesicles (3x1cm biggest ones)<br>6. Vesicle Filling: open<br>7. Matrix Color: dark grey to black<br>8. Primary Minerals: ol + cpx (?) 20%; fsp 10%<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh<br>11. Comment: some vesicles oval form/streched | x | x | | | | | | | | USC: 1x<br>GC+TS | |
| DR15-2 | 1. Rock Type: porphyric lava, similar to 15-1<br>2. Size: 40x30x25<br>3. Shape/Angularity: angular<br>4. Encrustations: similar to 15-1<br>5. Vesicularity: 20%<br>6. Vesicle Filling: open, bigger in the outer rim<br>7. Matrix Color: dark grey to black<br>8. Primary Minerals: 25% ol + cpx (?); 10% plag<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh<br>11. Comment: maybe vesicles mark flowing structure | x | x | | | | | | | | USC: 1x<br>GC+TS | |
| DR15-3 | 1. Rock Type: porphyric lava, similar to 15-2<br>2. Size: 70x20x20<br>3. Shape/Angularity: angular (long)<br>4. Encrustations: none<br>5. Vesicularity: 20%, similar to 15-1<br>6. Vesicle Filling: open<br>7. Matrix Color: dark grey to black<br>8. Primary Minerals: 25% ol + cpx (?); 10% plag<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh | x | x | | | | | | | | USC: 1x<br>GC+TS | |
| DR15-4 | 1. Rock Type: porphyric lava<br>2. Size: 40x40x30<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: 15% vesicles<br>6. Vesicle Filling: open<br>7. Matrix Color: dark grey to black<br>8. Primary Minerals: 20% ol + cpx; 10% plag<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh<br>11. Comment: some vesicles bigger, open shape | x | x | | | | | | | | USC: 1x<br>GC+TS | |
| DR15-5 | 1. Rock Type: similar to 15-1<br>2. Size: 40x30x20<br>5. Vesicularity: vesicles are more rounded | x | x | | | | | | | | USC: 1x<br>GC+TS | |
| DR15-6 | 1. Rock Type: porphyric lava<br>2. Size: 35x25x20<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: 5-10% smaller vesicles<br>6. Vesicle Filling: open<br>7. Matrix Color: dark grey to black<br>8. Primary Minerals: 15% ol + cpx (?); 10% plag<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh<br>11. Comment: more dense than the other ones, different distribution of vesicles; one part has less vesicles than the other samples | x | x | | | | | | | | USC: 1x<br>GC+TS | |

**SO201-1b-DR16**

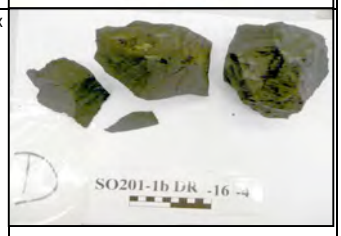
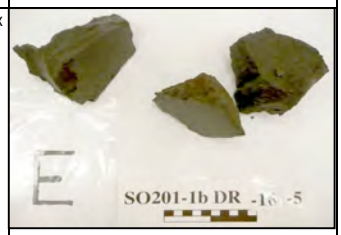
**Description of Location and Structure: Central Aleutians 50 nm NW from Buldir Isl., Ingenstrem Depression, cone 4A. Small cone-like structure adjacent to 4B.**

Dredge on b\ UTC 21/06/09 01:12hrs, lat 52°30,62'N, long 175°13,05'E, depth 1160m

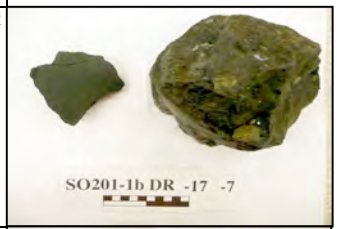
Dredge off b\ UTC 21/06/09 01:55hrs, lat 52°30,81'N, long 175°12,58'E, depth 1015m

*total volume: 3/4 full*

*Comments: Volcanics, large blocks, no dropstones.*

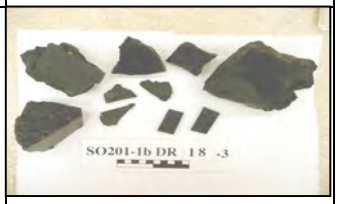
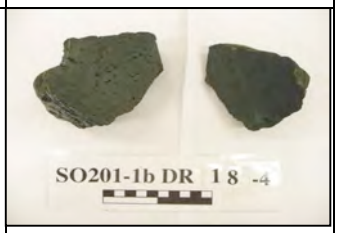
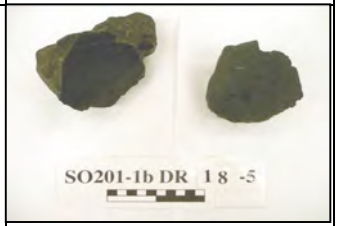
| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR16-1 | 1. Rock Type: porphyric lava ; fragment of block A<br>2. Size: 40x30x25<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: 15-20% vesicles<br>6. Vesicle Filling: open vesicles<br>7. Matrix Color: dark grey<br>8. Primary Minerals: 15-20% Ol up to 3 mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh<br>11. Comment: some small inclusions up to 7mm with dark grey aphyric matrix | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR16-2 | 1. Rock Type: porphyric lava; fragment of block B<br>2. Size: 70x45x35<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: vesicles more rounded<br>6. Vesicle Filling: open<br>7. Matrix Color: dark grey<br>8. Primary Minerals: Ol 10-15 % around 2-3 mm, CPx 1-2 %, Pl - ?<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR16-3 | 1. Rock Type: porphyric lava; fragment of block C<br>2. Size: 40x40x35<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: 20% vesicles<br>6. Vesicle Filling: open<br>7. Matrix Color: dark grey<br>8. Primary Minerals: Ol - 15%, CPx - 5%, Pl - ?<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh<br>11. Comment: Inclusion - 4 cm | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR16-4 | 1. Rock Type: porphyric lava ; fragment of block C<br>2. Size: 20x25x20<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: 20% vesicles<br>6. Vesicle Filling: open<br>7. Matrix Color: dark grey<br>8. Primary Minerals: Ol - 15-20 % up to 5 mm, CPx - <=2 %, Pl - 1-2 %<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh<br>11. Comment: Inclusion - 1 cm, Pl - phiric basalt (?). Good large Ol crystals | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR16-5 | 1. Rock Type: porphyric lava. Similar to number 2 ; fragment of block E<br>2. Size: 25x20x15<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: 20 % vesicles<br>6. Vesicle Filling: open<br>7. Matrix Color: dark grey<br>8. Primary Minerals: Ol - 10-15 %, Pl - <= 2 %, Amph - <= 2 %<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh<br>11. Comment: looks slightly more evolved, Amph phenocrysts, Single inclusion altered. | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR16-6 | 1. Rock Type: porphyric lava, volcanic ; fragmnet of block F<br>2. Size: 15x15x15<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: 10-15 % rounded large interconnected cavities<br>6. Vesicle Filling: open<br>7. Matrix Color: dark grey<br>8. Primary Minerals: Ol - 15-20 % predominantly 1, up to 5 mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh<br>11. Comment: good olivine | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR16-7 | 1. Rock Type: volcanic, looks similar to number 6, It has relatively well preserved glass margins; fragment of block G.<br>2. Size: 15x10x10<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: 10-15 %<br>6. Vesicle Filling: open<br>7. Matrix Color: dark grey<br>8. Primary Minerals: Ol - 20 %<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh<br>11. Comment: Good olivine; glass might be preserved. | x | x | | | | | | | | USC: 1x GC+TS |  |

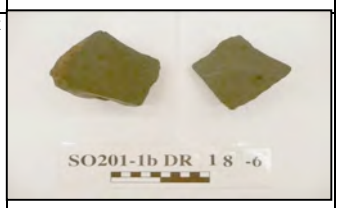
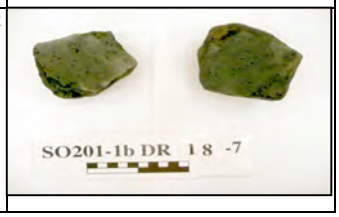
**SO201-1b-DR17**
**Description of Location and Structure: Central Aleutians 50 nm NW from Buldir Isl., Ingenstrem Depression, cone 5A - elongation of cone 5B. SE slope from base to top.**
Dredge on b\ UTC 21/06/09 04:25hrs, lat 52°29,83'N, long 175°14,43'E, depth 1175m
Dredge off b\ UTC 21/06/09 05:08hrs, lat 52°30,07'N, long 175°14,23'E, depth 993m
*total volume: 1/4 full*
*Comments:*

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR17-1 | 1. Rock Type: volcanic rock with slightly fluidal texture; fragment of block A<br>2. Size: 20x15x15<br>3. Shape/Angularity: subangular, subrounded<br>4. Encrustations: some thin black film<br>5. Vesicularity: angular vesicles, 15%<br>6. Vesicle Filling: none<br>7. Matrix Color: dark grey<br>8. Primary Minerals: ol <10% up to 2mm (mostly 0.5mm); plag <10% up to 3mm; cpx single crystals <1-3mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh<br>11. Comment: some glass maybe preserved | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR17-2 | 1. Rock Type: similar to 17-1, somewhat more vesicular; fragment of block B.<br>2. Size: 25x20x20<br>5. Vesicularity: 15-20% vesicles, not equaly distributed, rounded up to 5mm<br>11. Comment: glassy margin partially preserved | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR17-3 | 1. Rock Type: volcanic basalt, sinilar to 17-1/-2; fragment of block C<br>2. Size: 20x20x15<br>11. Comment: glassy margin partially preserved; xenolith of a alevrolite (?) included in a margin (dark grey); could be inbedded in the margin upon eruption on the ocean floor; It is worth to look for glass | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR17-4 | 1. Rock Type: volcanic basalt, similar to 17-1/-2/-3, but more vesicular<br>2. Size: 25x25x15<br>3. Shape/Angularity: subangular<br>5. Vesicularity: 20-25%; large, subangular, elongated along glasses, up to 1 cm<br>8. Primary Minerals: maybe somewhat more plag/ol | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR17-5 | 1. Rock Type: volcanic, vesicular basalt<br>2. Size: 15x10x10<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: 30% vesicles; angular, small, <1mm<br>6. Vesicle Filling: -<br>7. Matrix Color: dark grey<br>8. Primary Minerals: small crystals predominate; ol <10%, < 0.5mm; plag <10%, <1.5mm (rare large crystals); a few cpx crystals up to 5mm<br>9. Secondary Minerals: -<br>10. Overall Degree of Alteration: fresh<br>11. Comment: should be good for chemistry | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR17-6 | 1. Rock Type: volcanic, vesicular, ol-plag-phyric basalt<br>2. Size: 15x10x10<br>3. Shape/Angularity: subrounded<br>4. Encrustations: -<br>5. Vesicularity: 20%, rounded, up to 1cm<br>6. Vesicle Filling: -<br>7. Matrix Color: dark grey<br>8. Primary Minerals: ol<10% up to 3mm; plag 15-20%, mostly<1mm, some up to 2mm; cpx<2%, <1mm<br>9. Secondary Minerals: -<br>10. Overall Degree of Alteration: fresh<br>11. Comment: a single, elongated inclusion of basalt (?): rich in ol+plag (50%), 2x0,5cm (visible size), diffusive contacts with host basalt | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR17-7 | 1. Rock Type: volcanic, basalt; similar to 17-5<br>2. Size: 15x15x20<br>11. Comment: no glass, minerals are small <1mm, subphenocrysts; could be good for chemistry | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR17-8 | 1. Rock Type: volcanic, basalt; similar to 17-5, -7<br>11. Comment: contains some large ol (1,5cm); some cracks crossing sample; glassy margin not preserved | x | x | | | | | | | | USC: 1x GC+TS |  |

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR17-9 | 1. Rock Type: volcanic, basalt; similar to 17-5, -7, -8<br>2. Size: 20x20x15<br>8. Primary Minerals: rare large plag (<3cm); plag: 15%; cpx<5mm, <5%; ol<2mm; <10%<br>11. Comment: well preserved glassy margin - look for glass! might be good for well quenched melt inclusions in olivine. | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR17-10 | 1. Rock Type: volcanic, basalt; similar to 17-5..-8<br>2. Size: 10x10x15<br>5. Vesicularity: small vesicles (<1mm), form bands<br>11. Comment: glassy margin not preserved | x | x | | | | | | | | USC: 1x GC+TS |  |

**SO201-1b-DR18**
**Description of Location and Structure: Central Aleutians 50 nm NW from Buldir Isl., Ingenstrem Depression, Cone 5B, SE slope from base to top.**
Dredge on b UTC 21/06/09 06:24hrs, lat 52°29,84'N, long 175°13,42'E, depth 1128m
Dredge off b UTC 21/06/09 07:05hrs, lat 52°30,11'N, long 175°13,30'E, depth 967m
*total volume: 1/3 full*
*Comments: Volcanics, no dropstones.*

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR18-1 | 1. Rock Type: volcanic, basalt. Fragment of block A.<br>2. Size: 55x20x38<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: 15-20%, rounded, 3mm, some elongated<br>6. Vesicle Filling: none<br>7. Matrix Color: dark grey<br>8. Primary Minerals: ol: 10-15%, <2mm (mostly small <0.5); plag: 10% microliths 0,5mm; cpx: ?<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh<br>11. Comment: contains small xenoliths of visicular, aphyric basalt (?), size 0,5-1cm; a single white rounded xenolith of qtz (?). | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR18-2 | 1. Rock Type: similar to 18-1. Fragment of block B.<br>2. Size: 38x16x20<br>3. Shape/Angularity: angular<br>4. Encrustations:<br>5. Vesicularity:<br>6. Vesicle Filling:<br>7. Matrix Color:<br>8. Primary Minerals:<br>9. Secondary Minerals:<br>10. Overall Degree of Alteration:<br>11. Comment: contains crystals of qtz (?): 1x0.7cm, sharp boundaries with basalt - no evidence for interaction | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR18-3 | 1. Rock Type: similar to 18-1, but without any xenoliths. Fragment of block C.<br>2. Size: 13x17x18<br>3. Shape/Angularity: angular<br>4. Encrustations:<br>5. Vesicularity:<br>6. Vesicle Filling:<br>7. Matrix Color:<br>8. Primary Minerals:<br>9. Secondary Minerals:<br>10. Overall Degree of Alteration: | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR18-4 | 1. Rock Type: volcanic, basalt<br>2. Size: 12x10x8<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: 15-20% vesicles, round to oval shape, up to 6mm<br>6. Vesicle Filling: none<br>7. Matrix Color: dark grey<br>8. Primary Minerals: ol: 15-20%, up to 5mm, most of them <2mm; plag: 5-10%, <2mm; cpx: 1-2% (?)<br>9. Secondary Minerals: -<br>10. Overall Degree of Alteration: fresh<br>11. Comment: inclusions at the rim, white-yellow, diamond-shaped - hydrothermal quartz (?). | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR18-5 | 1. Rock Type: porphyric lava<br>2. Size: 10x12x12<br>3. Shape/Angularity: spherical; subangular<br>4. Encrustations: none<br>5. Vesicularity: 10-15% some are elongate up to 1 cm, small ones rounded<br>6. Vesicle Filling: none<br>7. Matrix Color: dark gray<br>8. Primary Minerals: ol: 25%, clots up to 1cm, smaller than 2mm, inclusions of spinel; plag: 10%, smaller than 2 mm; cpx- 1%<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh | x | x | | | | | | | | USC: 1x GC+TS |  |

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR18-6 | 1. Rock Type: porphyric lava<br>2. Size: 9x9x7<br>3. Shape/Angularity: subangular to rounded<br>4. Encrustations: none<br>5. Vesicularity: 10-15% up to 5 mm, some are elongate and thin, most vesicles are rounded<br>6. Vesicle Filling: none<br>7. Matrix Color: dark gray<br>8. Primary Minerals: ol: 10-15% up to 5mm, smaller ones less than 2mm; plag: 10% up to 3mm; cpx: 1-2%<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh<br>11. Comment: xenoliths 4mm white color | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR18-7 | 1. Rock Type: porphyric lava<br>2. Size: 8x8x10<br>3. Shape/Angularity: subangular to rounded<br>4. Encrustations: none<br>5. Vesicularity: 25% up to 7mm elongate and rounded<br>6. Vesicle Filling: none<br>7. Matrix Color: dark gray<br>8. Primary Minerals: ol: 25%; plag:5-10%; cpx: 1-2%<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh | x | x | | | | | | | | USC: 1x GC+TS |  |

**SO201-1b-DR19**

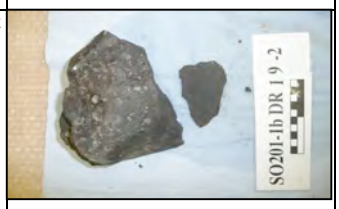
**Description of Location and Structure: Central Aleutians 50 nm NW from Buldir Isl., Ingenstrem Depression, relatively large, steep cone 7A, upper part of the SE slope.**

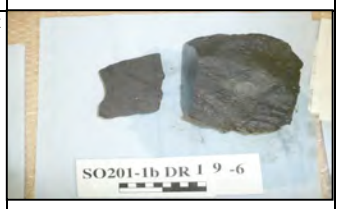
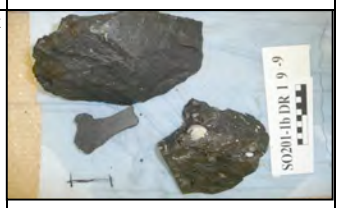
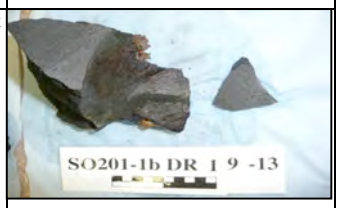
Dredge on b UTC 21/06/09 08:47hrs, lat 52°28,04'N, long 175°17,56'E, depth 785m

Dredge off b UTC 21/06/09 09:43hrs, lat 52°28,40'N, long 175°17,30'E, depth 558m

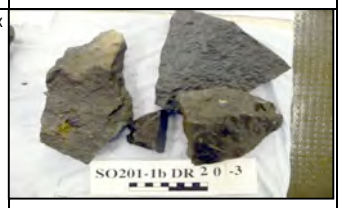
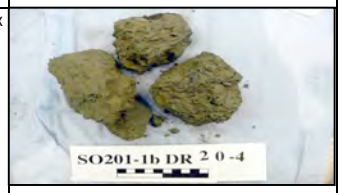
*total volume: full*

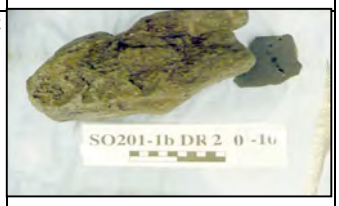
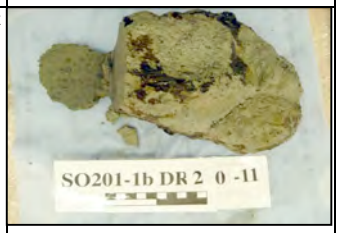
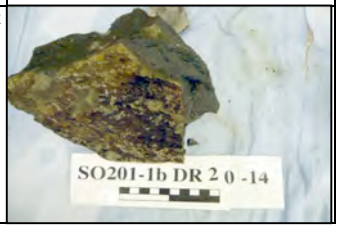
*Comments: very homogeneous dredge: basically differences between samples are mostly regarding vesicularity and occurence of xenoliths*

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR19-1 | 1. Rock Type: ol-phyric basalt (black) with pale apple-green mantle xenoliths of sizes 0.5x0.8 cm to 4x6 cm<br>2. Size: 19x29x20<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: none<br>6. Vesicle Filling: none<br>7. Matrix Color: black<br>8. Primary Minerals: Basalt ol: up to 30%, px up to 15%; Xenoliths ol: 80% ; opx, cpx, spinel: 20%<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR19-2 | 1. Rock Type: ol-phyric basalt with cognate fragments of vesicular basalts of same composition and very small angular mantle xenoliths (3-5mm)<br>2. Size: 40x30x20cm<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: some, only in small portion of rock<br>6. Vesicle Filling: none<br>7. Matrix Color: black<br>8. Primary Minerals: ol: 20-25%; px and pl in matrix<br>9. Secondary Minerals: possibly calcite<br>10. Overall Degree of Alteration: fresh<br>11. Comment: sample is similar to DR19-1 | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR19-3 | 1. Rock Type: ol-basalt with mantle xenoliths (sp-lherzolites)<br>2. Size: 40x35x27 cm. Xenolith 4x5 mm<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: slightly<br>6. Vesicle Filling: none<br>7. Matrix Color: black<br>8. Primary Minerals: ol: 15-20%; px: up to 10%; xenolith: ol:80-85%; px and sp 15-20%<br>9. Secondary Minerals: none | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR19-4 | 1. Rock Type: ol-basalt with mantle xenolith<br>2. Size: 32x14x27 cm<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: 0-30% from 0-2mm<br>6. Vesicle Filling: none<br>7. Matrix Color: black<br>8. Primary Minerals: ol: up to 20%; px. xenolith: sp-lherzolite and plag<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR19-5 | 1. Rock Type: ol-basalt with mantle xenoliths<br>2. Size: 38x17x14 cm. Xenolith 0.8x2.5 cm.<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: slightly<br>6. Vesicle Filling: none<br>7. Matrix Color: black<br>8. Primary Minerals: ol: 25%; px: 5-10%. xenolith: ol:85%, px and spinel 15%<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh | x | x | | | | | | | | USC: 1x GC+TS |  |

