Data Article

Rock and sediment dataset of petit-spots in the northwestern Pacific

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ARTICLE INFO

Article history:  
Received 21 October 2022  
Revised 12 November 2022  
Accepted 16 November 2022  
Available online 21 November 2022

Dataset link: Sample photos and description of rocks and sediments from petit-spots in the northwestern Pacific (Original data)

ABSTRACT

Rock and sediment samples were collected from petit-spots in the northwestern Pacific. The sampling was conducted using deep-submergence vehicle (DSV) Shinkai 6500 and its mother ship, research vessel (RV) Yokosuka during YK20-14S and YK21-07S cruises. The collected rock samples are basalt and xepite. Some of the basalts include small mantle xenoliths (\~{}3 cm in diameter). The dataset of rock and sediment samples from the petit-spots located on \textgreek{>}130 Ma northwestern Pacific plate are presented herein. The peperites are a reaction product between petit-spot magma and wet
sediment, and the mantle xenoliths are fragmented mantle materials transported by the petit-spot magmas. Therefore, the petit-spot samples are of significant importance to elucidate modification process of the surface condition by petit-spot magma and to characterize the deep lithospheric mantle. The dataset presented herein provides in a sense a unique insight into the whole Pacific plate just before its subduction beneath the Japan arc.

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Specifications Table

| Subject | Geology, Oceanography |
|---------|-----------------------|
| Specific subject area | Sample description, Magma-sediment interaction, Igneous petrology, Mantle petrology, Sedimentology |
| Type of data | Table, Image, Figure |
| How the data were acquired | Geological observations were conducted using DSV Shinkai 6500 and its mother ship, RV Yokosuka during YK20-14S and YK21-07S cruises. The rock samples were collected using manipulators and push cores equipped in DSV Shinkai 6500. The rock samples were described by shipboard scientists and modified in part during off-shore scientific dedications by the authors. |
| Data format | Raw |
| Description of data collection | Sample size was measured in three dimension by a ruler. Sample weight was measured using a Yamato Scale Co. Ltd. SD-50 top plate scale for samples heavier than 2 kg, and an inhouse balance scale for samples lighter than 2 kg. For visual observation, most of the rock samples were cut by a Maruto Instrument Co. Ltd. MC-420 rock saw. |
| Data source location | Petit-spot Site A |
| | • YK20-14S-6K1564-R1 to R10: 39°23.7812'N, 144°26.2871'E |
| | • YK20-14S-6K1564-R11 to R28: 39°23.7567'N, 144°26.2724'E |
| | • YK20-14S-6K1565-R1-1 to R1-36, R1-Extra 1 to R1-Extra 5, R1-101 to R1-142, and R1-xenolith others: 39°23.7650'N, 144°26.2922'E |
| | YK20-14S-6K1565-R2-1 to R2-44, and R2-Extra 1 to R2-Extra 3: 39°23.7904'N, 144°26.3011'E |
| | Petit-spot Site B |
| | • YK21-07S-6K1586-R1 to R3: 37°37.5822'N, 149°30.4206'E |
| | • YK21-07S-6K1586-R4, and R5-bio: 37°37.5642'N, 149°30.4152'E |
| | • YK21-07S-6K1586-R6 to R10, R7-bio, R16, PC1, and PC2: 37°37.5234'N, 149°30.4140'E |
| | • YK21-07S-6K1586-R11 to R15, R17, and R18: 37°37.4424'N, 149°30.4452'E |
| | • YK21-07S-6K1586-SC1, and SC1-bio: 37°37.4748'N, 149°30.4344'E |
| | • YK21-07S-6K1586-SC2-a to SC2-g, SC2-h-bio, and SC2-i-bio: 37°37.4232'N, 149°30.4764'E |
| Data accessibility | Repository name: Mendeley data |
| Title of dataset: Sample photos and description of rocks and sediments from petit-spots in the northwestern Pacific |
| DOI of dataset: 10.17632/3wzygvbhv4.3 |
| Direct URL to dataset: https://data.mendeley.com/datasets/3wzygvbhv4/3 |
| Related research article | N. Akizawa, N. Hirano, K.M. Matsuzaki, S. Machida, C. Tamura, J. Kaneko, H. Iwano, T. Danhara, T. Hirata, A direct evidence for disturbance of whole sediment layer in the subducting Pacific plate by petit-spot magma–water/sediment interaction, Mar. Geol. 444 (2022) 106712. https://doi.org/10.1016/j.margeo.2021.106712 [1] |
Value of the Data

- Rock and sediment samples from petit-spots in the northwestern Pacific record petit-spot magma–wet sediment interaction. Mantle xenoliths have been found in some rock samples. The dataset of the rock and sediment samples from the petit-spots are of significant importance to elucidate modification process of the surface condition by the petit-spot magma and to characterize the deep lithospheric mantle of the Pacific plate just before its subduction beneath the Japan arc.
- The dataset can be utilized by geologists, geophysicists, and even biologists.
- Pacific plate can be imaged by geophysical observation. On the contrary, it has generally no access throughout the old, and thus thick Pacific plate. As the petit-spot magma derives from the deep asthenospheric mantle to the seafloor [2], the samples from the Petit-spots in the northwestern Pacific can provide us unique investigations of the old Pacific plate at ~135 Ma both from geological and geophysical view points. In addition, because the samples are from ~6500 m-deep ocean floor (Table 1), they give perspectives on the seawater–rock interactions and associated biological processes.