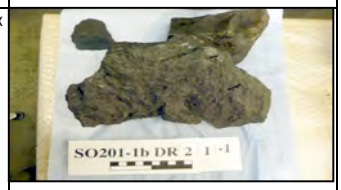
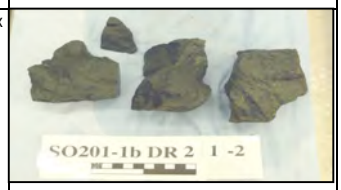
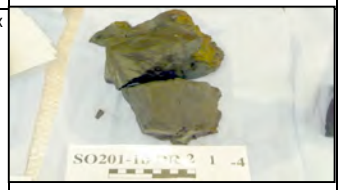
| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR19-6 | 1. Rock Type: ol-basalt with small mantle xenoliths<br>2. Size: 38x25x25 cm. Xenolith 2x5 mm.<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: 25%<br>6. Vesicle Filling: none<br>7. Matrix Color: black<br>8. Primary Minerals: ol:10-15%; px:5%; pl in matrix. Xenolith: spinel-lherzholite<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR19-7 | 1. Rock Type: ol-basalt<br>2. Size: 35x30x18 cm<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: 15% (1-2 mm)<br>6. Vesicle Filling: none<br>7. Matrix Color: black<br>8. Primary Minerals: ol: 25%; px: 10%; pl in matrix<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR19-8 | 1. Rock Type: ol-basalt with mantle xenoliths<br>2. Size: 24x20x14 cm. Xenolith 0.5-1.3 cm.<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: some<br>6. Vesicle Filling: none<br>7. Matrix Color: black<br>8. Primary Minerals: ol: 15-20%; px: 10%. Xenolith: spinel-lherzolite<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR19-9 | 1. Rock Type: highly ol-px phyric basalt<br>2. Size: 18x18x24 cm<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: 10% up to 2mm<br>6. Vesicle Filling: none<br>7. Matrix Color: black<br>8. Primary Minerals: ol: 20% px: 3-5% (sub-mm up to 1-2 mm); xenoliths 3-5mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR19-10 | 1. Rock Type: ol-px phyric basalt<br>2. Size: 25x17x15<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: 5-10% up to 1mm<br>6. Vesicle Filling: none<br>7. Matrix Color: black<br>8. Primary Minerals: ol: 20% px:5% (sub-mm up to 1-2 mm); xenoliths 2-3 mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR19-11 | 1. Rock Type: ol-px phyric basalt<br>2. Size: 26x18x17 cm<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: 10% up to 1mm<br>6. Vesicle Filling: none<br>7. Matrix Color: black<br>8. Primary Minerals: ol: 20% px: 5%, xenoliths 5-6mm up to 1cm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh<br>11. Comment: partlty glomeroporphyritic texture | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR19-12 | 1. Rock Type: highly ol-px phyric basalt<br>2. Size: 20x26x27 cm<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: 15% up to 1mm<br>6. Vesicle Filling: none<br>7. Matrix Color: black<br>8. Primary Minerals: ol:20% px: 5% (up to 1-2 mm)<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none<br>11. Comment: large ol crystals or mantle xenoliths 2-3mm | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR19-13 | 1. Rock Type: highly ol-px phyric basalt<br>2. Size: 23x34x43 cm<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: 20-30%, some are elongate, parallel orientation, (degassing channels?)<br>6. Vesicle Filling: none<br>7. Matrix Color: black<br>8. Primary Minerals: ol:20% px 5-10% (up to 1-2 mm)<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh<br>11. Comment: olivine xenoliths up to 1.2 cm | x | x | | | | | | | | USC: 1x GC+TS |  |

**SO201-1b-DR20**
**Description of Location and Structure: Central Aleutians 50 nm NW from Buldir Isl., Ingenstrem Depression, small cone 7B east of 7A, extension of 7a (?). East slope from base to top.**
Dredge on bottom UTC 21/06/09 10:48hrs, lat 52°28,39'N, long 175°18,42'E, depth 990m
Dredge off bottom UTC 21/06/09 11:37hrs, lat 52°28,65'N, long 175°17,79'E, depth 795m
*total volume: full*
*Comments: Volcanics (lavas of andesites, basalts with xenoliths and pyroclastic rocks).*

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR20-1 | 1. Rock Type: highly hbl-pl phyric andesite<br>2. Size: 23x25x42 cm<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: very small vesicles, sub-mm size<br>6. Vesicle Filling: none<br>7. Matrix Color: light gray<br>8. Primary Minerals: hbl: elongate prisms and needles, sub-mm size, 15-20%; pl: tablets and equant individuals, sub-mm to 5 mm size, 10-15%<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: only rimmed by weathering halo<br>11. Comment: some pl show a dark gray rim also in large crystals, zonation is visible | x | x | | | | | | | | USC: 1x<br>GC+TS |  |
| DR20-2 | 1. Rock Type: highly ol phyric basalt with xenoliths<br>2. Size: 22x27x34<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: sub-mm to 1mm size, 5-10%<br>6. Vesicle Filling: none<br>7. Matrix Color: dark gray to black<br>8. Primary Minerals: ol: up to 1-2mm in size, equant shape, 15-20%; pl: up to 1mm in size, 2-3%<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: almost fresh to fresh<br>11. Comment: xenoliths appear 1-8mm in size | x | x | | | | | | | | USC: 1x<br>GC+TS |  |
| DR20-3 | 1. Rock Type: highly ol phyric basalt with mantle xenoliths<br>2. Size: 28x37x45 cm<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: sub-mm to 1mm in size, 5-10%<br>6. Vesicle Filling: none<br>7. Matrix Color: dark gray to black<br>8. Primary Minerals: ol: 1-2mm, equant shape, 15%; pl: only few present, maybe 3-5 %<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh<br>11. Comment: one xenolithic piece visible, dark gray aphanitic rock, 2cm size; also mantle xenoliths (pale apple green) are visible, up to 6mm in size | x | x | | | | | | | | USC: 1x<br>GC+TS |  |
| DR20-4 | 1. Rock Type: pyroclastic rock with volcanic clasts up to 2 cm in size and of andesitic composition (hbl phyric)<br>2. Size: 14x22x24 cm<br>3. Shape/Angularity: subrounded<br>4. Encrustations: none<br>5. Vesicularity: non<br>6. Vesicle Filling: none<br>7. Matrix Color: greenish gray<br>8. Primary Minerals: andesitic clasts (hbl phyric, 1-3 mm in size, prismatic or needle-shaped); matrix (greenish gray cement, also hbl phenocrysts)<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: slightly altered matrix and fresh clasts<br>11. Comment: subangular volcanic clasts are bounded by fine-grained volc. ash material (andesitic matrix), not pretty solidified | | x | | | | | | | | USC: 1x<br>GC+TS |  |
| DR20-5 | 1. Rock Type: pyroclastic rock of andesitic composition showing clasts of highly hbl-phyric andesite<br>2. Size: 9x14x15 cm<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: accessory vesicles appear, up to 1mm in size<br>6. Vesicle Filling: none<br>7. Matrix Color: green gray<br>8. Primary Minerals: hbl: 20%, less than 1mm to 4mm in size; pl: 5%, 1-3mm in size<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: moderate (crystals fresh, groundmass altered)<br>11. Comment: greenish brownish clasts bounded by gray andesitic matrix (breccia) | x | x | | | | | | | | USC: 1x<br>GC+TS |  |
| DR20-6 | 1. Rock Type: highly ol-phyric basalt with some pl and px phenocrysts<br>2. Size: 9x15x16<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: moderate (10-15%)<br>6. Vesicle Filling: none<br>7. Matrix Color: black<br>8. Primary Minerals: ol: 20%, sub-mm to 3mm in size, equant, some large individuals up to 3-4mm; px: 1-10mm, 5%; subordinate pl (up to 1 mm in size)<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh<br>11. Comment: large pale green inclusions, perhaps mantle xenoliths | x | x | | | | | | | | USC: 1x<br>GC+TS |  |

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR20-7 | 1. Rock Type: highly ol-phyric basalt (similar to DR20-6)<br>2. Size: 16x16x23 cm<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: 25%, 1-2mm in size<br>6. Vesicle Filling: none<br>7. Matrix Color: black<br>8. Primary Minerals: ol: 20%, sub-mm to 3mm in size, equant, some large individuals up to 3-4mm; px: 1-6mm, 5%<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR20-8 | 1. Rock Type: volcaniclastic rock with andesitic clasts<br>2. Size: 35x21x17 cm<br>3. Shape/Angularity: subrounded<br>4. Encrustations: none<br>5. Vesicularity: none<br>6. Vesicle Filling: none<br>7. Matrix Color: light gray<br>8. Primary Minerals: shown by 1st type of clasts (0.4-4 cm in size): amph phyric andesites (30 %, up to 3 mm); 2nd clast type: dense, aphyric ones<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: clasts appear fresh, matrix is moderately altered<br>11. Comment: andesitic clasts within grey matrix more solidified than sample DR20-4 | | x | | | | | | | | USC: 1x GC+TS |  |
| DR20-9 | 1. Rock Type: volcanic rock with plate joining<br>2. Size: 25x22x16 cm<br>3. Shape/Angularity: subrounded<br>4. Encrustations: none<br>5. Vesicularity: very small vesicles, up to 1mm, 5%<br>6. Vesicle Filling: white mineral<br>7. Matrix Color: dark gray<br>8. Primary Minerals: probably amphibole needles, up to 3mm, 5%<br>9. Secondary Minerals: not clear<br>10. Overall Degree of Alteration: slightly altered<br>11. Comment: may contain some ol and px, less than 1mm, less than 5% | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR20-10 | 1. Rock Type: volcanic<br>2. Size: 19x9x10 cm<br>3. Shape/Angularity: subrounded<br>4. Encrustations: none<br>5. Vesicularity: 20% angular vesicles<br>6. Vesicle Filling: none<br>7. Matrix Color: dark gray<br>8. Primary Minerals: ol: 3mm; pl: 2mm; both total 20%<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR20-11 | 1. Rock Type: volcanics<br>2. Size: 20x18x13<br>3. Shape/Angularity: subrounded<br>4. Encrustations: none<br>5. Vesicularity: none<br>6. Vesicle Filling: none<br>7. Matrix Color: light gray<br>8. Primary Minerals: hornblende, 3mm, 20%<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none<br>11. Comment: pyroclastic seems to be one lithology, lithic fragments in ash matrix of the same composition. | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR20-12 | 1. Rock Type: volcanic<br>2. Size: 14x12x10 cm<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: 15% sub-mm angular vesicles<br>6. Vesicle Filling: none<br>7. Matrix Color: dark graz<br>8. Primary Minerals: ol: up to 4mm, 12%; pl (?) 1mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR20-13 | 1. Rock Type: SAMPLE NO HAS NOT BEEN ASSIGNED | | | | | | | | | | | |
| DR20-14 | 1. Rock Type: volcanic<br>2. Size: 18x28x13 cm<br>3. Shape/Angularity: subrounded<br>4. Encrustations: none<br>5. Vesicularity: 1% angular vesicles<br>6. Vesicle Filling: none<br>7. Matrix Color: gray<br>8. Primary Minerals: ol: up to 3mm; pl: up to 2mm. both total 10%<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none | x | x | | | | | | | | USC: 1x GC+TS |  |

**SO201-1b-DR21**
**Description of Location and Structure: Central Aleutians 50 nm NW from Buldir Isl., Ingenstrem Depression, cone 8B SE facing slope, ca. 2nm SSE of DR20, top area at 500 mbsl.**
Dredge on bottom UTC 21/06/09 13:20hrs, lat 52°27,57'N, long 175°21,13'E, depth 790m
Dredge off bottom UTC 21/06/09 14:18hrs, lat 52°28,11'N, long 175°20,64'E, depth 570m
*total volume: full*
*Comments: fresh volcanics*

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR21-1 | 1. Rock Type: highly ol-phyric basalt with subordinate pl<br>2. Size: 29x32x43 cm<br>3. Shape/Angularity: subrounded<br>4. Encrustations: none<br>5. Vesicularity: 20-25%, sub-mm to 2cm in size<br>6. Vesicle Filling: none<br>7. Matrix Color: black<br>8. Primary Minerals: ol: 20%, up to 2mm; pl: less than 10%, up to 2mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none<br>11. Comment: small ultramafic inclusions up to 5 mm in size | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR21-2 | 1. Rock Type: highly ol-phyric basalt with some pl phenocrysts<br>2. Size: 28x33x42 cm<br>3. Shape/Angularity: subrounded<br>4. Encrustations: none<br>5. Vesicularity: 20%<br>6. Vesicle Filling: none<br>7. Matrix Color: black<br>8. Primary Minerals: ol: 10-15%, up to 2mm; pl: up to 20%, up to 2mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR21-3 | 1. Rock Type: highly ol-phyric basalt with pl phenocrysts and one 2cm hydrothermically altered inclusion<br>2. Size: 25x33x43 cm<br>3. Shape/Angularity: subrounded<br>4. Encrustations: none<br>5. Vesicularity: none<br>6. Vesicle Filling: 20-25%, sub-mm to 2mm<br>7. Matrix Color: black<br>8. Primary Minerals: ol: 20%, up to 2mm; pl: less than 10%, up to 2mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none<br>11. Comment: small, maybe ultramafic, inclusions visible | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR21-4 | 1. Rock Type: highly ol-phyric basalt with pl phenocrysts<br>2. Size: 22x28x43 cm<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: 20%<br>6. Vesicle Filling: none<br>7. Matrix Color: black<br>8. Primary Minerals: ol: 10-15%, up to 2mm; pl: up to 20%, up to 2mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none<br>11. Comment: quenched margin is preserved, up to 3mm inclusions (perhaps ultramafic) occassionally occur | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR21-5 | 1. Rock Type: highly ol-phyric basalt with subordinate pl<br>2. Size: 23x24x30 cm<br>3. Shape/Angularity: subrounded<br>4. Encrustations: none<br>5. Vesicularity:20-25%, sub-mm to 2mm<br>6. Vesicle Filling: none<br>7. Matrix Color: black<br>8. Primary Minerals: ol: 20%, up to 2mm; pl: 10-15%<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none<br>11. Comment: pale green inclusions, possibly ultramafic xenoliths (up to 4mm) | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR21-6 | 1. Rock Type: highly ol-phyric basalt with pl phenocrysts<br>2. Size: 25x25x26 cm<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity:20%, up to 2 cm<br>6. Vesicle Filling: none<br>7. Matrix Color: black<br>8. Primary Minerals: ol: 20%, up to 2mm; pl: 10%, up to 3mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR21-7 | 1. Rock Type: highly ol-phyric basalt with pl phenocrysts<br>2. Size: 16x21x30 cm<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: 1-2%<br>6. Vesicle Filling: none<br>7. Matrix Color: black<br>8. Primary Minerals: ol: 15%, up to 3mm; pl: 10%, up to 3mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none | x | x | | | | | | | | USC: 1x GC+TS |  |

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR21-8 | 1. Rock Type: highly ol-phyric basalt with pl phenocrysts<br>2. Size: 8x17x19 cm<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity:1-2%<br>6. Vesicle Filling: none<br>7. Matrix Color: black<br>8. Primary Minerals: ol: 15%, up to 2mm; pl: 10%, up to 3mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none<br>11. Comment: almost dense rock | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR21-9 | 1. Rock Type: highly ol-phyric basalt with pl phenocrysts<br>2. Size: 15x20x23 cm<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: 20-25%, sub-mm to 2mm in size<br>6. Vesicle Filling: none<br>7. Matrix Color: black<br>8. Primary Minerals: pl: less than 10%, up to 1mm; ol: 20%, up to 2-3 mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none<br>11. Comment: voids up to 7mm, probably mantle xenoliths, pale green color, up to 5mm in size | x | x | | | | | | | | USC: 1x GC+TS |  |

**SO201-1b-DR22**

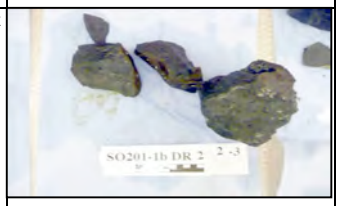
**Description of Location and Structure: Central Aleutians 50 nm NW from Buldir Isl., Ingenstrem Depression, cone 9A - new, a very small cone in the eastern Ingenstrem.**

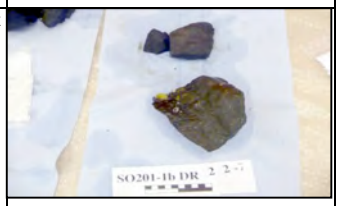
Dredge on bottom UTC 21/06/09 16:34hrs, lat 52°26,35'N, long 175°30,98'E, depth 715m

Dredge off bottom UTC 21/06/09 17:30hrs, lat 52°26,73'N, long 175°30,61'E, depth 437m

*total volume: few rocks*

*Comments: volcanics, coral plants on the lava blocks, mouth of dredge got blocked; probably all samples of this dredge are part of the same*

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR22-1 | 1. Rock Type: highly ol-px-pl phyric basalt<br>2. Size: 21x24x26 cm<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: 15%<br>6. Vesicle Filling: none<br>7. Matrix Color: black<br>8. Primary Minerals: ol 15-20%, sub-mm to 4 mm; pl less than 10%, sub-mm to 1mm; px 5%, 1-3mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh<br>11. Comment: 35-40% phenocrysts, more porphyritic than DR21. Large phenocrysts of olivine appear --> primary candidate for mineralogical investigations | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR22-2 | 1. Rock Type: highly ol-px-pl phyric basalt<br>2. Size: 23x22x13 cm<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: 15%<br>6. Vesicle Filling: none<br>7. Matrix Color: black<br>8. Primary Minerals: ol 15%, sub-mm to 3mm; px 10%, sub-mm to 3mm; pl 5-10%, sub-mm to 2mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh<br>11. Comment: similar to DR22-1 | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR22-3 | 1. Rock Type: highly ol-px-pl phyric basalt<br>2. Size: 14x16x17 cm<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity:15%<br>6. Vesicle Filling: none<br>7. Matrix Color: black<br>8. Primary Minerals: ol 15%, sub-mm to 3mm; px 5%, sub-mm to 2.5mm; pl 10%, sub-mm to 2mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR22-4 | 1. Rock Type: highly ol-px-pl phyric basalt<br>2. Size: 22x31x36 cm<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: 15%<br>6. Vesicle Filling: none<br>7. Matrix Color: black<br>8. Primary Minerals: ol 20%, sub-mm to 5mm; px 10%, sub-mm to 3mm; pl 5%, sub-mm to 1mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh<br>11. Comment: fewer large ol phenocrysts than in sample DR22-1 | x | x | | | | | | | | USC: 1x GC+TS |  |

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR22-5 | 1. Rock Type: highly ol-px-pl phyric basalt<br>2. Size: 24x28x28 cm<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: 15%<br>6. Vesicle Filling: none<br>7. Matrix Color: black<br>8. Primary Minerals: ol 10-15%, sub-mm to 4mm; px 10%, sub-mm to 2mm; pl less than 10%, sub-mm to 2mm (more larger crystals, however)<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR22-6 | 1. Rock Type: highly ol-px-pl phyric basalt<br>2. Size: 19x21x24 cm<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: 15%<br>6. Vesicle Filling: none<br>7. Matrix Color: black<br>8. Primary Minerals: ol 15%, sub-mm to 3mm; px 10%, sub-mm to 2mm; pl less than 10%, sub-mm to 1mm; hbl (accessory), 2-4 mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh<br>11. Comment: black needle-shaped phenocrysts (probably hbl). fewer larger phenocrysts compared to DR22-1 | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR22-7 | 1. Rock Type: highly ol-px-pl phyric basalt<br>2. Size: 15x16x31 cm<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: 15%<br>6. Vesicle Filling: none<br>7. Matrix Color: black<br>8. Primary Minerals: ol 15%, sub-mm to 4mm; px 10%, sub-mm to 5mm; pl 5%, sub-mm to 1mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none | x | x | | | | | | | | USC: 1x GC+TS |  |

**SO201-1b-DR23**

**Description of Location and Structure: Central Aleutians 50 nm NW from Buldir Isl., Ingenstrem Depression, cone 9B, SE facing slope, the shallowest station, within 20 nm of Buldir Isl.**

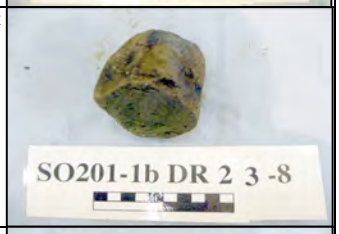
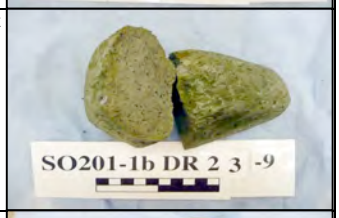
Dredge on bottom UTC 21/06/09 18:59hrs, lat 52°26,90'N, long 175°32,74'E, depth 559m

Dredge off bottom UTC 21/06/09 20:05hrs, lat 52°27,28'N, long 175°32,46'E, depth 233m

*total volume: full*

*Comments: lava boulders, rounded in many cases, appear heterolithological (2 types of andesites differing in the amount of phenocrysts: 1st type: dense rock with small amount of hbl phenocrysts; 2nd type: rock with large amount of hbl phenocr. (also larger in size compared to type one --> 2nd type predominates; shows inclusions of vesicular basalt).*

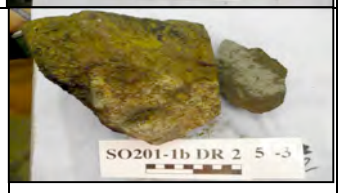
| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR23-1 | 1. Rock Type: highly hbl-px phyric andesite<br>2. Size: 20x26x28 cm<br>3. Shape/Angularity: rounded<br>4. Encrustations: none<br>5. Vesicularity:none<br>6. Vesicle Filling: none<br>7. Matrix Color: light greenish gray<br>8. Primary Minerals: hbl 10%, needle shaped (maybe preferred orientation), sub-mm to 3.5mm; px 1-2 %, prismatic, dark to light greenish, 1-5mm (probably cpx)<br>9. Secondary Minerals: none, except for one cavity filled with secondary min´s<br>10. Overall Degree of Alteration: minor<br>11. Comment: phenocryst proportion 10-12 %; dark gray porous xenoliths (probably basalt), 6-8 mm maximum size, visible | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR23-2 | 1. Rock Type: highly hbl-px phyric andesite<br>2. Size: 66x50x46 cm<br>3. Shape/Angularity: rounded<br>4. Encrustations: none<br>5. Vesicularity:none<br>6. Vesicle Filling: none<br>7. Matrix Color: gray<br>8. Primary Minerals: hbl 20-25%, sub-mm to almost 1cm, prismatic to needle-shaped (larger needles may have parallel orientation), forms some glomeroporphyritic aggregates.<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: slightly<br>11. Comment: Larger amount of hbl phenocrysts compared to no. 1 (1st type andesites) | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR23-3 | 1. Rock Type: highly hbl-phyric andesite<br>2. Size: 24x37x45 cm<br>3. Shape/Angularity: rounded<br>4. Encrustations: none<br>5. Vesicularity:none<br>6. Vesicle Filling: none<br>7. Matrix Color: gray<br>8. Primary Minerals: hbl 15%, sub-mm to 8mm, mostly needles<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: slightly, faint pinkish color (due to oxidation?)<br>11. Comment: - | x | x | | | | | | | | USC: 1x GC+TS |  |

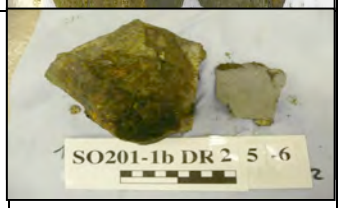
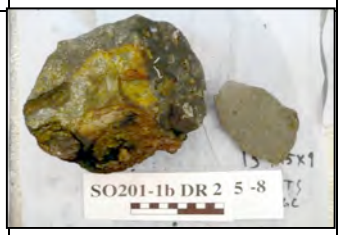
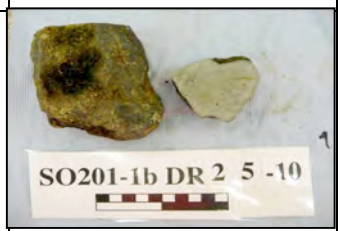
| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR23-4 | 1. Rock Type: highly hbl phyric andesite<br>2. Size: 11x17x25 cm<br>3. Shape/Angularity: rounded<br>4. Encrustations: none<br>5. Vesicularity:none<br>6. Vesicle Filling: none<br>7. Matrix Color: gray<br>8. Primary Minerals: hbl 15%, sub-mm to 8mm, prismatic or needle-shaped<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: hbl phenocrysts appear fresh, groundmass slightly to moderatly altered<br>11. Comment: decomposed g.m. shows a moderate alteration. | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR23-5 | 1. Rock Type: highly hbl phyric andesite<br>2. Size: 28x12x26 cm<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: 1-2%, less than 2mm<br>6. Vesicle Filling: none<br>7. Matrix Color: brownto yellowish<br>8. Primary Minerals: hbl 20%, up to 2mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: moderately | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR23-6 | 1. Rock Type: highly hbl phyric andesite<br>2. Size: 25x17x11<br>3. Shape/Angularity: rounded to subrounded<br>4. Encrustations: none<br>5. Vesicularity:none<br>6. Vesicle Filling: none<br>7. Matrix Color: brown<br>8. Primary Minerals: hbl 30-35%, up to 1 cm, elongate crystals; opx 1-2%, up to 3mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: moderately to slightly | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR23-7 | 1. Rock Type: porphyric volcanic rock<br>2. Size: 10x10x6 cm<br>3. Shape/Angularity: rounded<br>4. Encrustations: none<br>5. Vesicularity:none<br>6. Vesicle Filling: none<br>7. Matrix Color: greenish-gray<br>8. Primary Minerals: hbl 5%, up to 4mm; cpx 1-2%, up to 5mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh<br>11. Comment: black-colored intrusion (maybe basaltic) | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR23-8 | 1. Rock Type: porphyric volcanic lava<br>2. Size: 8x10x6 cm<br>3. Shape/Angularity: rounded<br>4. Encrustations: none<br>5. Vesicularity: 5%, up to 1mm<br>6. Vesicle Filling: none<br>7. Matrix Color: brownish-gray<br>8. Primary Minerals: hbl 10%, up to 6mm; pl 5-10%; cpx 2%<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR23-9 | 1. Rock Type: volcanic porphyric lava<br>2. Size: 9x5x11.5 cm<br>3. Shape/Angularity: rounded<br>4. Encrustations: none<br>5. Vesicularity:none<br>6. Vesicle Filling: none<br>7. Matrix Color: gray<br>8. Primary Minerals: hbl 15%, up to 6mm; cpx 1-2%, up to 4mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR23-10 | 1. Rock Type: porphyric lava<br>2. Size: 14x8x5 cm<br>3. Shape/Angularity: rounded<br>4. Encrustations: none<br>5. Vesicularity:none<br>6. Vesicle Filling: none<br>7. Matrix Color: brownish-green gray<br>8. Primary Minerals: hbl 15%, up to 5mm; cpx 5%, up to 1 mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh | x | x | | | | | | | | USC: 1x GC+TS |  |

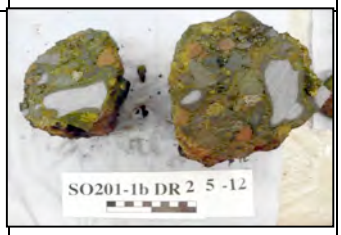
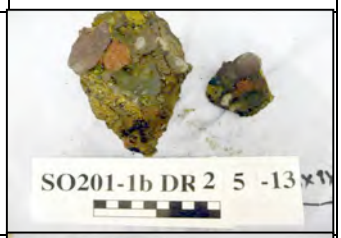
**SO201-1b-DR24**
**Description of Location and Structure: Valley cut into NE slope of Bowers Ridge. Relatively steep E facing walls are dredged.**
**Reconaissance attempt to verify nature of basement outcrop; sedimentary versus magmatic**
Dredge on bottom UTC 22/06/09 17:56hrs, lat 54°40,86'N, long 179°38,11'E, depth 2718m
Dredge off bottom UTC 22/06/09 19:16hrs, lat 54°40,92'N, long 179°37,49'E, depth 2143m
*total volume: few rocks, some freshly broken*
*Comments: Solidified sediments, some with fresh broken surfaces*

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR24-1 | 1. Rock Type: solidified carbonate rock<br>2. Size: 10x11x22; 4 seperate pieces taken<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>7. Matrix Color: grey<br>10. Overall Degree of Alteration: minor Mn coating | | | | | | | | | | |  |
| DR24-2 | 1. Rock Type: marl<br>2. Size: 5x9x12<br>3. Shape/Angularity: rounded<br>4. Encrustations: none<br>7. Matrix Color: yellowish-beige-grey<br>10. Overall Degree of Alteration: probably fresh<br>11. Comment: possibly contains fossil shells | | | | | | | | | | |  |

**SO201-1b-DR25**
**Description of Location and Structure: NW section of Bowers Ridge (Area C), NNE facing slope in small valley just beneath plateau**
Dredge on bo UTC 23/07/09 11:37hrs, lat 54°58,06'N, long 176°24,87'E, depth 1386m
Dredge off bottom UTC 23/06/09 13:03hrs, lat 54°57,47'N, long 176°24,50'E, depth 936m
*total volume: few rocks in mud*
*Comments: VOLCANIC!!! All rock are covered in mud. Predominantly CPx basalts (about 70%), andesites (about 10%), fragments of breccia are consisting of various types of clasts (basalts, andesites), xtls of CPx, (maybe Ol), Hbl, Mt, Ilm.*

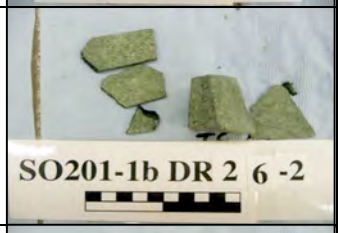
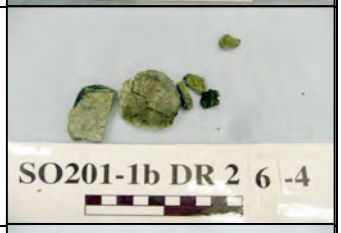
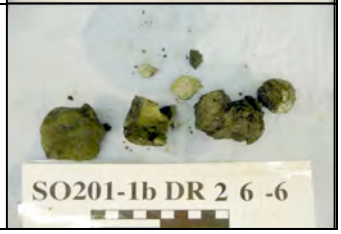
| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR25-1 | 1. Rock Type: volcanic<br>2. Size: 19x14x4<br>3. Shape/Angularity: subangular<br>4. Encrustations: thin film on surface<br>5. Vesicularity: <=2%<br>6. Vesicle Filling: white<br>7. Matrix Color: dark grey to greenish grey at margins<br>8. Primary Minerals: about 25% CPx up to 5 mm, <= 5% Ol up to 2 mm - altered, Pl microphenocrysts<br>9. Secondary Minerals: some chloritization, altered Ol<br>10. Overall Degree of Alteration: low to moderate<br>11. Comment: predominant type of rock in the dredge. The rock is likely a block (large clast) from breccia | x | x | | | | | | | | |  |
| DR25-2 | 1. Rock Type: similar to number 1<br>2. Size: 27x11x6<br>3. Shape/Angularity:<br>4. Encrustations:<br>5. Vesicularity: somewhat more visicular, visicules up to 3 mm<br>6. Vesicle Filling:<br>7. Matrix Color:<br>8. Primary Minerals:<br>9. Secondary Minerals:<br>10. Overall Degree of Alteration: slightly<br>11. Comment: GOOD FOR CHEMISTRY! | x | x | | | | | | | | |  |
| DR25-3 | 1. Rock Type: similar to number -1, -2, but more visicular and altered<br>2. Size: 17x14x12<br>3. Shape/Angularity: subangular<br>4. Encrustations: fragment of breccia on the surface<br>5. Vesicularity: about 10-15%<br>6. Vesicle Filling: none<br>7. Matrix Color: redish brown<br>8. Primary Minerals: the same as number 1<br>9. Secondary Minerals: Oxidation and chloritization<br>10. Overall Degree of Alteration: moderate<br>11. Comment: At least 6-8 fragments of such rock type were found in the dredge. | x | x | | | | | | | | |  |
| DR25-4 | 1. Rock Type: similar to number 3, volcanic visicular rock<br>2. Size: 20x13x12<br>3. Shape/Angularity: subrounded<br>4. Encrustations: thin Mn-film on surface<br>5. Vesicularity: about 20%<br>6. Vesicle Filling: none, open<br>7. Matrix Color: brown<br>8. Primary Minerals: the same as number 3, CPx up to 6 mm<br>9. Secondary Minerals: the same as number 3<br>10. Overall Degree of Alteration: moderate<br>11. Comment: none | x | x | | | | | | | | |  |

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR25-5 | 1. Rock Type: similar to number 3, 4, volcanic CPx-phyric rock<br>2. Size: 17x12x10<br>3. Shape/Angularity: subrounded<br>4. Encrustations: thin Mn-crust on surface<br>5. Vesicularity: about 20%, <=1% angular<br>6. Vesicle Filling: none<br>7. Matrix Color: brown to grey<br>8. Primary Minerals: the same as number 3, 4, CPx up to 6 mm<br>9. Secondary Minerals: the same as number 3, 4<br>10. Overall Degree of Alteration: low to moderate<br>11. Comment: probably the best for chemistry compared to number -3, -4. | x | x | | | | | | | | |  |
| DR25-6 | 1. Rock Type: volcanic rock (basalt or andesite).<br>2. Size: 11x11x12<br>3. Shape/Angularity: angular<br>4. Encrustations: fragments of breccia<br>5. Vesicularity: none<br>6. Vesicle Filling: none<br>7. Matrix Color: brown to grey<br>8. Primary Minerals: CPx about 20% up to 6 mm, Pl about 15% up to 2 mm<br>9. Secondary Minerals: not clear<br>10. Overall Degree of Alteration: moderate<br>11. Comment: none | x | x | | | | | | | | |  |
| DR25-7 | 1. Rock Type: volcanic rock, similar to 3, 4, 5<br>2. Size: 9x10x6<br>3. Shape/Angularity: subangular<br>4. Encrustations: thin Mn-crust<br>5. Vesicularity: <= 20%, open, up to 3 mm<br>6. Vesicle Filling: none<br>7. Matrix Color: dark grey to green<br>8. Primary Minerals: about 20-25% large <= 5 mm CPx, Amph <=5% altered Ol <=3 mm<br>9. Secondary Minerals: chlorite ?<br>10. Overall Degree of Alteration: low to moderate | x | x | | | | | | | | |  |
| DR25-8 | 1. Rock Type: volcanic rock, andesite ?<br>2. Size: 15x15x9<br>3. Shape/Angularity: subangular<br>4. Encrustations: 1cm sedimentary on one side<br>5. Vesicularity: <5% visicules angular, <=0.1 mm<br>6. Vesicle Filling: Fe oxides<br>7. Matrix Color: grey to light grey<br>8. Primary Minerals: Hbl ca. 8% up to 1 cm, Plag ca. 5% <=8 mm, altered (?) Cpx 20-30%<br>9. Secondary Minerals: Fe oxides<br>10. Overall Degree of Alteration: low to moderate<br>11. Comment: might be good for chemistry, 2nd major rock type in the dredge; Hbl looks very fresh. | x | x | | | | | | | | |  |
| DR25-9 | 1. Rock Type: volcanic rock (similar to no. 8)<br>2. Size: 10x8x6<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: none<br>6. Vesicle Filling: none<br>7. Matrix Color: grey to light grey<br>8. Primary Minerals: Hbl, Cpx<br>9. Secondary Minerals:<br>10. Overall Degree of Alteration: low<br>11. Comment: similar to number 8, no sedimentary encrustation, Hbl is slightly smaller, 4-5 CPx grains have black rims. Likely intergrowth of olivine+CPx. Good for chemistry. | x | x | | | | | | | | |  |
| DR25-10 | 1. Rock Type: volcanic rock similar to no. - 8, -9.<br>2. Size: 11x7x6<br>3. Shape/Angularity: subangular<br>4. Encrustations:<br>5. Vesicularity:<br>6. Vesicle Filling: none<br>7. Matrix Color: grey to light grey<br>8. Primary Minerals:<br>9. Secondary Minerals:<br>10. Overall Degree of Alteration: low<br>11. Comment: similar to number 8, 9, no sedimentary encrustation, Amph is slitly smaller, up to 5 mm. Possible lithic fragment. Crystal of olivine - 1 cm. Texture is a intergrouth of Amph and Pl. Not very altered. Good for chemistry. | x | x | | | | | | | | |  |
| DR25-11 | 1. Rock Type: volcanic rock<br>2. Size: 9x10x6<br>3. Shape/Angularity: subrounded<br>4. Encrustations: 1-2 cm thick sedimentary crust, likely large breccia fragment<br>5. Vesicularity: 10-15 % angular vesicles 1 mm<br>6. Vesicle Filling: none<br>7. Matrix Color: dark grey to black, brown at rims<br>8. Primary Minerals: CPx - 4 mm, pretty fresh 10-15%, Amph - 3 mm long, 2%, <1% olivine, up to 5 mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: low to moderate<br>11. Comment: Potentially lithic fragment. Minerals are fresh. Home on plane. | x | | | | | | | | | |  |

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR25-12 | 1. Rock Type: breccia<br>2. Size: 18x13x13<br>3. Shape/Angularity: subrounded, clasts subangular to rounded<br>4. Encrustations: none<br>5. Vesicularity: none<br>6. Vesicle Filling: none<br>7. Matrix Color: light brown, green in some places<br>8. Primary Minerals: clasts of andesite - CPx, Amph, Pl, Basalt - CPx, Amph, some altered red serpentinite, large quartz+feldspars, shale<br>9. Secondary Minerals:<br>10. Overall Degree of Alteration:<br>11. Comment: Small breccia clast within breccia. Very fresh xsls in matrix. | | | | | | | | | | |  |
| DR25-13 | 1. Rock Type: the same as number 12<br>2. Size: 10x9x7<br>3. Shape/Angularity: subrounded, clasts subangular to rounded<br>4. Encrustations: none<br>5. Vesicularity: none<br>6. Vesicle Filling: none<br>7. Matrix Color: light brown, green in some places<br>8. Primary Minerals: clasts of andesite - CPx, Amph, Pl, Basalt - CPx, Amph, some altered red serpentinite, large quartz+feldspars, shale<br>9. Secondary Minerals:<br>10. Overall Degree of Alteration: | | | | | | | | | | |  |
| DR25-14 | 1. Rock Type: the same as no. 12<br>2. Size: 10x10x5<br>3. Shape/Angularity: subrounded, clasts subangular to rounded<br>4. Encrustations: none<br>5. Vesicularity: none<br>6. Vesicle Filling: none<br>7. Matrix Color: light brown, green in some parts<br>8. Primary Minerals: clasts of andesite: Cpx, Hbl, Plag; basaltic clasts : CPx, Hbl; some altered red serpentinite (?); light aggregates of Qtz+Fsp; shale. | | | | | | | | | | |  |
| DR25-15 | 1. Rock Type: the same as number 12<br>2. Size: 12x12x10<br>3. Shape/Angularity: subrounded, clasts subangular to rounded<br>4. Encrustations: none<br>5. Vesicularity: none<br>6. Vesicle Filling: none<br>7. Matrix Color: light brown, green in some places<br>8. Primary Minerals: clasts of andesite - CPx, Amph, Pl, Basalt - CPx, Amph, some altered red serpentinite, large quartz+feldspars, shale | x | | | | | | | | | |  |
| DR25-16 | 1. Rock Type: volcanic<br>2. Size: 7x6x4<br>3. Shape/Angularity: subrounded<br>4. Encrustations: none<br>5. Vesicularity: <1% sub mm vesicles<br>6. Vesicle Filling: none<br>7. Matrix Color: dark grey to grey<br>8. Primary Minerals: CPx up to 4 mm, Amph up to 3 mm - 5%, Pl up to 2 mm - 10%<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none<br>11. Comment: very fresh xstalls, good for chemistry | x | x | | | | | | | | |  |
| DR25-17 | 1. Rock Type: volcanic<br>2. Size: 5x5x4<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: subrounded vesicles up to 2 cm<br>6. Vesicle Filling: none<br>7. Matrix Color: dark grey to black<br>8. Primary Minerals: olivine up to 2 mm - 5%, Amph < 1%<br>9. Secondary Minerals: calcite precipitate in 1 vesicle<br>10. Overall Degree of Alteration: none<br>11. Comment: very fresh, good for chemistry | x | | | | | | | | | |  |
| DR25-18S | Fine grainded brown sediment silt size, layered, 10x4x4 | | | | | | | | x | | |  |
| DR25-19S | The same as 18S, 7x6x4 | | | | | | | | x | | |  |

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR25-20S | Silt sized grey sedimentary rock doesn't obuious layers, sub mm quartz grains multiple pieces 5x5x5 | | | | | | | | x | | |   |
| DR25-12x | 1. Rock Type: backup sample no. 12 | | | | | | x | | | | | |

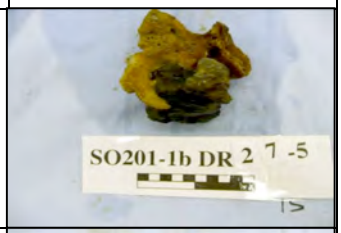
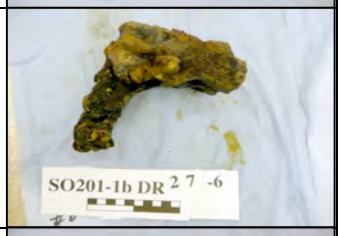
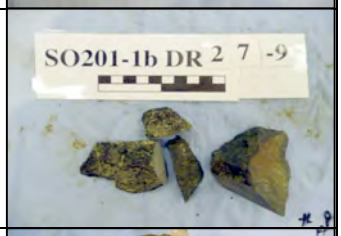
**SO201-1b-DR26**
**Description of Location and Structure: NW facing slope beneath plateau edge, steepest slope in the area, erosion valley develops beneath this position.**
Dredge on b UTC 23/06/09 14:43hrs, lat 54°56,82'N, long 176°17,79'E, depth 1420m
Dredge off b UTC 23/06/09 16:13hrs, lat 54°56,34'N, long 176°18,85'E, depth 749m
*total volume: very few rocks*
*Comments: cm- sized rock fragments, volcanics and sediment. 4 small pieces of Hbl-Pl andesites, 1 breccia similar to DR25, solid fresh sediments with normal grading*