Table 1
Summary of petit-spot samples collected during submersible dive numbers 6K1564, 6K1565, and 6K1586.

| Sample name                      | Latitude (N) | Longitude (E) | Depth (m) | Range of sample size in maximum diameter (cm) | Range of sample weight (kg) | Sample type               |
|----------------------------------|--------------|---------------|-----------|-----------------------------------------------|----------------------------|---------------------------|
| YK20-14S-6K1564-R1 to R10        | 39°23.7812'  | 144°26.2871'  | 6478      | 7.5 to 20                                     | <0.2 to 2.0                | Basalt                    |
| YK20-14S-6K1564-R11 to R28       | 39°23.7567'  | 144°26.2724'  | 6455      | 2 to 10                                       | <0.2                       | Basalt                    |
| YK20-14S-6K1565-R1 to R1-36      | 39°23.7650'  | 144°26.2922'  | 6488      | 5 to 14                                       | <0.2 to 1.4                | Basalt                    |
| YK20-14S-6K1565-R1-Extra 1 to Extra 5 | 39°23.7650'  | 144°26.2922'  | 6488      | 0.6 to 21                                     | <0.2                       | Basalt                    |
| YK20-14S-6K1565-R1-101 to R1-142 | 39°23.7650'  | 144°26.2922'  | 6488      | 1 to 12                                       | <0.2                       | Peridotite (xenolith)     |
| YK20-14S-6K1565-R1-xenolith others | 39°23.7650'  | 144°26.2922'  | 6488      | *                                             | 0.4                        | Peridotite (xenolith)     |
| YK20-14S-6K1565-R2-1 to R2-44    | 39°23.7904'  | 144°26.3011'  | 6476      | 5.5 to 27                                     | <0.2 to 4.6                | Basalt                    |
| YK20-14S-6K1565-R2-Extra 1 to Extra 3 | 39°23.7904'  | 144°26.3011'  | 6476      | *                                             | 0.2 to 2.8                 | Basalt                    |
| YK21-07S-6K1586-R1 to R3         | 37°37.5822'  | 149°30.4206'  | 5969      | 19 to 40                                      | 3.6 to 41                  | Basalt                    |
| YK21-07S-6K1586-R4               | 37°37.5642'  | 149°30.4152'  | 5958      | 30                                            | 7.6                        | Peperite                  |
| YK21-07S-6K1586-R5-bio           | 37°37.5642'  | 149°30.4152'  | 5958      | *                                             | **                         | Basalt                    |
| YK21-07S-6K1586-R6 to R10        | 37°37.5234'  | 149°30.414'   | 5909      | 13 to 25                                      | 0.2 to 3.4                 | Peperite                  |
| YK21-07S-6K1586-R7-bio           | 37°37.5234'  | 149°30.4140'  | 5909      | *                                             | **                         | Basalt                    |
| YK21-07S-6K1586-R11, R12, R15    | 37°39.4424'  | 149°30.4452'  | 5841      | 10 to 24                                      | 0.2 to 5.6                 | Basalt                    |
| YK21-07S-6K1586-R13, R14         | 37°39.4424'  | 149°30.4452'  | 5841      | 14 to 15                                      | 1.0 to 1.8                 | Peperite                  |
| YK21-07S-6K1586-R16              | 37°37.5234'  | 149°30.414'   | 5909      | *                                             | <0.1                       | Basalt                    |
| YK21-07S-6K1586-R17              | 37°37.4424'  | 149°30.4452'  | 5841      | 8                                             | 0.1                        | Basalt                    |
| YK21-07S-6K1586-R18              | 37°37.4424'  | 149°30.4452'  | 5841      | *                                             | 0.1                        | Basalt                    |
| YK21-07S-6K1586-PC1, PC2         | 37°37.5234'  | 149°30.414'   | 5909      | ***                                           | ***                        | Sediment core             |
| YK21-07S-6K1586-SC1              | 37°37.4748'  | 149°30.4344'  | 5863      | *                                             | 0.3                        | Basalt                    |
| YK21-07S-6K1586-SC1-bio          | 37°37.4748'  | 149°30.4344'  | 5863      | *                                             | **                         | Basalt                    |
| YK21-07S-6K1586-SC2-a, SC2-b     | 37°37.4232'  | 149°30.4764'  | 5834      | 6 to 17                                       | 0.1 to 1.1                 | Solidified mud            |
| YK21-07S-6K1586-SC2-c to SC2-g   | 37°37.4232'  | 149°30.4764'  | 5834      | 4 to 6                                        | <0.1                       | Basalt                    |
| YK21-07S-6K1586-SC2-h-bio, SC2-i-bio | 37°37.4232'  | 149°30.4764'  | 5834      | *                                             | **                         | Basalt                    |