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR26-1 | 1. Rock Type: volcanic<br>2. Size: 3x4x7<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: 2% angular vesicles<br>6. Vesicle Filling: none<br>7. Matrix Color: grey<br>8. Primary Minerals: Pl - 3 mm, 15%; Cpx - 2 mm, 10%; Hbl - 2 mm, 6%<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: low<br>11. Comment: slightly altered, good for chemistry | x | x | | | | | | | | |   |
| DR26-2 | 1. Rock Type: same as no.1<br>2. Size: 3x6x11 | x | x | | | | | | | | |   |
| DR26-3 | 1. Rock Type: same as no. 1<br>2. Size: 3x4x5 | x | | | | | | | | | |   |
| DR26-4 | 1. Rock Type: same as no. 1, but not as fresh<br>2. Size: 4x4x5 | x | | | | | | | | | |   |
| DR26-5 | 1. Rock Type: volcanic<br>2. Size: 3x4x4<br>3. Shape/Angularity: rounded<br>4. Encrustations: none<br>5. Vesicularity: none<br>6. Vesicle Filling: -<br>7. Matrix Color: blue grey<br>8. Primary Minerals: <1% px up to 5mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: low to moderate | x | | | | | | | | | |   |
| DR26-6 | 1. Rock Type: breccia<br>2. Size: 3x6x7<br>3. Shape/Angularity: subrounded<br>4. Encrustations: none<br>5. Vesicularity: none<br>6. Vesicle Filling: none<br>7. Matrix Color: green<br>8. Primary Minerals: similar to breccia from DR25 (sample DR25-12), contains clasts of Andesite, Basalt, Px, Hbl, Pl, Fe-Ti oxide.<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: moderate | | | | | | | | | | |   |

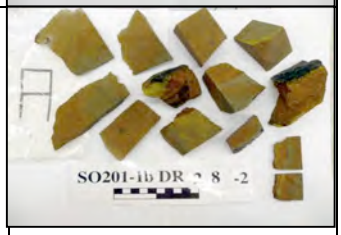
| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR26-7S | 1. Rock Type: sed rock<br>2. Size: 7x2x2<br>11. Comment: silt sized, no layering, small basalt grain, cherty | | | | | | | | x | | |  |
| DR26-8S | 1. Rock Type: sed rock, same as no. 7S<br>2. Size: 3x6x11 | | | | | | | | x | | |  |
| DR26-9S | 1. Rock Type: sed rock<br>11. Comment: fine grained, sub mm layers | | | | | | | | x | | |  |

**SO201-1b-DR27**
**Description of Location and Structure: NW part of Bowers Ridge, N-facing slope below below plateau edge.**
Dredge on b UTC 23/06/09 17:55hrs, lat 54°52,54'N, long 176°12,72'E, depth 1206m
Dredge off b UTC 23/06/09 19:23hrs, lat 54°51,61'N, long 176°12,42'E, depth 763m
*total volume: few rocks*
*Comments: sediment: semi consolidated, sponges with volcanics attached, 1x dropstone (most likely, because rounded); px-phyric basalts, breccia, some exotic rocks (dropstones?)*

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR27-1 | 1. Rock Type: volcanic<br>2. Size: 7x7x7cm<br>3. Shape/Angularity: subrounded<br>4. Encrustations: none<br>5. Vesicularity: 10-15% subrounded vesicles<br>6. Vesicle Filling: most none, some calcite?<br>7. Matrix Color: rust<br>8. Primary Minerals: weathered px ca. 1cm, 6%; altered olivine 2mm, ca. 3%.<br>9. Secondary Minerals: some<br>10. Overall Degree of Alteration: moderate to high<br>11. Comment: resembles basalt in prior dredges, but more altered | x | x | | | | | | | | |  |
| DR27-2 | 1. Rock Type: volcanic, lava.<br>2. Size: 15x12x5<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: none<br>6. Vesicle Filling: -<br>7. Matrix Color: grey<br>8. Primary Minerals: plag 1-2mm, 4%; px 4mm, 3%<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: moderate<br>11. Comment: matrix doesn´t appear strongly altered (?). Good for chemistry (?). | x | x | | | | | | | | |  |
| DR27-3 | 1. Rock Type: breccia<br>2. Size: 5x8x5<br>3. Shape/Angularity: subrounded<br>4. Encrustations: none<br>5. Vesicularity: none<br>6. Vesicle Filling: -<br>7. Matrix Color: brown to grey<br>8. Primary Minerals: ol + px<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: high<br>11. Comment: appears to be volcanoclastic. Chunks of vesicular basalt in brown matrix | x | | | | | | | | | |  |
| DR27-4 | 1. Rock Type: breccia<br>2. Size: 9x6x5<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: none<br>6. Vesicle Filling: none<br>7. Matrix Color: brown to grey<br>8. Primary Minerals: ol, px, plag, Fe-Ti-oxide<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: high<br>11. Comment: breccia more clastic than no. 3; clasts of vesicular basalt altered red and brown, individual minerals in matrix | x | | | | | | | | | |  |

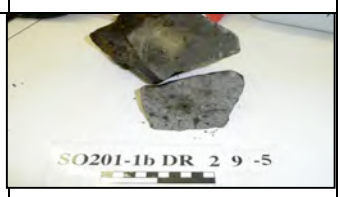
| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR27-5 | 1. Rock Type: volcanic<br>2. Size: 7x6x5<br>3. Shape/Angularity: subangular<br>4. Encrustations: large sponge<br>5. Vesicularity: 5-10% subrounded vesicles<br>6. Vesicle Filling: greenish mineral, calcite?<br>7. Matrix Color: rust<br>8. Primary Minerals: px up to 3mm, 10%<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: moderate<br>11. Comment: similar to 27-1, more altered | x | x | | | | | | | | |  |
| DR27-6 | 1. Rock Type: volcanic<br>2. Size: 11x5x3<br>3. Shape/Angularity: subangular<br>4. Encrustations: large sponge<br>5. Vesicularity: 10% angular vesicles<br>6. Vesicle Filling: none<br>7. Matrix Color: reddish brown grey<br>8. Primary Minerals: px up to 4mm, 8%; plag to 2mm, 6%; ol?<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: high<br>11. Comment: similar to 27-5, with plag, worse alteration | x | | | | | | | | | |  |
| DR27-7 | 1. Rock Type: volcanic<br>2. Size: 10x7x3<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: none<br>6. Vesicle Filling: -<br>7. Matrix Color: dark grey<br>8. Primary Minerals: 30-35% plag 2mm; px 10% 2mm<br>9. Secondary Minerals: pyrite<br>10. Overall Degree of Alteration: very low<br>11. Comment: likely dropstone, angular, very fresh, mineralogy differs from other samples in area | x | x | | | | | | | | |  |
| DR27-8 | 1. Rock Type: volcanic, same as no. 5<br>2. Size: 7x5x4<br>10. Overall Degree of Alteration: highly altered | x | | | | | | | | | |  |
| DR27-9 | 1. Rock Type: volcanic<br>2. Size: 10x4x3<br>3. Shape/Angularity: subrounded<br>4. Encrustations: none<br>5. Vesicularity: <5% angular vesicles<br>6. Vesicle Filling: yellow min, Fe-oxide? sulfide?<br>7. Matrix Color: rust<br>8. Primary Minerals: px <2mm, 10%; ol <1mm, 5%; hbl <1cm, 1%<br>9. Secondary Minerals: Fe oxides<br>10. Overall Degree of Alteration: moderate | x | x | | | | | | | | |  |
| DR27-10S | 1. Rock Type: sediment<br>2. Size: 6x6x2<br>11. Comment: fine grained, grey sed rock, slight layering, some 1mm sized qtz grains. | | | | | | | | x | | |  |
| DR27-1-1SP DR27-1-2SP DR27-1-3SP DR27-1-4SP DR27-1-5SP DR27-1-6SP | 1. Type: sponge<br>11. Comment: each in separate bag in blue paper, placed in blue box together with magmatic rocks. | | | | | | | | | | | |

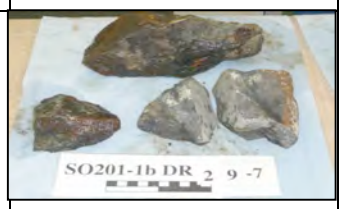
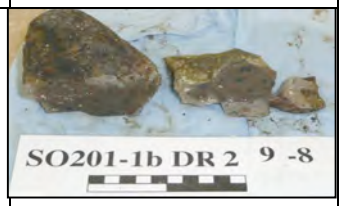
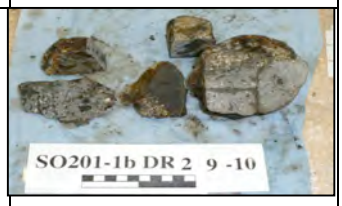
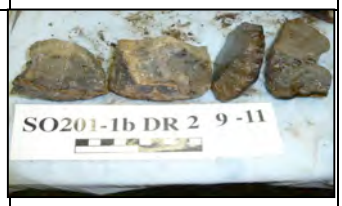
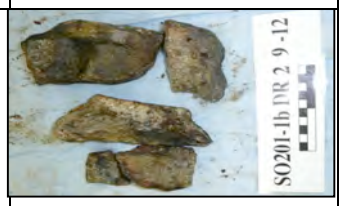
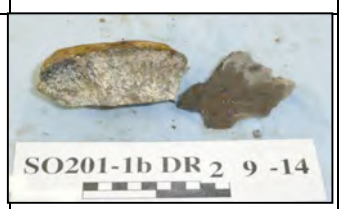
**SO201-1b-DR28**
**Description of Location and Structure: NW of Bowers Ridge, approx.3 nm NE of DR27. N-faing slope of small valley that cuts the slope**
Dredge on b\ UTC 23/06/09 20:44hrs, lat 54°54,71'N, long 176°16,54'E, 1136m
Dredge off b\ UTC 23/06/09 22:10hrs, lat 54°54,19'N, long 176°16,5'E, 710m
*Total volume: few rocks*
*Comments: sponge, few large angular blocks*

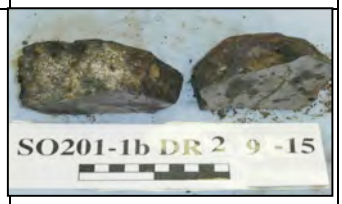
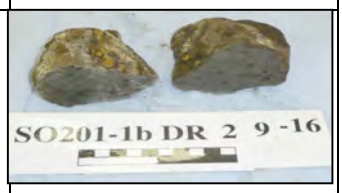
| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR28-1 | 1. Rock Type:volcanic, altered lava (block B - picture)<br>2. Size: 25x17x21<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: 5% up to 3mm<br>6. Vesicle Filling: none<br>7. Matrix Color: fresh - grey, altered - orange to yellow<br>8. Primary Minerals: hbl <8mm, 10%; pl <2mm, ca. 3%; cpx?<br>9. Secondary Minerals: FeO* - Fe(OH)*, clay min<br>10. Overall Degree of Alteration: outer part - strongly altered, inner part - appears fresh<br>11. Comment: altered from all sides (from rim toward core) by interaction with cold (?) seawater. | x | x | | | | | | | | |  |
| DR28-2 | 1. Rock Type: altered volcanic lava (block A - picture)<br>2. Size: 28x24x26<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: 5% up to 1mm<br>6. Vesicle Filling: none<br>7. Matrix Color: fresh: grey, altered: orange<br>8. Primary Minerals: hbl <4mm, 5%; plag <1mm, 5%; cpx<br>9. Secondary Minerals: FeO* - Fe(OH)*, clay min, carb?<br>10. Overall Degree of Alteration: strongly altered at rim, more fresh toward the core.<br>11. Comment: similar to 28-1 | x | | | | | | | | | |  |
| DR28-3 | 1. Rock Type: volcanic breccia (andesite ?)<br>2. Size: 13x6x10,5; andesitic clasts: 1-3cm<br>3. Shape/Angularity: subangular; clasts: subangular<br>4. Encrustations: 1-2mm Mn-crust<br>5. Vesicularity: 1-3%; matrix: <1mm; clasts: 1-3mm<br>6. Vesicle Filling: none<br>7. Matrix Color: yellowish - orange<br>8. Primary Minerals: hbl <2mm, 3%;<br>9. Secondary Minerals: FeO*<br>10. Overall Degree of Alteration: clasts: moderately; matrix: strongly altered | x | | | | | | | | | |  |
| DR28-4 | 1. Rock Type: volcanic, lava, large clast from breccia<br>2. Size: 17x8,5x13<br>3. Shape/Angularity: subrounded<br>4. Encrustations: up to 3mm Mn-crust<br>5. Vesicularity: 5%, up to 2mm<br>6. Vesicle Filling: open<br>7. Matrix Color: inner part - brown, outer part - yellow<br>8. Primary Minerals: hbl <4mm, 10-15%; pl <2mm, 5-10%<br>9. Secondary Minerals: FeO* - Fe(OH)*, carb?<br>10. Overall Degree of Alteration: strongly altered, particularly outer part<br>11. Comment: accumulation of dark fragments and minerals in outer margin (1-2cm) | x | | | | | | | | | |  |
| DR28-5 | 1. Rock Type: fragment of volcanic rock in a sponge<br>2. Size: 2x3x3<br>3. Shape/Angularity: rounded<br>4. Encrustations: mn-crust <4mm<br>5. Vesicularity: 5%, <2mm<br>6. Vesicle Filling: none<br>7. Matrix Color: inner part: brownish dark grey, outer part: yellow<br>8. Primary Minerals: px <3mm, 30%; pl 5%; cpx?<br>9. Secondary Minerals: FeO* - Fe(OH)*, carb? in outer part<br>10. Overall Degree of Alteration: inner part slightly altered<br>11. Comment: px-plag basalt | x | | | | | | | | | |  |
| DR28-6 | 1. Rock Type: volcanic breccia<br>2. Size: 11x7x10; clasts <1,5cm<br>3. Shape/Angularity: angular<br>4. Encrustations: <1mm mn-crust<br>5. Vesicularity: 5%; <1mm<br>6. Vesicle Filling: none<br>7. Matrix Color: yellow<br>8. Primary Minerals: in clasts: amph 20%; plag 10%<br>9. Secondary Minerals: FeO* - Fe(OH)*, clay min, carb?<br>10. Overall Degree of Alteration: strongly altered<br>11. Comment: light and dark bands of alteration cut clasts in breccia. | | | | | | | | | | |  |
| DR28-7 | 1. Rock Type: volcanic breccia<br>2. Size: 11,5x8x8<br>3. Shape/Angularity: angular<br>4. Encrustations: <5mm mn-crust<br>5. Vesicularity: 5-10%; <1mm<br>6. Vesicle Filling: open<br>7. Matrix Color: yellow - orange<br>8. Primary Minerals: clasts: hbl <2mm, 15%; plag <2mm, 15%; matrix +/- same composition<br>9. Secondary Minerals: FeO* - Fe(OH)*, clay min, carb?<br>10. Overall Degree of Alteration: strongly altered | | | | | | | | | | |  |

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR28-8SP | 1. Rock Type: sponge; 3 of 12 sponges taken for archive | | | | | | | | | | |  |

**SO201-1b-DR29**
**Description of Location and Structure: E-W elongated ridge (seamount), "extention" of Bowers Ridge, upper southern slope.**
Dredge on bottom UTC 24/06/09 6:52hrs, lat 54°12,14'N, long 174°25,85'E, depth 2509m
Dredge off bottom UTC 24/06/09 8:00hrs, lat 54°12,41'N, long 174°25,35'E, depth 2018m
*total volume: 1/2 full*
*Comments: altered pillows and pillow fragments, some show chilled margins*

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR29-1 | 1. Rock Type: Pillow Fragment<br>2. Size: 15x8x11<br>3. Shape/Angularity: sub rounded<br>4. Encrustations: 1 cm Mn crust<br>5. Vesicularity: 10% up to 5mm<br>6. Vesicle Filling: Green open minerneral<br>7. Matrix Color: brownish grey<br>8. Primary Minerals: Ol 10-15% up to 3 mm altered<br>9. Secondary Minerals: Calcite?<br>10. Overall Degree of Alteration: Moderate<br>11. Comment: has glassy rim | x | x | | | x | | | | | |  |
| DR29-2 | 2. Rock Type: pillow fragment<br>2. Size: 19x10x17<br>3. Shape/Angularity: sub rounded<br>4. Encrustations: none<br>5. Vesicularity: 10-15% vesicles, <6mm<br>6. Vesicle Filling: some filled with white and green min<br>7. Matrix Color: brownish grez<br>8. Primary Minerals: 10-15% Ol ca. 3 mm, altered<br>9. Secondary Minerals: calcite? glaukonite?<br>10. Overall Degree of Alteration: moderate<br>11. Comment: fresher dark sports, 8mm glassy margin, basalt | x | x | | | x | | | | | |  |
| DR29-3 | 3. Rock Type: pillow fragment<br>2. Size: 15x15x12<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: 10-15% mostlz 1-2mm<br>6. Vesicle Filling: open in the inner par, outer part filled with calcite (?)<br>7. Matrix Color: brownish grey<br>8. Primary Minerals: 15% altered Ol <6mm<br>9. Secondary Minerals: calcite?<br>10. Overall Degree of Alteration: moderate<br>11. Comment: 6mm glassy margin, pillow basalt | x | | | | x | | | | | |  |
| DR29-4 | 3. Rock Type: pillow fragment<br>2. Size: 17x15x17<br>3. Shape/Angularity: subangular, piece of cake shaped<br>4. Encrustations: 1.5 cm Mn crust<br>5. Vesicularity: 15% mostly 1-2mm, some 2.7 cm<br>6. Vesicle Filling: open in the inner par, outer part filled with calcite?<br>7. Matrix Color: brownish grey<br>8. Primary Minerals: 15% altered Ol <3mm<br>9. Secondary Minerals: calcite? glaukonite? FeO*<br>10. Overall Degree of Alteration: moderate<br>11. Comment: 6mm glassy margin, pillow basalt | x | | | | | | | | | |  |
| DR29-5 | 3. Rock Type: pillow fragment<br>2. Size: 18x9x11<br>3. Shape/Angularity: subangular<br>4. Encrustations: thin Mn crust<br>5. Vesicularity: 15% mostly 3mm, rounded<br>6. Vesicle Filling: open in the inner par, outer part f#illed with calcite?<br>7. Matrix Color: brownish grey with black spots<br>8. Primary Minerals: <5% altered Ol <2mm<br>9. Secondary Minerals: calcite? glaukonite?<br>10. Overall Degree of Alteration: low<br>11. Comment: black spots of fresher matix. | x | | | | | | | | | |  |
| DR29-6 | 3. Rock Type: pillow fragment<br>2. Size: 20x15x15<br>3. Shape/Angularity: subrounded<br>4. Encrustations: 2-3cm Mn crust<br>5. Vesicularity: 15-30% in homogenous<br>6. Vesicle Filling: open in the inner par, outer part filled with calcite?<br>7. Matrix Color: brown with black spots<br>8. Primary Minerals: 20% Ol <5mm, 1 crystal of plag 4mm<br>9. Secondary Minerals: calcite?<br>10. Overall Degree of Alteration: moderate<br>11. Comment: black spots of fresher matix, less altered | x | | | | | | | | | |  |

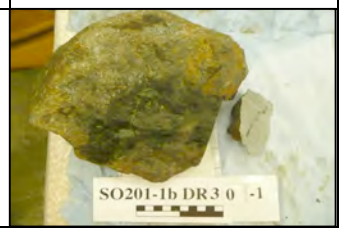
| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR29-7 | 3. Rock Type: pillow fragment<br>2. Size: 15x10x7<br>3. Shape/Angularity: piece of cake shaped<br>4. Encrustations:<5mm Mn crust<br>5. Vesicularity: 20% mostly 1mm some <1cm<br>6. Vesicle Filling: open in the inner par, outer part filled with calcite?<br>7. Matrix Color: brownis grez<br>8. Primary Minerals: 15% Ol <3mm<br>9. Secondary Minerals: calcite?<br>10. Overall Degree of Alteration: moderate<br>11. Comment: Glass | x | | | | x | | | | | |  |
| DR29-8 | 3. Rock Type: pillow fragment<br>2. Size: 15x6x8<br>3. Shape/Angularity: subrounded<br>4. Encrustations: none<br>5. Vesicularity: 30%<br>6. Vesicle Filling: mostly open some closed bz white min, calcite?<br>7. Matrix Color: brown with black spots<br>8. Primary Minerals: 15-20% Ol <5mm, plag <2% <4mm<br>9. Secondary Minerals: calcite?<br>10. Overall Degree of Alteration: moderate<br>11. Comment: black spots in matrix less altered | x | | | | | | | | | |  |
| DR29-9 | 3. Rock Type: pillow fragment<br>2. Size: 9x7x7<br>3. Shape/Angularity: apple shaped<br>4. Encrustations: 3-5cm Mn crust<br>5. Vesicularity: 30%, mostly 1mm, up to 1 cm<br>6. Vesicle Filling: mostly open some closed bz white min, calcite?<br>7. Matrix Color: greenish grez<br>8. Primary Minerals: 15 Ol <3mm<br>9. Secondary Minerals: calcite? FeO*<br>10. Overall Degree of Alteration: moderate to high<br>11. Comment: glassy rim 6mm | x | | | | x | | | | | |  |
| DR29-10 | 3. Rock Type: pillow fragment<br>2. Size: 20x10x10<br>3. Shape/Angularity: sub rounded<br>4. Encrustations: none<br>5. Vesicularity: 30%, mostly rounded <3mm, up to 1 cm<br>6. Vesicle Filling: mostly open some closed bz white min, calcite?<br>7. Matrix Color: brownish grey<br>8. Primary Minerals: 15 Ol <4mm<br>9. Secondary Minerals: calcite? clay?<br>10. Overall Degree of Alteration: moderate | x | | | | | | | | | |  |
| DR29-11 | 3. Rock Type: pillow fragment<br>2. Size: 6x11x11<br>3. Shape/Angularity: sub rounded<br>4. Encrustations: none<br>5. Vesicularity: 20%, mostly rounded <3mm<br>6. Vesicle Filling: white min, calcite?<br>7. Matrix Color: grey<br>8. Primary Minerals: 5% altered Ol <4mm<br>9. Secondary Minerals: calcite?<br>10. Overall Degree of Alteration: moderate<br>11. Comment: rind with fresh glass | | | | | x | | | | | |  |
| DR29-12 | 1. Rock Type: pillow fragment<br>2. Size: 7x15x12<br>3. Shape/Angularity: sub rounded<br>4. Encrustations: none<br>5. Vesicularity: 15%, mostly rounded <5mm<br>6. Vesicle Filling: white mud calcite?<br>7. Matrix Color: grey<br>8. Primary Minerals: 5% altered Ol <2mm<br>9. Secondary Minerals: calcite?<br>10. Overall Degree of Alteration: moderate<br>11. Comment: rind with fresh glass | | | | | x | | | | | |  |
| DR29-13 | 1. Rock Type: pillow fragment<br>2. Size: 5x10x23<br>3. Shape/Angularity: rounded<br>4. Encrustations: none<br>5. Vesicularity: 15%, mostly rounded <5mm<br>6. Vesicle Filling: calcite?<br>7. Matrix Color: grey<br>8. Primary Minerals: 5% altered Ol <2mm<br>9. Secondary Minerals: calcite?<br>10. Overall Degree of Alteration: moderate<br>11. Comment: rind with fresh glass | x | x | | | x | | | | | |  |
| DR29-14 | 1. Rock Type: pillow fragment<br>2. Size: 6x7x8<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: 20%, mostly rounded <5mm, some small frothy pockets full of vesicles<br>6. Vesicle Filling: calcite? some white mud<br>7. Matrix Color: browngrey<br>8. Primary Minerals: 12% altered Ol <4mm, 1% altered Pyx 3mm<br>9. Secondary Minerals: calcite?<br>10. Overall Degree of Alteration: moderate<br>11. Comment: rind with fresh glass | | | | | x | | | | | |  |

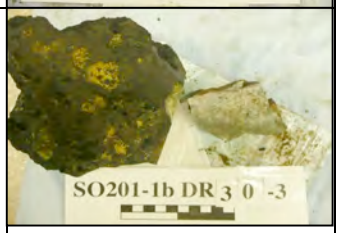
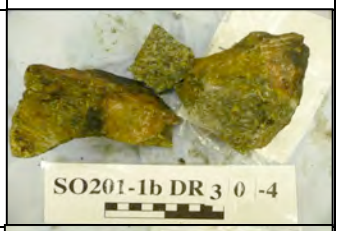
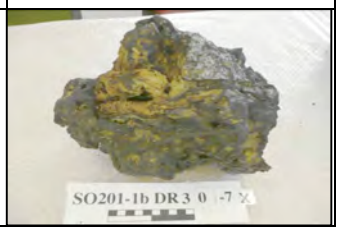
| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR29-15 | 1. Rock Type: pillow fragment<br>2. Size: 6x9x10<br>3. Shape/Angularity: rounded<br>4. Encrustations: 2mm Mn crust<br>5. Vesicularity: 10%, mostly rounded 1-2mm some frothy pockets<br>6. Vesicle Filling: calcite? Fe Oxide, sulfides?<br>7. Matrix Color: grey<br>8. Primary Minerals: 8% altered Ol 3mm, Pyx? 1%<br>9. Secondary Minerals: calcite?<br>10. Overall Degree of Alteration: moderate<br>11. Comment: rind with fresh glass | | | | | x | | | | | |  |
| DR29-16 | 1. Rock Type: pillow fragment<br>2. Size: 6x7x13<br>3. Shape/Angularity: sub angular<br>4. Encrustations: none<br>5. Vesicularity: 20%, rounded 5mm<br>6. Vesicle Filling: calcite?<br>7. Matrix Color: grey<br>8. Primary Minerals: 6% altered Ol 4mm, Plag 1% to 2mm, Pyx? 1mm<br>9. Secondary Minerals: calcite?<br>10. Overall Degree of Alteration: moderate<br>11. Comment: rind with fresh glass | | | | | x | | | | | |  |
| DR29-17 | 1. Rock Type: dolerite<br>2. Size: 5x9x15<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: none<br>6. Vesicle Filling: -<br>7. Matrix Color: dark grey<br>8. Primary Minerals: plag to 7mm 3%<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: low<br>11. Comment: could be weaklz metamorphosed | x | | | | | | | | | |  |
| DR29-18 | 1. Rock Type: dolerite<br>2. Size: 5x8x18<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: none<br>6. Vesicle Filling: -<br>7. Matrix Color: dark grey<br>8. Primary Minerals: hornblende 1mm 9%<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: low<br>11. Comment: | x | | | | | | | | | |  |
| DR29-19M | layered Mn crust 8x8x11 | | | | | | | | | x | |  |
| DR29-20M | layered Mn crust 8x11x17 | | | | | | | | | x | |  |

**SO201-1b-DR30**

**Description of Location and Structure: Second Smnt W of Bowers Ridge; NE-SW striking ridge with steep flanks. SE facing flank . The main part of the Smnt lies 4nm further West**

Dredge on bottom UTC 24/06/09 16:00hrs, lat 54°00,25'N, long 172°56,57'E, depth 3107m
Dredge off bottom UTC 24/06/09 17:35hrs, lat 54°00,78'N, long 172°56,13'E, depth 2527m
*total volume: half full*
*Comments: mostly Mn crust. A few igneous rocks (mostly granitic) are found as cemented breccia clasts within the Mn crusts*

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR30-1 | 1. Rock Type: subvolcanic rock, dolerite<br>2. Size: 47x15x34cm<br>3. Shape/Angularity: subangular<br>4. Encrustations: Fe-Mn crust, thickness 18cm<br>5. Vesicularity: dense<br>7. Matrix Color: greenish-grey<br>8. Primary Minerals: Amphibole (Actinolite?), 30%<br>10. Overall Degree of Alteration: possibly low green shist facies conditions<br>11. Comment: after first impresssion - is a typical diabasic rock, most likely **DROPSTONE**! | x | x | | | | | | | | |  |

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR30-2 | 1. Rock Type: Ol-phyric basalt<br>2. Size: 5x87x7<br>3. Shape/Angularity: angular<br>4. Encrustations: no encrustations<br>5. Vesicularity: non-vesicular<br>7. Matrix Color: grey<br>8. Primary Minerals: Ol altered, 15%; Px altered, 5%<br>9. Secondary Minerals: Iddingsite like phase or Hydroxide + CC after Ol and Cpx<br>10. Overall Degree of Alteration: moderate<br>11. Comment: maybe this rock is similar to pillow basalts from DR29, most likely **DROPSTONE!** | x | x | | | | | | | | |  |
| DR30-3 | 1. Rock Type: Plagiogneiss<br>2. Size: 24x18x22<br>3. Shape/Angularity: angular fragment in thick Mn-crust<br>4. Encrustations: Fe-Mn crust, 7-10cm<br>7. Matrix Color: light grey<br>8. Primary Minerals: Plag 70%, Phlogopite 10%, Amph 10, Qz 10-20%<br>11. Comment: A lot of angular fragments of these plutonic rocks were found within Fe-Mn crusts as inclusions. These granodiorite-gneissic rocks are characterized by large variations in textures and color which are typical for plutonic complexes. It is puzzling that the all hardrocks recovered from within the Mn crust belong to this gneissic lithology. This may suggest that they are a tallus deposit originating from that ridge. | x | | | | | | | | | |  |
| DR30-4 | 1. Rock Type: granite-gneiss<br>2. Size: 15x10x5<br>3. Shape/Angularity: angular<br>7. Matrix Color: grey<br>8. Primary Minerals: Plag 80%, Qz 10%, Phlogopite 10%<br>9. Secondary Minerals: possibly serecite after plag | x | | | | | | | | | |  |
| DR30-5 | 1. Rock Type: plagiogneiss<br>2. Size: 10x5x5cm<br>3. Shape/Angularity: angular<br>7. Matrix Color: pale grey<br>8. Primary Minerals: Plag 50%, Qz 10%, Amph 40%<br>11. Comment: Typical Plagio-Gneiss | x | | | | | | | | | |  |
| DR30-6 | 1. Rock Type: Mn-crust<br>2. Size: 20x10x15<br>7. Matrix Color: black<br>8. Primary Minerals:<br>11. Comment: thivk Mn crusts are a typical feature of DR30: most rocks recoverd are covered by such crusts | | | | | | | | | | |  |
| DR30-1M | 1. Rock Type: Mn crust from sample -1<br>2. Size: 20x15x18<br>7. Matrix Color: black<br>11. Comment: sample no. sould be changed to -8M | | | | | | | | | x | | |
| DR30-7X | 1. Rock Type: Mn encrusted, angular granitic clasts. Saved to document how the granitic rocks of this dredge were found | | | | | | x | | | | |  |

**SO201-1b-DR31**

**Description of Location and Structure: Seamount W of Bowers Ridge. 3nm SW of DR30 at S facing slope of main structure which is oval-shaped along an E-W axis**

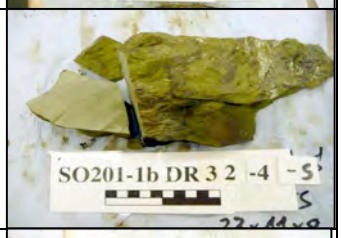
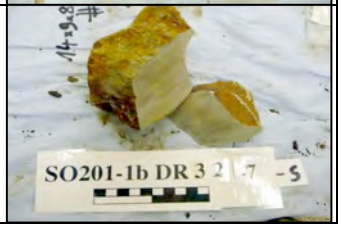
Dredge on bottom UTC 24/06/09 20:59hrs, lat 53°58,30'N, long 172°51,24'E, depth 3236m

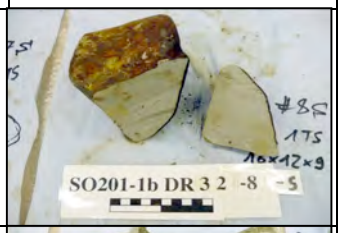
Dredge off bottom UTC 24/06/09 22:18hrs, lat 53°58,65'N, long 172°51,28'E, depth 2895m

*total volume: empty; single piece of partially consolidated sediment fragment*

*Comments: Site has been choosen because DR30 gave ambigous results in terms of the insitu origin of the granitic rocks*

**SO201-1b-DR32**
**Description of Location and Structure: 3rd Smnt W of Bowers Ridge; top region of the plateau has been dredged along NE facing slope**
Dredge on bottom UTC 25/06/09 05:50hrs, lat 54°02,25'N, long 171°36,92'E, depth 2383m
Dredge off bottom UTC 25/06/09 06:57hrs, lat 54°01,80'N, long 171°36,41'E, depth 2172m
*total volume: 3/4 full*
*Comments: organics, dropstones, 9 large blocks*

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR32-1 | 1. Rock Type: breccia with basalt clasts (block D)<br>2. Size: 20x15x16<br>3. Shape/Angularity: subnagular<br>4. Encrustations: up to 1cm Mn crust<br>5. Vesicularity: none<br>6. Vesicle Filling: none<br>7. Matrix Color: greenish brown<br>8. Primary Minerals: Ol 5%, <1mm: plag 5% up to 2mm (basalt clasts only)<br>9. Secondary Minerals: pyrite in basalt<br>10. Overall Degree of Alteration: slight to moderate<br>11. Comment: basalt clasts are up to 2x2cm in size an subrounded | x | | | | | | | | | |  |
| DR32-2S | 1. Rock Type: sediment<br>2. Size: 24x14x12cm<br>3. Shape/Angularity: sub-rounded<br>4. Encrustations: up to 5mm Mn crust<br>5. Vesicularity: none<br>7. Matrix Color: light brown<br>10. Overall Degree of Alteration: slight to moderate<br>11. Comment: possibly clastic / carbonate mix rock | x | | | | | | | x | | |  |
| DR32-3S | 1. Rock Type: matamorphosed sedimentary rock<br>2. Size: 21x19x9<br>3. Shape/Angularity: subangular<br>4. Encrustations: up to 5mm<br>7. Matrix Color: dark green/grey<br>9. Secondary Minerals: epidote?<br>10. Overall Degree of Alteration: fresh | x | | | | | | | x | | |  |
| DR32-4S | 1. Rock Type: volcanic tuff, slightly metamorphic (block A)<br>2. Size: 23x11x18<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: none<br>7. Matrix Color: green<br>9. Secondary Minerals: epidote, chlorite<br>10. Overall Degree of Alteration: fresh<br>11. Comment: green shist facies? | x | | | | | | | x | | |  |
| DR32-5S | 1. Rock Type: volcanic tuff<br>2. Size: 19x9x13<br>3. Shape/Angularity: subangular<br>4. Encrustations: up to 5mm Mn crust<br>5. Vesicularity: none<br>6. Vesicle Filling: none<br>7. Matrix Color: light brown / green<br>10. Overall Degree of Alteration: slight | x | | | | | | | x | | |  |
| DR32-6S | 1. Rock Type: dolerite (?)<br>2. Size: 16x12x9<br>3. Shape/Angularity: subangular<br>4. Encrustations: up to 4mm Mn crust<br>7. Matrix Color: grey<br>10. Overall Degree of Alteration: slight | x | | | | | | | | | |  |
| DR32-7S | 1. Rock Type: volcanic tuff / sedimentary<br>2. Size: 14x9x8<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: none<br>7. Matrix Color: light brown<br>10. Overall Degree of Alteration: fresh<br>11. Comment: finer grained material in cut of rock grading to coarser grained on outsides | x | | | | | | | x | | |  |

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR32-8S | 1. Rock Type: diabase<br>2. Size: 16x12x9<br>3. Shape/Angularity: subangular<br>4. Encrustations: up to 2mm<br>5. Vesicularity: none<br>7. Matrix Color: greenish grey<br>8. Primary Minerals: Ol 10%, <2mm; Plag 10%, <2mm; Px <4%, <4mm<br>10. Overall Degree of Alteration: moderate | x | | | | | | | | | |  |
| DR32-9X | 1. Rock Type: 30x30x25 gabbro with Px and Plag, angular no encrustations (Block B). | x | | | | | x | | | | |  |
| DR32-10X | 1. Rock Type: 25x17x18 diabase with Plag, subangular, no encrustations, moderate alteration (Block I) | x | | | | | x | | | | |  |
| DR32-11X | 1. Rock Type: 30x28x23 gabbro with Px, Plag and Ol subangular no encrustations (Block C) | x | | | | | x | | | | |  |
| DR32-12X | 1. Rock Type: 40x26x28 basalt with Xenoliths (up to 2x3cm), subrounded. Vesuculated, with Plag and Ol phenocrysts (Block F). | x | | | | | x | | | | |  |
| DR32-13X | 1. Rock Type: 6x6x10 basalt with Plag, Ol and Px, subangular no encrustations, no vesicles | x | | | | | x | | | | |  |
| DR32-14X | 1. Rock Type: 40x23x23 subrounded dacite with abundant plag phenocrysts (up to 2x2mm) no encrustations. (Block E). | x | | | | | x | | | | |  |
| DR32-15X | 1. Rock Type: 20x14x12 diabase, no encrustations, no vesicles, subangular | x | | | | | x | | | | |  |

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR32-16X | 1. Rock Type: 40x30x30 granite with Amph and Plag, subrounded; Mn encrustation up to 1cm (Block H). | x | | | | | x | | | | |   |
| DR32-17X | 1. Rock Type: 30x30x20 granite with Plag, Amph and biotite, subrounded encrustations up to 1mm<br>11. Photo does not show sampled archive half | x | | | | | x | | | | |   |

**SO201-1b-DR33**

**Description of Location and Structure: West of Attu Island, Aleutian Arc. Small cone located 4nm NE of main ridge like structure. This is the largest ( 350m high, 1.4km diameter) of 3 cones in the area**

Dredge on bottom UTC 26/06/09 23:36hrs, lat 53°39,13'N, long 171°38,59'E, depth 3778m

Dredge off bottom UTC 26/06/09 0:31hrs, lat 53°38,88'N, long 171°38,10'E, depth 3457m

*total volume: 1 rock*

*Comments: 1 subangular stone covered with thin Fe-Mn crust*

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR33-1 | 1. Rock Type: dense glassy lava (?)<br>2. Size: 12x9x6<br>3. Shape/Angularity: subangular<br>4. Encrustations: thin Fe-Mn crust < 1mm<br>5. Vesicularity: < 30%<br>6. Vesicle Filling: filled with zeolithes(?) on the walls<br>7. Matrix Color: dark grey to black<br>8. Primary Minerals: none<br>9. Secondary Minerals: on vesiculare walls<br>10. Overall Degree of Alteration: glassy margin is fresh, secondary minerals occur in voids, degree of alteration low<br>11. Comment: this rock can be andesite or dacite, noticeable is slight plate-joining, suggesting (sub) alkalic composition | x | x | | | | | | | | USC: 1x GC+TS |   |

**SO201-1b-DR34**

**Description of Location and Structure: West of Attu Island, Aleutian Arc. Small cone 1nm SE of previous site. Second largest cone in the area, 150m high approx 500m base diameter**

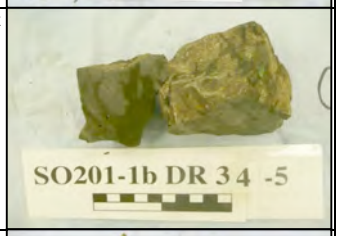
Dredge on bottom UTC 26/06/09 03:35hrs, lat 53°37,36'N, long 171°40,93'E, depth 3806m

Dredge off bottom UTC 26/06/09 4:32hrs, lat 53°37,42'N, long 171°40,18'E, depth 3569m

*total volume: about 20 rocks*

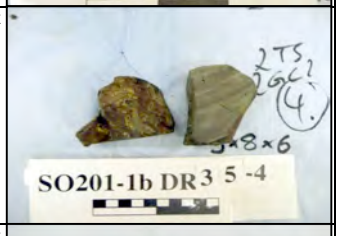
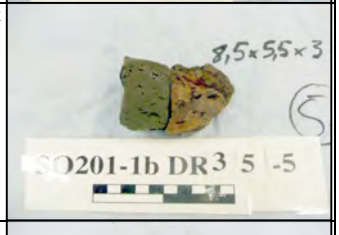
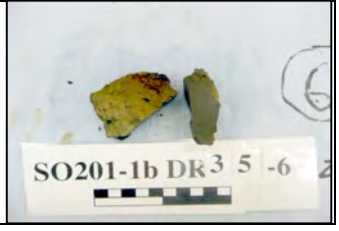
*Comments: homogeneous basalt, no manganese crust, angular clasts, fresh volcanics, no dropstones*

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR34-1 | 1. Rock Type: aphyric lava, massiv<br>2. Size: 18x15x18<br>3. Shape/Angularity: subangular<br>4. Encrustations:<br>5. Vesicularity: 10% subangular<br>6. Vesicle Filling: none<br>7. Matrix Color: grey-brownish<br>8. Primary Minerals: plag <5%, <4mm, cpx< 2%, <2mm<br>9. Secondary Minerals:<br>10. Overall Degree of Alteration: almost fresh´<br>11. Comment: basalt | x | x | | | | | | | | USC: 1x GC+TS |   |
| DR34-2 | 1. Rock Type: aphyric lava, massiv<br>2. Size: 12x9x14<br>3. Shape/Angularity: subangular<br>4. Encrustations: Mn-crust <1mm<br>5. Vesicularity: 30% elongated along planes, < 8mm<br>6. Vesicle Filling: none<br>7. Matrix Color: brownish- grey<br>8. Primary Minerals: plag, < 3% <3mm, cpx <2% <2mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: low<br>11. Comment: basalt | x | x | | | | | | | | USC: 1x GC+TS |   |
| DR34-3 | 1. Rock Type: aphyric lava, massive<br>2. Size: 8x8x4<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: 40% elongated along planes, <8 mm<br>6. Vesicle Filling: none<br>7. Matrix Color: brownish-grey<br>8. Primary Minerals: pl<3% <2mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: low<br>11. Comment: basalt -? | x | x | | | | | | | | USC: 1x GC+TS |   |

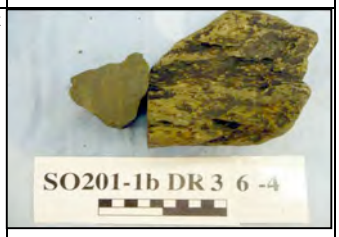
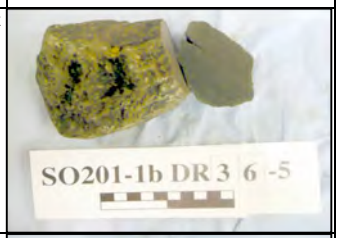
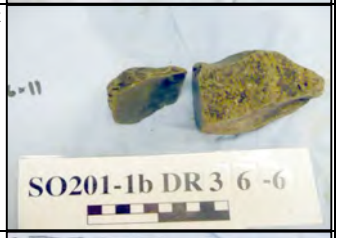
| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR34-4 | 1. Rock Type: aphyric lava, massiv<br>2. Size: 14x5x6<br>3. Shape/Angularity: subangular<br>4. Encrustations: Mn-crust <1mm<br>5. Vesicularity: 30% <1cm inhomogeneous spread<br>6. Vesicle Filling: none<br>7. Matrix Color: brownish-grey<br>8. Primary Minerals: pl 3% <1mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: almost fresh<br>11. Comment: basalt -? | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR34-5 | 1. Rock Type: aphyric lava, massive<br>2. Size: 12x8x8<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: 15-20%, very inhomogeneous<br>6. Vesicle Filling: none<br>7. Matrix Color: brownish-grey<br>8. Primary Minerals: pl<3% <1.5 mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: low<br>11. Comment: light grey felsic (?) xenoliths (<=1 cm) | x | | | | | | | | | USC: 1x TS |  |
| DR34-6 | 1. Rock Type: aphyric lava, massiv<br>2. Size: 11x7x7<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: 15% subrounded <1mm, few large ones <=3 cm.<br>6. Vesicle Filling: open<br>7. Matrix Color: brownish-grey<br>8. Primary Minerals: pl<3% <2mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: low | x | | | | | | | | | USC: 1x TS |  |
| DR34-7 | 1. Rock Type: aphyric lava, massive<br>2. Size: 8x8x5 cm<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: ca. 15% <=1.5 mm<br>6. Vesicle Filling: open<br>7. Matrix Color: brownish-grey<br>8. Primary Minerals: pl<3% <3mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: almost fresh | x | | | | | | | | | USC: 1x TS |  |
| DR34-8 | 1. Rock Type: aphyric lava, massive<br>2. Size: 8x6x7 cm<br>3. Shape/Angularity: angular<br>4. Encrustations: Mn-crust <1mm<br>5. Vesicularity: ca. 15% inhomogeneous, <=8 mm<br>6. Vesicle Filling: none<br>7. Matrix Color: brownish-grey<br>8. Primary Minerals: pl <2%, <1mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: almost fresh | x | | | | | | | | | USC: 1x TS |  |
| DR34-9 | 1. Rock Type: aphyric lava, massive<br>2. Size: 5.5x10x3 cm<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: ca. 15%, < 1mm<br>6. Vesicle Filling: none<br>7. Matrix Color: brownish-grey<br>8. Primary Minerals: pl <3%, <1mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: almost fresh | x | | | | | | | | | USC: 1x TS |  |
| DR34-10 | 1. Rock Type: aphyric lava, massive<br>2. Size: 5x6x8 cm<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: 15 %, inhomogenous, < 1 cm<br>6. Vesicle Filling: none<br>7. Matrix Color: brownish grey<br>8. Primary Minerals: pl < 3 %, < 2 mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: low<br>11. Comment: basalt | x | | | | | | | | | USC: 1x TS |  |
| DR34-11 | 1. Rock Type: aphyric lava, massive<br>2. Size: 6x9.5x10 cm<br>3. Shape/Angularity: angular<br>4. Encrustations: Mn-crust << 1 cm<br>5. Vesicularity: 15 %, mostly elongated < 2 mm, some larger are < 1 cm<br>6. Vesicle Filling: none<br>7. Matrix Color: brownish grey<br>8. Primary Minerals: pl < 2 %, < 1 mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: almost fresh<br>11. Comment: basalt | x | | | | | | | | | USC: 1x TS |  |

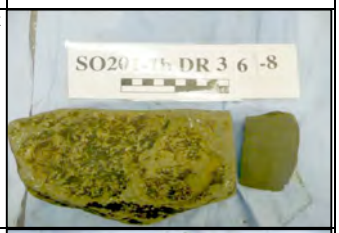
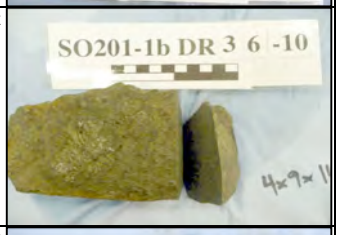
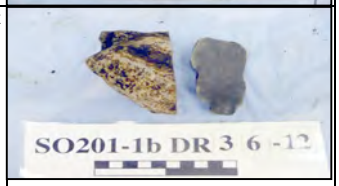
| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR34 - 12-20 | similar to all other samples, but smaller; all in one plastic bag | | | | | | | | | | |   |

**SO201-1b-DR35**
**Description of Location and Structure: West of Attu Island, Aleutian Arc. Small cone located 4nm NE of main ridge like structure. 2nd attempt at this cone after DR33.**
Dredge on bottom UTC 26/06/09 07:44hrs, lat 53°38,92'N, long 171°38,71'E, depth 3730m
Dredge off bottom UTC 26/06/09 08:55hrs, lat 53°38,92'N, long 171°38,04'E, depth 3457m
*total volume: 1x large bloc, 5x small blocs*
*Comments:*

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR35-1 | 1. Rock Type: volcanic<br>2. Size: 34x18x23<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: 8% sub mm, angular shape<br>6. Vesicle Filling: none<br>7. Matrix Color: grey<br>8. Primary Minerals: 10-15% Hbl, almost mircophenocrystic in size; up to 5mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: very fresh<br>11. Comment: some white plag like inclusions up to 2cm, likely xenocrystic | x | x | | | | x | | | | USC: 1x GC+TS |   |
| DR35-2 | 1. Rock Type: volcanic<br>2. Size: 20x30x9<br>3. Shape/Angularity: subrounded<br>4. Encrustations: none<br>5. Vesicularity: 5% angular vesicles up to 2cm<br>6. Vesicle Filling: none<br>7. Matrix Color: grey<br>8. Primary Minerals: Plag 2%, Hbl microphenocrysts, Cpx?<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: low<br>11. Comment: almost completely aphyric | x | x | | | | | | | | USC: 1x GC+TS |   |
| DR35-3 | 1. Rock Type: volcanic<br>2. Size: 14x10x8<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: 15% angular vesicles, sub mm, some elongate clusters<br>6. Vesicle Filling: none<br>7. Matrix Color: grey<br>8. Primary Minerals: Hbl 10% up to 3mm long, needle shape<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none | x | x | | | | | | | | USC: 1x GC+TS |   |
| DR35-4 | 1. Rock Type: volcanic<br>2. Size: 9x8x6<br>3. Shape/Angularity: subrounded<br>4. Encrustations: none<br>5. Vesicularity: 5% angular vesicles, sometimes clustered to 2cm<br>6. Vesicle Filling: none<br>7. Matrix Color: grey<br>8. Primary Minerals: almost completely aphyric, <1% Plag, 2mm; Cpx?<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none | x | x | | | | | | | | USC: 1x GC+TS |   |
| DR35-5 | 1. Rock Type: volcanic<br>2. Size: 9x6x3<br>3. Shape/Angularity: subrounded<br>4. Encrustations: none<br>5. Vesicularity: 10% angular vesicles up to 1cm<br>6. Vesicle Filling: none<br>7. Matrix Color: grey<br>8. Primary Minerals: almost completely aphyric, <1% Plag<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none | | x | | | | | | | | USC: 1x GC |   |
| DR35-6 | 1. Rock Type: volcanic<br>2. Size: 17x5x2<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: 11% sub mm, angular vesicles<br>6. Vesicle Filling: none<br>7. Matrix Color: grey<br>8. Primary Minerals: 13% Hbl, 2mm long; <1% Plag<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: none<br>11. Comment: 1mm white plag like inclusion, different from primary plag | | | | | | | | | | |   |

**SO201-1b-DR36**
**Description of Location and Structure: West of Attu Island, Aleutian Arc. Large (3x4 km) cone surrounded by several satellite cones.**
**Main edifice eastern slope, from middle to top.**
Dredge on bottom UTC 26/06/09 14:21hrs, lat 53°28,56'N, long 171°57,39'E, depth 3187m
Dredge off bottom UTC 26/06/09 15:32hrs, lat 53°28,81'N, long 171°57,25'E, depth 2829m
*total volume: 1/6 full; two large blocks with platy appearance*
*Comments: Dacites with banded texture of glassy and pumice layers*

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR36-1 | 1. Rock Type: felsic volcanic<br>2. Size: 25x28x22<br>3. Shape/Angularity: subrounded<br>4. Encrustations: none<br>5. Vesicularity: total 10% of rock is flow banded; 0% vesicles in dense parts, up to 35% in degassed parts<br>6. Vesicle Filling: none<br>7. Matrix Color: grey, brown, tan (depending on band)<br>8. Primary Minerals: <1% phenocrysts, Plag, Hbl, Px? all sub mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh<br>11. Comment: Alternating bands of pumice and glassy matrix; occassional black (andestic?) inclusions up to 2mm | x | x | | | | x | | | | USC: 1x GC+TS |  |
| DR36-2 | 1. Rock Type: felsic volcanic<br>2. Size: 63x52x25<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: total 10% of rock consists of alternating flow bands of pumice + glassy matrix, pumice has 30% vesicles<br>6. Vesicle Filling: none<br>7. Matrix Color: grey-brown<br>8. Primary Minerals: <1% phenocrysts of Plag, Hbl, Px? all sub mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh<br>11. Comment: similarly to sample -1 contains andesite inclusions | x | x | | | | | x | | | USC: 1x GC+TS |  |
| DR36-3 | 1. Rock Type: felsic volcanic<br>2. Size: 8x9x16<br>3. Shape/Angularity: subrounded<br>4. Encrustations: none<br>5. Vesicularity: total 10%, flow bands of pumice + glassy matrix, up to 40% vesicles<br>6. Vesicle Filling: none<br>7. Matrix Color: grey-brown-tan<br>8. Primary Minerals: 5-10% phenocrysts, mostly of Plag, Hbl, Px? all sub mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh<br>11. Comment: similarly to sample -1 contains andesite inclusions | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR36-4 | 1. Rock Type: felsic volcanic<br>2. Size: 7x10x14<br>3. Shape/Angularity: subrounded<br>4. Encrustations: none<br>5. Vesicularity: total 15%, flowbands of glassy matrix and pumice + up to 40% vesicles<br>6. Vesicle Filling: none<br>7. Matrix Color: grey-brown-tan<br>8. Primary Minerals: 5-10% phenocrysts, mostly microphenocrysts of Plag, Hbl, Qz? all sub mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR36-5 | 1. Rock Type: volcanic<br>2. Size: 5x9x14<br>3. Shape/Angularity: subrounded<br>4. Encrustations: none<br>5. Vesicularity: 15% angular vesicles<br>6. Vesicle Filling: none<br>7. Matrix Color: dark grey<br>8. Primary Minerals: mostly aphyric, Plag + Hbl up to 1mm, 5%<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh<br>11. Comment: might be more mafic than sample -1 to -4 | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR36-6 | 1. Rock Type: volcanic<br>2. Size: 4x6x11<br>3. Shape/Angularity: subrounded<br>4. Encrustations: none<br>5. Vesicularity: 10% angular vesicles<br>6. Vesicle Filling: none<br>7. Matrix Color: dark grey<br>8. Primary Minerals: fairly aphyric, 5% Plag + other crystals up to 2mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh<br>11. Comment: same lithology as sample -5 | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR36-7 | 1. Rock Type: volcanic<br>2. Size: 5x6x7<br>3. Shape/Angularity: subrounded<br>4. Encrustations: none<br>5. Vesicularity: 10% micro vesicles<br>6. Vesicle Filling: none<br>7. Matrix Color: grey<br>8. Primary Minerals: microphenocrysts of Plag, Px and Hbl<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh | | x | | | | | | | | USC: 1x GC+TS |  |

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR36-8 | 1. Rock Type: volcanic<br>2. Size: 4x11x22<br>3. Shape/Angularity: subrounded<br>4. Encrustations: none<br>5. Vesicularity: 5% angular vesicles, sub mm<br>6. Vesicle Filling: none<br>7. Matrix Color: grey<br>8. Primary Minerals: microphenocrysts of Plag and Hbl<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh<br>11. Comment: different from -7; small plag cluster, slight banding visible | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR36-9 | 1. Rock Type: felsic volcanic<br>2. Size: 3x7x12<br>3. Shape/Angularity: subrounded<br>4. Encrustations: none<br>5. Vesicularity: 5% angular vesicles, sub mm<br>6. Vesicle Filling: none<br>7. Matrix Color: grey<br>8. Primary Minerals: microphenocrysts of Plag and Hbl<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh<br>11. Comment: similar to -8, 2 small andesite or mafic inclusions | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR36-10 | 1. Rock Type: volcanic<br>2. Size: 4x9x16<br>3. Shape/Angularity: subrounded<br>4. Encrustations: none<br>5. Vesicularity: 10% angular vesicles, sub mm<br>6. Vesicle Filling: none<br>7. Matrix Color: grey<br>8. Primary Minerals: microphenocrysts of Plag and Hbl<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh<br>11. Comment: similar to -8 and -9, slight banding visible | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR36-11 | 1. Rock Type: volcanic<br>2. Size: 2x6x9<br>3. Shape/Angularity: rounded<br>4. Encrustations: none<br>5. Vesicularity: 1% sub mm vesicles<br>6. Vesicle Filling: none<br>7. Matrix Color: grey<br>8. Primary Minerals: microphenocrysts of Plag, Px and Hbl<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh<br>11. Comment: different from -8, -9 and -10 | | x | | | | | | | | USC: 1x GC+TS |  |
| DR36-12 | 1. Rock Type: volcanic<br>2. Size: 4x7x8<br>3. Shape/Angularity: subrounded<br>4. Encrustations: none<br>5. Vesicularity: total 1%, some pumice bands, 1mm<br>6. Vesicle Filling: none<br>7. Matrix Color: grey-brown<br>8. Primary Minerals: microphenocrysts of Plag and Hbl<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh<br>11. Comment: similar to -11, thinner pumice bands more glassy layers | x | x | | | | | | | | USC: 1x GC+TS |  |
| DR36-13X | 1. Rock Type: several small pieces of dacite clasts, cut into half | | | | | | x | | | | | |
| DR36-14 | 1. Rock Type: volcanic<br>2. Size: 7x6x4<br>3. Shape/Angularity: subrounded<br>4. Encrustations: none<br>5. Vesicularity: overall 5%, in fine pumice bands up to 30%<br>6. Vesicle Filling: none<br>7. Matrix Color: grey-brown<br>8. Primary Minerals: microphenocrysts of Plag and Hbl<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: fresh<br>11. Comment: flow banding felsic, cm sized amfic xenoliths up to 5cm with 1.5 cm sized Plag crystals | x | x | | | | | | | | |  |

**SO201-1b-DR37**
**Description of Location and Structure: Stalemate Fracture Zone, Seamount at the NE-margin of the FZ, central part of NE-slope**
Dredge on bottom UTC 27/06/09 05:06hrs, lat 51°16,66'N, long 169°48,88'E, depth 4360m
Dredge off bottom UTC 27/06/09 06:17hrs, lat 51°16,28'N, long 169°48,51'E, depth 3955m
*total volume: few rocks, 1 large rock*
*Comments: highly altered ultramafic rocks, few basaltic dropstones, few Mn-crusts with fragmented rocks included*

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR37-1 | 1. Rock Type: ultramafic rock; serpentinized dunite?<br>2. Size: 29x19x13<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: 5% vesicles < 1mm (alteration feature of a plutonic rock ?)<br>6. Vesicle Filling: mostly open, some are filled with white material, CC?<br>7. Matrix Color: yellow to light brown<br>8. Primary Minerals: > 90% serpentinite matrix, < 3% Cpx < 1cm, possibly spinel<br>9. Secondary Minerals: CC?, clay minerals<br>10. Overall Degree of Alteration: extremely high<br>11. Comment: altered dunite (?); outer 5mm extremely weathered | x | | | | | | | | | | |  |

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR37-2 | 1. Rock Type: ultramafic rock<br>2. Size: 19x14x9<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: 5-10%, <4mm growing along planes or lineaments<br>6. Vesicle Filling: none<br>7. Matrix Color: yello-brown<br>8. Primary Minerals: 95% serpentin, < 2% spinel?, <2mm<br>9. Secondary Minerals: slong fractures, CC and clay minerals<br>10. Overall Degree of Alteration: very high<br>11. Comment: serpentinized dunite with 1cm thick weathering rind | x | | | | | | | | | |  |
| DR37-3 | 1. Rock Type: ultramafic rock<br>2. Size: 9x7x8<br>3. Shape/Angularity: angular weathered surface<br>4. Encrustations: none<br>5. Vesicularity: <2%, <1mm<br>6. Vesicle Filling: none<br>7. Matrix Color: yellow to brown<br>8. Primary Minerals: > 95% serpentinite (matrix), 3% spinel, <3mm<br>9. Secondary Minerals: clay minerals, carbonate<br>10. Overall Degree of Alteration: very high<br>11. Comment: serpentinized dunite | x | | | | | | | | | |  |
| DR37-4 | 1. Rock Type: ultramafic rock<br>2. Size: 13x9x7<br>3. Shape/Angularity: angular weathered surface<br>4. Encrustations: none<br>5. Vesicularity: none<br>7. Matrix Color: orange to brown<br>8. Primary Minerals: > 95% serpentinite (matrix), 3% spinel, <3mm<br>9. Secondary Minerals: clay minerals, carbonate<br>10. Overall Degree of Alteration: very high, outer part completely altered, inner part highly altered<br>11. Comment: serpentinized dunite | x | | | | | | | | | |  |
| DR37-5 | 1. Rock Type: ultramafic rock<br>2. Size: 12x9x9<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: none<br>7. Matrix Color: yellowish-green<br>8. Primary Minerals: 15% altered Opx <1.5cm; <5% Cpx <1.5cm; <2% Spinel; 75% Serpentine<br>9. Secondary Minerals: minor Mn fillings along fractures<br>10. Overall Degree of Alteration: strongly altered<br>11. Comment: serpentinized harzburgite | x | | | | | | | | | |  |
| DR37-6 | 1. Rock Type: ultramafic rock<br>2. Size: 13x8x12<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: none<br>7. Matrix Color: brownish-yellow<br>8. Primary Minerals: 10% Opx <7mm; 2% Cpx <3mm; 2% Spinel <2mm; 85% Serpentine<br>10. Overall Degree of Alteration: strong<br>11. Comment: serpentinized harzburgite | x | | | | | | | | | |  |
| DR37-7 | 1. Rock Type: ultramafic rock, recovered as clast from Mn crust<br>2. Size: 11x13x8<br>3. Shape/Angularity: subrounded<br>4. Encrustations: >4cm Mn crust<br>5. Vesicularity: none<br>6. Vesicle Filling: none<br>7. Matrix Color: greenish yellow<br>8. Primary Minerals: 10% Opx <8mm; <5% Cpx <5mm, <2% Spinel <2mm<br>10. Overall Degree of Alteration: moderate<br>11. Comment: serpentinized harzburgite, groundmass altered to serpentinite <80% | x | | | | | | | | | |  |
| DR37-8 | 1. Rock Type: ultramafic rock<br>2. Size: 11x7x5<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: none<br>7. Matrix Color: orange to brown<br>10. Overall Degree of Alteration: strongly serpentinized peridotite<br>11. Comment: layered texture, 1cm thick layer of altered green material, 3cm of brown orange layer, 5cm of maybe glassy dark layer with dark filled fractures | x | | | | | | | | | |  |
| DR37-9 | 1. Rock Type: ultramafic rock<br>2. Size: 10x9x8<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: none<br>6. Vesicle Filling: none<br>7. Matrix Color: yellow-green-brown<br>8. Primary Minerals: 10% Opx <1cm: 15% Cpx <4mm, <2% Spinel <2mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: serpentinized lherzolith, Mn filling along fractures | x | | | | | | | | | |  |

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR37-10 | 1. Rock Type: ultramafic rock<br>2. Size: 9x8x8<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: <5% <2mm<br>6. Vesicle Filling: none<br>7. Matrix Color: green-yellowish<br>8. Primary Minerals: 8% Opx <8mm; 10-15% Cpx <4mm; <1% Spinel <1mm<br>9. Secondary Minerals: serpentine veins 3cm long<br>10. Overall Degree of Alteration: strong<br>11. Comment: serpentinized lherzolith; Mn fillings along fractures | x | | | | | | | | | |  |
| DR37-11 | 1. Rock Type: ultramafic rock<br>2. Size: 6y7x8<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: 5%, <2mm<br>6. Vesicle Filling: none<br>7. Matrix Color: greenish-yellow/orange<br>8. Primary Minerals: 10% Opx <5mm; 15% Cpx <5mm<br>9. Secondary Minerals: serpentine<br>10. Overall Degree of Alteration: strong<br>11. Comment: altered lherzolith | x | | | | | | | | | |  |
| DR11-12 | 1. Rock Type: ultramafic rock<br>2. Size: 8x6x4cm<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: 5%, <1mm<br>6. Vesicle Filling: none<br>7. Matrix Color: greenish-yellow/orange<br>8. Primary Minerals: 10% Opx up to 5mm; 10% Cpx up to 5mm; 1-2% Spinel up to 2mm<br>9. Secondary Minerals: serpentine<br>10. Overall Degree of Alteration: strong<br>11. Comment: lherzolith | x | | | | | | | | | |  |
| DR37-13 | 1. Rock Type: ultramafic rock<br>2. Size: 10x8x5cm<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: 5%, <1mm<br>6. Vesicle Filling: none<br>7. Matrix Color: greenish-yellow/orange<br>8. Primary Minerals: 5-10% Opx up to 5mm; 5% Cpx up to 4mm; 1-2% Spinel up to 2mm<br>9. Secondary Minerals: serpentine<br>10. Overall Degree of Alteration: strong<br>11. Comment: lherzolith | x | | | | | | | | | |  |
| DR37-14 | 1. Rock Type: ultramafic rock<br>2. Size: 8x9x5cm<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: 5%, <1mm<br>6. Vesicle Filling: none<br>7. Matrix Color: greenish-yellow/orange<br>8. Primary Minerals: 10% Opx up to 2mm; 5-10% Cpx up to 3mm; Spinel<br>9. Secondary Minerals: serpentine, large (5x5mm) white inclusions / mineral, maybe plag/chert?<br>10. Overall Degree of Alteration: strong<br>11. Comment: lherzolith | x | | | | | | | | | |  |
| DR37-15 | 1. Rock Type: ultramafic rock<br>2. Size: 8x7x5cm<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: 5-10%, up to 1mm<br>6. Vesicle Filling: none<br>7. Matrix Color: greenish-yellow/orange<br>8. Primary Minerals: 10% Opx up to 5mm; 5-10% Cpx up to 4mm; Spinel<br>9. Secondary Minerals: serpentine<br>10. Overall Degree of Alteration: strong<br>11. Comment: lherzolith | x | | | | | | | | | |  |
| DR37-16M | 1. Rock Type: Mn crust, ca 12cm thick<br>11. Comment: Contains numerous clasts of ultramfic rocks, basalts. All altered and of round shape. Typical size of clasts 0.3-0.7mm | | | | | | | | | | | |
| DR37-17X | 1. Rock Type: similar to sample -1. Subrounded block, white outer surface, resembles bread crust<br>2. Size: 35x15x10 | | | | | | | | | | | |
| DR37-18X | 1. Rock Type: similar to sample -1. 20<br>2. Size: 20x10x10cm | | | | | | | | | | | |
| DR37-19X | 1. Rock Type: several small pieces of ultramafic rocks up to 10cm in diameter. Some are cut and halfs taped together | | | | | | | | | | | |

**SO201-1b-DR38**

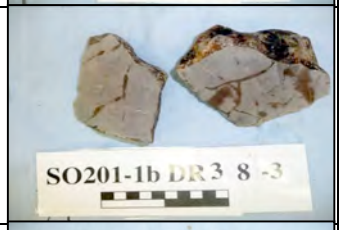
**Description of Location and Structure: NW-SE striking ridge separated from DR37 ridge by a NNW-SSE trendimg valley. N facing slope**

Dredge on bottom UTC 27/06/09 13:13hrs, lat 51°56,41'N, long 170°15,74'E, depth 4263m

Dredge off bottom UTC 27/06/09 14:24hrs, lat 51°55,91'N, long 170°16,49'E, depth 3979m

*total volume: some rocks*

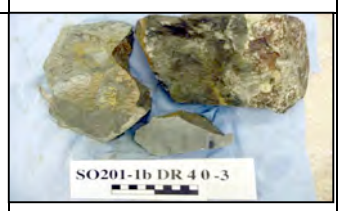
*Comments: 1 large piece (A) blocking the mouth of the dredge; strongly deformed rocks*

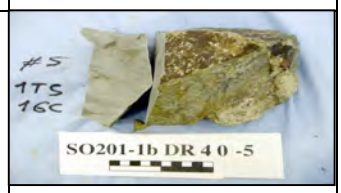
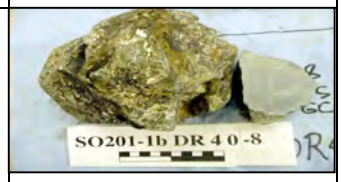
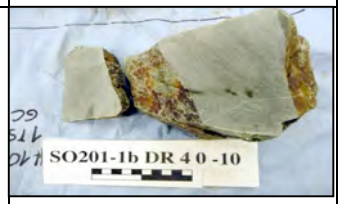
| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR38-1A | 1. Rock Type: Plag phyric basalt from big tectonized bloc A (111x52x48cm)<br>2. Size: 10x10x6<br>3. Shape/Angularity: angular<br>4. Encrustations: none, very thin Mn crust (<0.5cm)<br>5. Vesicularity: non vesicular<br>7. Matrix Color: green<br>8. Primary Minerals: Plag 5-10% up to 5mm<br>9. Secondary Minerals: Chlorite ± Actinolite (?)<br>10. Overall Degree of Alteration: possibly greenshist facies metamorphism<br>11. Comment: Most part of this tectonized bloc is composed of this metamorphosed plag phyric basalt | x | x | | | | | | | | |  |
| DR38-1B | 1. Rock Type: Plag phyric to aphyric basalt from single fragment<br>2. Size: 20x15x10<br>3. Shape/Angularity: angular<br>4. Encrustations: almost absent<br>5. Vesicularity: dense<br>7. Matrix Color: green<br>8. Primary Minerals: in Plag phyric part of sample Plag = 5%<br>9. Secondary Minerals: Chlorite in matrix & CC veins<br>10. Overall Degree of Alteration: possibly green shist facies metamorphism<br>11. Comment: originates from large bloc A and represents an aphyric lithological subfacies | x | x | | | | | | | | |  |
| DR38-2 | 1. Rock Type: aphyric basalt<br>2. Size: 20x20x5<br>3. Shape/Angularity: rounded<br>4. Encrustations: minor<br>5. Vesicularity: slightly vesicular<br>6. Vesicle Filling: possibly smectite<br>7. Matrix Color: brownish green<br>8. Primary Minerals: possibly Px in matrix<br>9. Secondary Minerals: Smectite and Fe-Hydroxides<br>10. Overall Degree of Alteration: moderate | x | x | | | | | | | | |  |
| DR38-3 | 1. Rock Type: aphyric basalt<br>2. Size: 8x5x5<br>3. Shape/Angularity: angular<br>5. Vesicularity: slightly vesicular, small vesicles<br>7. Matrix Color: brownish<br>8. Primary Minerals: possibly Plag & Px in matrix<br>9. Secondary Minerals: CC veins with very small fragments of lithoclastic breccia<br>10. Overall Degree of Alteration: moderate | x | x | | | | | | | | |  |
| DR38-4 | 1. Rock Type: Ol-Px phyric basalt<br>2. Size: 8x5x4<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>7. Matrix Color: green<br>8. Primary Minerals: Ol 15-20%, Cpx 5-10%<br>9. Secondary Minerals: possibly Ol partly replaced by carbonate and iddingsite. Px replaced by Chlorite and Actinolite (?)<br>10. Overall Degree of Alteration: moderate<br>11. Comment: This sample represents a single fragment and does not originate from bloc A | x | x | | | | | | | | |  |
| DR38-5 | 1. Rock Type: subvolcanic rock, almost dolerite<br>2. Size: 20y15x5<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>7. Matrix Color: greenish-grey<br>8. Primary Minerals: Plag 10-15%, Px 20-25%, Ol ca 5%<br>9. Secondary Minerals: relatively fresh rock<br>10. Overall Degree of Alteration: very low<br>11. Comment: This sample does not belong to bloc A | x | x | | | | | | | | |  |
| DR38-6 | 1. Rock Type: hydrothermally reworked matrix from bloc A<br>2. Size: 15x10x5<br>3. Shape/Angularity: angular<br>7. Matrix Color: pink (in veins) / green<br>9. Secondary Minerals: CC + Actinolite (after Px)<br>10. Overall Degree of Alteration: greenschist facies | | | | | | | | | | |  |

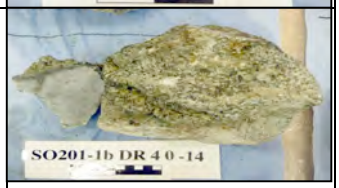
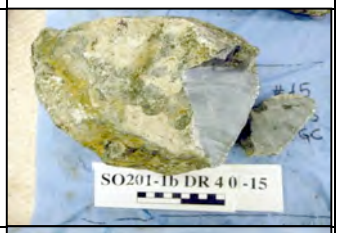
| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR38-7 | 1. Rock Type: very altered porphyric basalt<br>2. Size: 5x4x3<br>3. Shape/Angularity: angular<br>7. Matrix Color: brownish-pink<br>8. Primary Minerals: all phenocrysts are almost entirely replaced by secondary phases<br>9. Secondary Minerals: CC + Hematite ± Chlorite<br>10. Overall Degree of Alteration: lower greenshist facies conditions | | | | | | | | | | |  |
| DR38-8 | 1. Rock Type: fine grained matrix from block A<br>2. Size: 36x27x7<br>3. Shape/Angularity: angular<br>7. Matrix Color: pale green<br>9. Secondary Minerals: Tremolite + CC + Serpentine + Chlorite<br>10. Overall Degree of Alteration: green shist facies | x | | | | | | | | | |  |
| DR38-9 | 1. Rock Type: Thin slightly schistose silicate crust that covered different clasts from bloc A; possibly fault gauge<br>2. Size: 15x15x10<br>3. Shape/Angularity: angular / subangular<br>7. Matrix Color: grey / green<br>8. Primary Minerals:<br>9. Secondary Minerals: **??** + **??** +Actinolite + CC with small host rock fragments<br>10. Overall Degree of Alteration: green shist facies conditions | | | | | | | | | | |  |

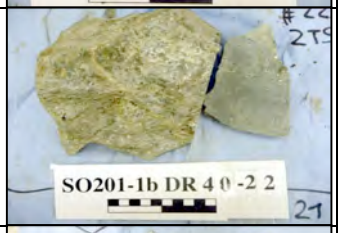
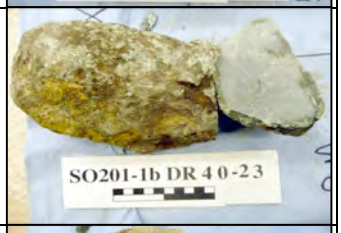
**SO201-1b-DR39**
**Description of Location and Structure: NW-SE elonated ridge. Planned dredge track was along SW slope just below the top region.**
**Dredge not conducted due to difficult current directions**
Dredge on bottom
Dredge off bottom
*total volume:*
*Comments:*

**SO201-1b-DR40**
**Description of Location and Structure: Same structure as attempted in DR39. This time the NE facing slope has been choosen blow plateau edge approx. 3nm further to the SE**
Dredge on bottom UTC 27/06/09 20:29hrs, lat 51°44,45'N, long 170°35,98'E, depth 3668m
Dredge off bottom UTC 27/06/09 22:02hrs, lat 51°44,14'N, long 170°35,38'E, depth 3064m
*total volume: half full*
*Comments:*

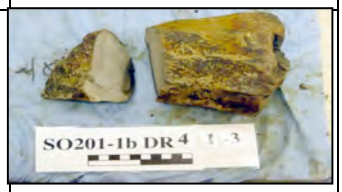
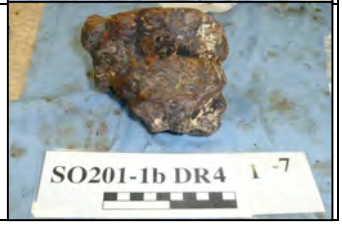
| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR40-1 | 1. Rock Type: massive porphyric volcanic (Block E)<br>2. Size: 18x20x10<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: none<br>7. Matrix Color: dark grey<br>8. Primary Minerals: Plag phenocrysts <30% <1cm, Ol/Cpx <5% <1cm altered to Fe Oxyhydroxides<br>9. Secondary Minerals: Fe oxyhydroxides after Ol/Cpx<br>10. Overall Degree of Alteration: very low<br>11. Comment: good for chemistry. The rock is a Plag-Ol phyric basalt, most likely lava | x | x | | | | | | | | |  |
| DR40-2 | 1. Rock Type: well crystallized intrusive / subvolcanic rock (Bloc C)<br>2. Size: 28x17x16<br>3. Shape/Angularity: angular<br>4. Encrustations: <1mm Mn crust and along sheared planes<br>7. Matrix Color: dark greenish grey<br>8. Primary Minerals: Plag 40% <4mm, Cpx (?) 40% <2-3mm<br>9. Secondary Minerals: slightly altered to green chlorite. veins cutting the rock are filled with carbonate<br>10. Overall Degree of Alteration: moderate<br>11. Comment: This rocks resembles a melanocratic gabbro (Px>Plag) | x | x | | | | | | | | |  |
| DR40-3 | 1. Rock Type: massive coarse grained porpyritic rock, subvolcanic (?); Block D<br>2. Size: 18x18x18<br>3. Shape/Angularity: angular<br>4. Encrustations: very thin Fe-Mn film<br>7. Matrix Color: dark grey to brown sandy texture<br>8. Primary Minerals: large Plag <5% <1cm, Groundmass composed of Cpx and Plag in 50:50 proportion<br>9. Secondary Minerals: slight chloritization<br>10. Overall Degree of Alteration: low to moderate<br>11. Comment: maybe good for chemistry. This rock is likely a fragment of a dike | x | x | | | | | | | | |  |

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR40-4 | 1. Rock Type: massive slightly porphyritic rock, similar to sample -3 (Block A)<br>2. Size: 58x35x40<br>3. Shape/Angularity: angular<br>8. Primary Minerals: large Plag <2% <0.7cm<br>9. Secondary Minerals: Overall the sample is more altered than sample -3<br>10. Overall Degree of Alteration: moderate<br>11. Comment: Veining is abundant in some parts of the sample. It is good for chemistry but carefull picking is required. The rock is lava or dyke of basaltic composition | x | x | | | | | | | | |  |
| DR40-5 | 1. Rock Type: massive well crystallized rock similar to sample -3 & -4 (Block B)<br>2. Size: 60x30x30<br>3. Shape/Angularity: subangular<br>4. Encrustations: thin film of Fe-Mn oxides<br>7. Matrix Color: dark brownish/greenish-grey "sandy"<br>8. Primary Minerals: Plag:Cpx = 50:50 in well crystallized groundmass. Unlike sample -3 & -4 the sample doesn't contain large Plag crystals<br>9. Secondary Minerals: Carbonate filling of secondary veins cutting the rock in different directions, some minor chloritization is possible<br>10. Overall Degree of Alteration: low to moderate<br>11. Comment: see description of sample -3 & -4. Also good for chemistry after picking veined parts | x | x | | | | | | | | |  |
| DR40-6 | 1. Rock Type: Dense massive volcanic rock<br>2. Size: 12x12x10<br>3. Shape/Angularity: angular<br>4. Encrustations: thin <1mm film of Mn oxide ± carbonate (?)<br>7. Matrix Color: dark grey to black<br>8. Primary Minerals: Plag phenocrysts 5-7%, elongated crystals <5mm<br>9. Secondary Minerals: filling of thin veins, carbonate (?)<br>10. Overall Degree of Alteration: very low<br>11. Comment: very good for chemistry. This sample could be lava or marginal well quenched dyke margin | x | x | | | | | | | | 1x TS Sergeii |  |
| DR40-7 | 1. Rock Type: dense very fine grained massive volcanic rock<br>2. Size: 16x10x7<br>3. Shape/Angularity: angular<br>4. Encrustations: rare, very thin veins cutting the rock + thin film of Fe-Mn oxides + carbonate on surface<br>7. Matrix Color: dark grey to black<br>8. Primary Minerals: unrecognizable, very finely crystallized / glassy rock<br>9. Secondary Minerals: minor vein filling<br>10. Overall Degree of Alteration: very low<br>11. Comment: very good for chemistry. The sample is likely basaltic lava, well quenched subaqueous, marginal part of sheet flow (?) | x | x | | | | | | | | |  |
| DR40-8 | 1. Rock Type: dense porphyritic volcanic rock<br>2. Size: 17x17x13<br>3. Shape/Angularity: subrounded<br>4. Encrustations: veins cutting the sample are relatively abundant in places<br>7. Matrix Color: dark greenish-grey<br>8. Primary Minerals: Plag <10% <5mm; Cpx/Plag 50:50 in groundmass<br>9. Secondary Minerals: Veins up to 2mm thick filled with white mineral (CC?). Matrix color changes to green near the veins - chloritization<br>10. Overall Degree of Alteration: moderate<br>11. Comment: The sample is similar to -3 & -4 but more altered. Altered parts near veins should be avoided when preparing sample for chemistry | x | x | | | | | | | | |  |
| DR40-9 | 1. Rock Type: massive slightly phyric volcanic rock<br>2. Size: 11x9x6<br>3. Shape/Angularity: subrounded<br>4. Encrustations: very thin veins inside sample (<0.2mm thick). Thin film of Fe-Mn oxides on outer surface:<br>7. Matrix Color: dark greenish grey<br>8. Primary Minerals: rare <1-2%, large (0.5cm) Plag crystals<br>9. Secondary Minerals: veins and ca 2-3mm altered margin right below surface which was exposed to seawater<br>10. Overall Degree of Alteration: low<br>11. Comment: This is likely a lava fragment, well quenched under water. Good for chemistry if outer margins are avoided. | x | x | | | | | | | | |  |
| DR40-10 | 1. Rock Type: Dense well crystallized volcanic rock. Somewhat similar to sample -4 but even more crystallized<br>2. Size: 16x11x10<br>3. Shape/Angularity: angular<br>4. Encrustations: veining similar to all samples above (veins up to 1mm thick). Thin Mn film on surface<br>7. Matrix Color: dark brownish-grey<br>8. Primary Minerals: no large phenocrysts Cpx and Plag in well crystallized groundmass up to 1-1.5mm<br>9. Secondary Minerals: in veins, some chloritization<br>10. Overall Degree of Alteration: low to moderate<br>11. Comment: good for chemistry. Veins and surface should be avoided. This rock appears to be lava. | x | x | | | | | | | | |  |

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR40-11 | 1. Rock Type: dense aphyric volcanic rock. Overall similar to sample -6 but has more veins filled with secondary minerals<br>2. Size: 17x12x8<br>11. Comment: Maybe good for chemistry but veins should be avoided | x | x | | | | | | | | |  |
| DR40-12 | 1. Rock Type: dense slightly Plag phyric volcanic rock similar to sample -6 & -11 but has some plag phenocrysts<br>2. Size: 19x14x10<br>3. Shape/Angularity: subrounded<br>8. Primary Minerals: Plag <5% <5mm<br>9. Secondary Minerals: Some relatively thick veins up to 1mm and rare angular voids filled with carbonate<br>10. Overall Degree of Alteration:<br>11. Comment: parts away from veins might be good for chemistry | x | x | | | | | | | | |  |
| DR40-13 | 1. Rock Type: dense massive volcanic rock similar to sample -10 but with more abundant Plag crystals <1cm<br>2. Size: 20x13x8 | x | x | | | | | | | | |  |
| DR40-14 | 1. Rock Type: well crystallized, coarse grained intrusive rock<br>2. Size: 24x18x13<br>3. Shape/Angularity: subangular<br>4. Encrustations: breccia like, light grey cement with clast of basalt and altered rocks (sediments?)<br>7. Matrix Color: brownish dark grey<br>8. Primary Minerals: Plag <40% <1cm; Cpx <40% <0.5cm; Opx ca 20%<br>9. Secondary Minerals: few viens filled with white mineral<br>10. Overall Degree of Alteration: low<br>11. Comment: likely a gabbro norite, in some inner parts grained (not crystallized). Good for chemistry | x | x | | | | | | | | 1x TS Sergeii |  |
| DR40-15 | 1. Rock Type: similar to sample -14<br>2. Size: 24x18x17<br>8. Primary Minerals: some very large Plag Megacrysts (<1cm) | x | x | | | | | | | | 1x TS Sergeii |  |
| DR40-16 | 1. Rock Type: similar to sample -14 & -15. More homogeneous, more crystallized<br>2. Size: 12x10x7<br>7. Matrix Color: pinkish-greenish grey<br>8. Primary Minerals: pinkish grains = altered Px?<br>10. Overall Degree of Alteration: moderate, possibly chloritization | x | x | | | | | | | | 1x TS Sergeii |  |
| DR40-17 | 1. Rock Type: similar to sample -14 & -15<br>2. Size: 10x8x5<br>8. Primary Minerals: large crystals <2cm<br>9. Secondary Minerals: some minerals replaced by Fe oxides; Ol? | x | x | | | | | | | | 1x TS Sergeii |  |
| DR40-18 | 1. Rock Type: similar to sample -14 & -15<br>2. Size: 13x10x8<br>4. Encrustations: 5mm thick encrustation; breccia like consisting mainly of white minerals (CC?)<br>7. Matrix Color: dark green; chloritization<br>9. Secondary Minerals: few minerals replaced by Fe oxides; Ol? | x | x | | | | | | | | 1x TS Sergeii |  |

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR40-19 | 1. Rock Type: fragment of breccia with rel. large clasts of gabbro<br>2. Size: 20x20x12<br>3. Shape/Angularity:<br>4. Encrustations:<br>5. Vesicularity:<br>6. Vesicle Filling:<br>7. Matrix Color:<br>8. Primary Minerals:<br>9. Secondary Minerals:<br>10. Overall Degree of Alteration:<br>11. Comment: Fragments of basalt / gabbro and possibly sediments in breccia are subrounded and range from mm-sized to large blocks. Basaltic rocks in breccia are badly altered and different from basalt described above | x | | | | | | | | | 1x TS<br>Sergeii |  |
| DR40-20 | 1. Rock Type: similar to sample -19<br>2. Size: 21x16x11 | x | | | | | | | | | 1x TS<br>Sergeii |  |
| DR40-21 | 1. Rock Type: strongly altered volcanic rock (?)<br>2. Size: 17x10x7<br>11. Comment: It is likely a fragment from the breccia. Primary rock was likely Plag basalt, now totally replaced by secondary minerals , sheared. | x | | | | | | | | | 1x TS<br>Sergeii |  |
| DR40-22 | 1. Rock Type: similar to sample -21<br>2. Size: 16x14x10<br>3. Shape/Angularity: subrounded<br>11. Comment: Possibly less altered than -21, so that promary texture is seen better | x | | | | | | | | | 1x TS<br>Sergeii |  |
| DR40-23 | 1. Rock Type: Clast of slightly phyric basalt from breccia<br>2. Size: 21x10x11<br>7. Matrix Color: greenish grey, cut by numereous veins<br>10. Overall Degree of Alteration: strongly altered | x | | | | | | | | | 1x TS<br>Sergeii |  |
| DR40-24 | 1. Rock Type: hydrothermally reworked breccia (?)<br>2. Size: 19y15x13<br>3. Shape/Angularity: subrounded<br>7. Matrix Color: light greenish grey<br>10. Overall Degree of Alteration: totally altered<br>11. Comment: | x | | | | | | | | | 1x TS<br>Sergeii |  |
| DR40-25X | 1. Rock Type: aphyric basalt similar to -6 but more veined | | | | | | | | | | |  |

**SO201-1b-DR41**
**Description of Location and Structure: Kula plate N of Stalemate Fracture Zone. Fossil Spreading Center, SE margin**
Dredge on bottom UTC 29/06/09 03:32hrs, lat 51°40,07'N, long 171°02,55'E, depth 4334m
Dredge off bottom UTC 29/06/09 04:58hrs, lat 51°39,59'N, long 171°02,52'E, depth 4070m
*total volume: 3/4 full*
*Comments: pillow fragments with fresh glass rinds, glassy hyaloclastites*

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR41-1 | 1. Rock Type: aphyric pillow lava<br>2. Size: 27x41x46<br>3. Shape/Angularity: subangular<br>4. Encrustations: none, except weathering halo<br>5. Vesicularity: slightly vesicular, vesicles partially up to 1mm<br>6. Vesicle Filling: none<br>7. Matrix Color: grey<br>8. Primary Minerals: occassionally Plag crystals visible <1%, sub mm size<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: slightly altered | x | x | | | | | | | | |  |
| DR41-2 | 1. Rock Type: aphyric pillow lava<br>2. Size: 12x15x27<br>3. Shape/Angularity: subrounded<br>4. Encrustations: weathering crust, partly thin (<1mm) Mn crust<br>5. Vesicularity: slightly vesicular, up to 1mm<br>6. Vesicle Filling: mostly open, partly some fillings with green brown secondary phase<br>7. Matrix Color: grey<br>8. Primary Minerals: not visible<br>10. Overall Degree of Alteration: slightly altered<br>11. Comment: fragment of a pillow lava with polygonal shape, rimmed by a glass margin of 1cm thickness | | | | | | | | | | |  |
| DR41-3 | 1. Rock Type: aphyric fragment of pillow lava<br>2. Size: 13x17x22<br>3. Shape/Angularity: subangular to subrounded<br>4. Encrustations: weathering crust and occasional thin Mn patches<br>5. Vesicularity: slightly vesicular (sub mm)<br>6. Vesicle Filling: open<br>7. Matrix Color: grey<br>8. Primary Minerals: partly Plag laths are visible (<1%, sub mm in size)<br>9. Secondary Minerals: secondary yellowish glassy phase visible (1-2mm)<br>10. Overall Degree of Alteration: slightly altered<br>11. Comment: polygonal fragment of a pillow lava with 0.5-1cm glassy rim | | | | | | | | | | |  |
| DR41-4 | 1. Rock Type: pillow lava<br>2. Size: 22x14xx12<br>3. Shape/Angularity: subrounded<br>4. Encrustations: yes<br>5. Vesicularity: 5%<br>6. Vesicle Filling: none<br>7. Matrix Color: grey<br>8. Primary Minerals: aphyric<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: moderate<br>11. Comment: rock has not been cut due to technical problems with saw | | | | | | | | | | |  |
| DR41-5 | 1. Rock Type: pillow lava<br>2. Size: 21x15x10<br>3. Shape/Angularity: angular<br>4. Encrustations: 2-3mm Mn crust<br>7. Matrix Color: grey<br>8. Primary Minerals: aphyric<br>10. Overall Degree of Alteration: moderate<br>11. Comment: glassy margin, uncut piece due to broken saw | | | | | | | | | | |  |
| DR41-6 | 1. Rock Type: pillow lava<br>2. Size: 16x11x9<br>3. Shape/Angularity: subangular<br>4. Encrustations: <2mm<br>7. Matrix Color: black<br>8. Primary Minerals: aphyric<br>10. Overall Degree of Alteration: moderate | | | | | | | | | | |  |
| DR41-7 | 1. Rock Type: pillow lava<br>2. Size: 15x12x13<br>3. Shape/Angularity: subangular<br>4. Encrustations: <1mm<br>7. Matrix Color: grey<br>8. Primary Minerals: aphyric<br>10. Overall Degree of Alteration: moderate<br>11. Comment: abundant fresh glass on exterior. uncut piece due to broken saw | | | | | | | | | | |  |

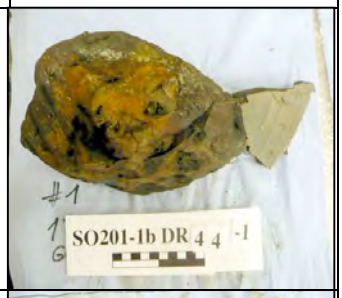
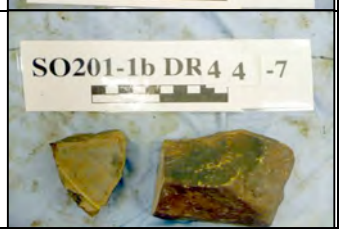
| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR41-8X | 1. Rock Type: Hylaoclastite with fragments of basalt up to 9c and glass fragments up to 3cm in palagonite matrix.<br>2. Size: 28x21x24 | | | | | | | | | | |  |
| DR41-9X | 1. Rock Type: multiple subrounded pillow fragments, all sub 10cm with 1cm glassy margin | | | | | | | | | | |  |
| DR41-10X | 1. Rock Type: multiple subangular pillow fragments up to 25cm, some have glassy margin, not all | | | | | | | | | | |  |
| DR41-11M | 1. Rock Type: Mn crust with outer pillow margin at center<br>2. Size: 24x17x15<br>11. Comment: since age of the basalt can be obtained from dating of palmag record (age of the fossil spreading center) the growth rate of the Mn crust can be obtained and thus a compete archive over the past XXMa. | | | | | | | | | | |  |

**SO201-1b-DR42**
**Description of Location and Structure: Northern Emperor Smnts; Hanzei Smnt eastern side. E facing slope beneath plateau edge**
Dredge on bottom UTC 28/06/09 21:08hrs, lat 50°09,69'N, long 168°24,95'E, depth 3615m
Dredge off bottom UTC 28/06/09 22:25hrs, lat 50°09,86'N, long 168°24,51'E, depth 3311m
*total volume: few rocks*
*Comments: 1 bloc of Mn crust, dropstones. No samples taken*

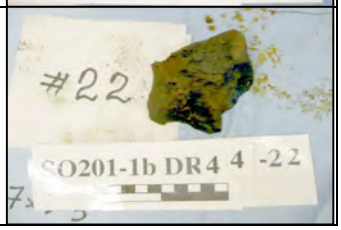
**SO201-1b-DR43**
**Description of Location and Structure: Northern Emperor Smnts; Hanzei Smnt eastern side. E facing slope beneath plateau edge ca**
Dredge on bottom UTC 29/06/09 02:43hrs, lat 50°05,81'N, long 168°24,81'E, depth 4014m
Dredge off bottom UTC 29/06/09 04:08hrs, lat 50°05,90'N, long 168°23,88'E, depth 3527m
*total volume: 2 rocks*
*Comments:*

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR43-1X | 1. Rock Type: massive volcanic rock (ophitic)<br>2. Size: 17x15x14<br>3. Shape/Angularity: angular<br>4. Encrustations: none<br>5. Vesicularity: none<br>6. Vesicle Filling: none<br>7. Matrix Color: dark grey<br>8. Primary Minerals: well crystallized groundmass (Pl, Px: small <1mm black crystals (magnetite?)<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: overall fresh with a few veins (2mm) filled with white minerals<br>11. Comment: diabase | | | | | | | | | | |  |
| DR43-2S | 1. Rock Type: fine grained sediment<br>2. Size: 17x13x13<br>3. Shape/Angularity: rounded<br>4. Encrustations: Mn crust 0.5mm<br>7. Matrix Color: dark brown<br>8. Primary Minerals: Fe Hydroxides?<br>10. Overall Degree of Alteration: slightly altered<br>11. Comment: tuff with concentric alteration halo | | | | | | | | | | |  |

**SO201-1b-DR44**
**Description of Location and Structure: Northern Emperor Seamounts; Suizei Smnt, Eastern slope beneath plateau edge at the SW**
Dredge on bottom UTC 29/06/09 09:05hrs, lat 49°45,45'N, long 168°33,86'E, depth 3137m
Dredge off bottom UTC 29/06/09 10:36hrs, lat 49°45,40'N, long 168°33,28'E, depth 2671m
*total volume: full*
*Comments: 5 large blocs of volcanic breccia, abundant lava fragments mostly angular, a few dropstones*

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR44-1 | 1. Rock Type: basalt<br>2. Size: 25x13x15<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: 5% vesicles, up to 3cm, mostly large vesicles<br>6. Vesicle Filling: occasionally filled with CC, Organics, Fe Hydroxide<br>7. Matrix Color: dark grey<br>8. Primary Minerals: 25% altered olivine up to 2mm, some still somewhat fresh, Plag? < 1%<br>9. Secondary Minerals: CC and Fe Hydroxides<br>10. Overall Degree of Alteration: moderate<br>11. Comment: most common rock in dredge was breccia desribed in sample -12. This rock (olivine basalt) is second most abundant in dredge. Only sample with vesicles | x | x | | | | | | | | |  |
| DR44-2 | 1. Rock Type: similar to sample -1. Similar degree of alteration<br>2. Size: 20x15x12<br>8. Primary Minerals: 20% Ol, Plag? | x | x | | | | | | | | |  |
| DR44-3 | 1. Rock Type: similar to sample -1. Slightly more altered<br>2. Size: 21x16x12<br>8. Primary Minerals: 25% Ol | x | x | | | | | | | | |  |
| DR44-4 | 1. Rock Type: similar to sample -1. more altered no fresh grainss<br>2. Size: 18x11x9<br>8. Primary Minerals: 30% Ol | | | | | | | | | | |  |
| DR44-5 | 1. Rock Type: similar to sample -1. Less altered than -4 but no fresh grains<br>2. Size: 11x12x4<br>8. Primary Minerals: 25% Ol | | | | | | | | | | |  |
| DR44-6 | 1. Rock Type: similar to sample -1. Most altered, some moderately fresh grains<br>2. Size: 9x8x8<br>8. Primary Minerals: 20% Ol | | | | | | | | | | |  |
| DR44-7 | 1. Rock Type: similar to sample -1. Highly altered<br>2. Size: 13x9x7<br>8. Primary Minerals: 25% Ol | | | | | | | | | | |  |

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR44-8 | 1. Rock Type: similar to sample -1. Moderately altered, some fresh olivine<br>2. Size: 11x7x3<br>8. Primary Minerals: 15% Ol | | | | | | | | | | |  |
| DR44-9 | 1. Rock Type: similar to sample -1. Highly altered except for 5cm long fresh core<br>2. Size: 14x7x8<br>8. Primary Minerals: 25% Ol | | | | | | | | | | |  |
| DR44-10 | 1. Rock Type: similar to sample -1. Severely altered, matrix is redish brown<br>2. Size: 15x11x8<br>8. Primary Minerals: 25% Ol | | | | | | | | | | |  |
| DR44-11 | 1. Rock Type: similar to sample -1. Only other sample with large vesicles. Alteration is severe, matrix rust colored<br>2. Size: 14x13x10<br>8. Primary Minerals: 30% Ol | | | | | | | | | | |  |
| DR44-12 | 1. Rock Type: breccia<br>2. Size: 10x11x8<br>3. Shape/Angularity: subrounded<br>4. Encrustations: none<br>5. Vesicularity: 5% vesicles in clasts<br>6. Vesicle Filling: CC, Fe-oxide<br>7. Matrix Color: tanish redish brown<br>8. Primary Minerals: clasts are Ol basalt similar to sample -1. Palagonite, Ol and CC in matrix<br>9. Secondary Minerals: CC and Fe-oxide<br>10. Overall Degree of Alteration: high, some clasts have fresh cores<br>11. Comment: predominant rock in dredge | x | | | | | | | | | |  |
| DR44-13 | 1. Rock Type: volcanic<br>2. Size: 11x8x8<br>3. Shape/Angularity: subrounded<br>4. Encrustations: none<br>5. Vesicularity: 12% vesicles up to 2mm, angular<br>6. Vesicle Filling: CC, chert?<br>7. Matrix Color: dark brown<br>8. Primary Minerals: 4% Ol up to 2mm, Px 10% up to 1mm<br>9. Secondary Minerals: CC, chert<br>10. Overall Degree of Alteration: high | x | x | | | | | | | | |  |
| DR44-14 | 1. Rock Type: volcanic<br>2. Size: 20x10x8<br>3. Shape/Angularity: subrounded<br>4. Encrustations: none<br>5. Vesicularity: 20% subrounded vesicles up to 1mm<br>6. Vesicle Filling: CC<br>7. Matrix Color: brownish grey<br>8. Primary Minerals: Ol 20% up to 1mm, Px 8% sub mm<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: moderate | x | x | | | | | | | | |  |
| DR44-15 | 1. Rock Type: multiple clasts from within breccia, all same lithology as sample -1. Varying degrees of alteration, all high amounts of Ol and vesicularity | x | | | | | | | | | |  |

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR44-16X | 1. Rock Type: breccia similar to sample -12 | | | | | | | | | | |   |
| D44-17S | 1. Rock Type: Tuff<br>2. Size: 16x10x8<br>3. Shape/Angularity: subrounded<br>4. Encrustations: none<br>7. Matrix Color: sand brown<br>8. Primary Minerals: Ol?, all highly altered Plag<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: extreme | x | | | | | | | | | |   |
| DR44-18 | 1. Rock Type: Tuff?<br>2. Size: 15x12x8<br>3. Shape/Angularity: subangular<br>4. Encrustations: none<br>5. Vesicularity: none<br>7. Matrix Color: grey<br>8. Primary Minerals: microphenocrysts Plag, Px, Ol<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: low | x | | | | | | | | | |   |
| DR44-19X | 1. Rock Type: Ol basalt same as -1. 2cm sized vesicles filled with white mud, highly altered, 25% Ol<br>2. Size: 13x12x8 | | | | | | | | | | |   |
| DR44-20X | 1. Rock Type: Ol basalt same as -1, very highly altered matrix to red brown<br>2. Size: 16x11x7 | | | | | | | | | | |   |
| DR44-21 | 1. Rock Type: chert<br>2. Size: 10x?x4<br>3. Shape/Angularity: rounded<br>4. Encrustations: 2mm Mn crust<br>7. Matrix Color: redish brown<br>8. Primary Minerals: chert<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: low | | | | | | | | | | |   |
| DR44-22 | 1. Rock Type: similar to sample -1, 30% Ol | | | | | | | | | | |   |

**SO201-1b-DR45**

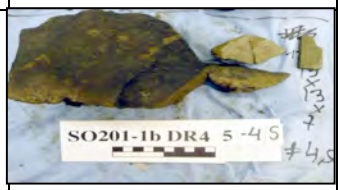
**Description of Location and Structure: Suizei Smnt E facing slope in the S part of the structure beneath plateau edge**

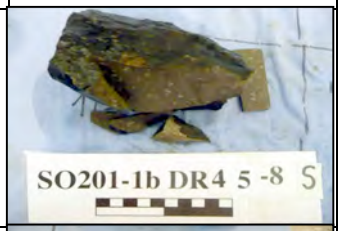
Dredge on bottom UTC 29/06/09 15:40hrs, lat 49°30,70'N, long 168°32,34'E, depth 4870m

Dredge off bottom UTC 29/06/09 15:40hrs, lat 49°31,05'N, long 168°31,60'E, depth 4266m

*total volume: few rocks*

*Comments: several angular pieces of basalt or sediment, some larger blocs are rounded*

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR45-1 | 1. Rock Type: highly Plag-Px phyric basalt<br>2. Size: 18x25x37<br>3. Shape/Angularity: well rounded<br>4. Encrustations: none<br>5. Vesicularity: none<br>7. Matrix Color: dark-grey to black<br>8. Primary Minerals: Plag 10-15%, sub mm to 2mm; Px 5%, 1-3mm<br>9. Secondary Minerals: occasionally; greenish-beige color<br>10. Overall Degree of Alteration: slightly altered<br>11. Comment: could be an insitu sample, though it's rounded | x | x | | | | | | | | |  |
| DR45-2 | 1. Rock Type: Plag-Px phyric basalt<br>2. Size: 6x8x11<br>3. Shape/Angularity: subangular<br>4. Encrustations: very thin Mn crust (<1mm)<br>5. Vesicularity: slightly vesicular /sub mm to 2mm, 5%)<br>6. Vesicle Filling: none<br>7. Matrix Color: dark-grey<br>8. Primary Minerals: Plag sub mm to 2mm; 5-10%; Px sub mm to 1mm; <5%<br>9. Secondary Minerals: Plag shows slight greenish color<br>10. Overall Degree of Alteration: moderately altered<br>11. Comment: mineralogically quite similar to sample -1 | x | | | | | | | | | |  |
| DR45-3 | 1. Rock Type: Plag-Px phyric basalt<br>2. Size: 5x9x10<br>3. Shape/Angularity: rounded<br>4. Encrustations: sub mm Mn crust<br>5. Vesicularity: moderately (15-20%)<br>6. Vesicle Filling: none<br>7. Matrix Color: dark grey<br>8. Primary Minerals: Plag 10% sub mm to 1mm; Px 5-10%, sub mm to 2mm<br>9. Secondary Minerals: most Plag appears altered<br>10. Overall Degree of Alteration: slightly altered core rimmed by highly altered weathered margin<br>11. Comment: mineralogically quite similar to sample -1 and -2 | | | | | | | | | | |  |
| DR45-4S | 1. Rock Type: clastic rock; coarse grained sandstone<br>2. Size: 7x13x19<br>3. Shape/Angularity: angular<br>4. Encrustations: partly very thin (<1mm) Mn crust<br>5. Vesicularity: none<br>7. Matrix Color: greenish grey<br>8. Primary Minerals: consists of rounded lithoclasts (black grey, altered) and black mineral individuals (probably Px)<br>9. Secondary Minerals: some beige phases are visible (sub mm -1mm)<br>10. Overall Degree of Alteration: slightly altered, also owing to the fact that it consists of altered clasts in parts). | | | | | | | | | | |  |
| DR45-5S | 1. Rock Type: clastic rock; fine grained sandstone<br>2. Size: 4x17x23<br>3. Shape/Angularity: angular<br>4. Encrustations: <1mm Mn crust (partly)<br>5. Vesicularity: none<br>7. Matrix Color: greenish grey<br>8. Primary Minerals: subangular clasts (lithoclasts and mineral individuals<br>10. Overall Degree of Alteration: fresh to slightly altered | | | | | | | | | | |  |
| DR45-6S | 1. Rock Type: very fine grained sandstone<br>2. Size: 9x12x13<br>3. Shape/Angularity: subrounded<br>4. Encrustations: none<br>5. Vesicularity: none<br>7. Matrix Color: grey<br>10. Overall Degree of Alteration: fresh<br>11. Comment: very fine grained rounded clasts compose this rock | | | | | | | | | | |  |
| DR45-7S | 1. Rock Type: matrix supported conglomerate<br>2. Size: 4x10x13<br>3. Shape/Angularity: subangular to subrounded<br>4. Encrustations: none<br>5. Vesicularity: none<br>7. Matrix Color: greenish-yellowish matrix, coloured lithoclasts<br>10. Overall Degree of Alteration: slightly altered<br>11. Comment: differemt types of lithoclasts | | | | | | | | | | |  |

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR45-8 | 1. Rock Type: highly Plag phyric andesite<br>2. Size: 5x11x11<br>3. Shape/Angularity: subangular<br>4. Encrustations: <1mm (Mn)<br>5. Vesicularity: very slightly (<5%)<br>6. Vesicle Filling: none<br>7. Matrix Color: light reddish grey<br>8. Primary Minerals: Plag sub mm to 4mm, 10-15%<br>9. Secondary Minerals: none<br>10. Overall Degree of Alteration: slightly altered | | | | | | | | | | |  |
| DR45-9S | 1. Rock Type: maybe tuff or meta-sedimentary rock<br>2. Size: 5x6x11<br>3. Shape/Angularity: angular<br>4. Encrustations: <1mm Mn crust<br>5. Vesicularity: none<br>7. Matrix Color: light green<br>8. Primary Minerals: Plag (?) 1-2mm, <1%<br>9. Secondary Minerals: not visible<br>10. Overall Degree of Alteration: greenschist facies | | | | | | | | | | |  |
| DR45-10S | 1. Rock Type: maybe altered tuff or meta-sedimantary rock<br>2. Size: 5x5x8<br>11. Comment:: quite similar to sample -9S | | | | | | | | | | |  |
| DR45-11X | 1. Rock Type: greenschist of mafic composition<br>2. Size: 8x15x29<br>3. Shape/Angularity: angular (elongated)<br>4. Encrustations: none<br>5. Vesicularity: none<br>7. Matrix Color: grey<br>8. Primary Minerals: matamorphic phases: Amph (40-50% + mica + Plag + Sphene (or Garnet?)<br>10. Overall Degree of Alteration: conditions of greenschist to amphibolite facies<br>11. Comment: origin of this fragment is unclear because it occured as single piece. | | | | | | | | | | |  |

**SO201-1b-TVG46**
**Description of Location and Structure: Top region of small cone between Hanzei and Suzei Smnts**
TVG near bottom UTC 29/06/09 23:20hrs, lat 49°53,86'N, long 168°05,60'E, depth 3634m
TVG Sampling UTC 29/06/09 00:27hrs, lat 49°53,79'N, long 168°05,32'E, depth 3664m
*total volume: full*
*Comments: sediment, small Mn-crusts & nodules; a few dropstones. Cone is covered by sediment*

| SAMPLE # | SAMPLE DESCRIPTION | TS | CHEM | Ar | Rest | GL/MIN | ARCH | VULC | SED | MN | NOTES | Photo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TVG46-1M | 1. Rock Type: Mn crust | | | | | | | | | | | |
| TVG46-2 | 1. Rock Type: grey volcaniclastics | | | | | | | | | | | |

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