* Sample size is not given for sets of small sample pieces.
** Rock samples for biological investigation were frozen or chilled once they arrived at the deck of RV Yokosuka. Hence, sample size and weight values are not measured.
*** Sample size and weight values are not presented for sediment core samples.
1. Objective

Remarkably small knolls known as petit-spots (~1 km$^3$ in observable surface volume) are believed to be formed in response to plate flexure in the outer trench swell [3,4]. After the discovery of petit-spots in the northwestern Pacific by Hirano et al. [5], the petit-spots have been investigated by geochemical (cf., Hirano and Machida [6] and references therein) and geophysical [7–9] approaches. To facilitate the understanding of the old Pacific Plate just before the subduction into the Japan arc, we conducted intense rock sampling using DSV Shinkai 6500 and its mother ship RV Yokosuka. With the two cruises of YK20-14S and YK21-07S, more than 168 rocks and 2 sediment cores (Table 1) were sampled from the petit-spots located in the northwestern Pacific [10]. Akizawa et al. [1] in part investigated and presented the rock and sediment samples, but the sample information is still limited in public. Hence, we share the dataset of petit-spot rocks and sediments collected during YK20-14S and YK21-07S cruises herein.

2. Data Description

Fig. 1 shows the sampling sites, Sites A and B in the northwestern Pacific. The rock and sediment samples were collected during three submersible diving: dive numbers of 6K1564 and 6K1565 at Site A, and dive number of 6K1586 at Site B. The collected samples are >108 basalts and 42 peridotite xenoliths at Site A, and >15 basalts, 3 pererites, and 2 sediment cores at Site B (Table 1). 10 sets of small (~a few cm in diameter) rock pieces were assorted in boxes (Table 1). The basalts are highly vesicular (~30 %) and in part include solidified sediment portions [1]. The basaltic fragments are embedded in the peperites. The sediment cores are biosiliceous clayey silt mainly composed of clay-sized minerals, diatom, siliceous sponge spicules, radiolaria, volcanic glass, and quartz grains. Some of the basalts from Site B include peridotite xenoliths. The sample size of basalts and peperites ranges from a few cm to 40 cm in diameter, whereas that of peridotite xenoliths is ~a few cm in diameter (Table 1). The weight of rock samples ranges from <0.2 g to 41 kg (Table 1).

![Fig. 1](image_url)

Fig. 1. Study area. (a) Closeup view of the petit-spot knoll at Site A. (b) Closeup view of the petit-spot knoll at Site B. Submersible dives of 6K1564 and 6K1565 were conducted at Site A, and that of 6K1586 was conducted at Site B. Please refer to Akizawa et al. [1] for the locations of Sites A and B in a large-area map.
3. Experimental Design, Materials and Methods

The rock and sediment samples were respectively collected using manipulators and push cores equipped in DSV Shinkai 6500. Sampling details during the submersible diving are summarized hereafter.

• Dive number 6K1564 at 14 October 2020

Dive traverse began on a steep talus slope. The slope is comprised of black angular to sub-angular basaltic rocks covered with a yellowish gray thin mud layer. Basalts (YK20-14S-6K1564-R1 to R3) were collected from a brecciated loose part of the slope. Basaltic boulders (YK20-14S-6K1564-R4 to R10) buried on a mud layer were collected from a terrace of the slope. Many fragmented basalts (YK20-14S-6K1564-R11 to R28) were recovered from a sub-vertical cliff. At the shallowest part of the cliff, the dive traverses ended.

• Dive number 6K1565 at 15 October 2020

Dive traverses began on the sub-vertical cliff, where YK20-14S-6K1564-R10 to R28 were collected during 6K1564 dive. The cliff is composed by talus deposits of black angular to sub-angular basaltic rocks. In part, pillow lavas are covered with thin yellowish gray mud. Basalts (YK20-14S-6K1565-R1-1 to R1-36, and R1-Extra1 to R1-Extra 5), and mantle xenolith-bearing basalts (YK20-14S-6K1565-R1-101 to R1-142, YK20-14S-6K1565-R1-xenolith others) were collected from the cliff. Other basaltic samples (YK20-14S-6K1565-R2-1 to R2-44, R2-Extra 1 to R2-Extra 3) were collected from the same cliff. After climbed up on the cliff, the dive traverses ended.

• Dive number 6K1586 at 5 May 2021

Dive traverses began on a flat seafloor covered with a yellowish gray thin mud layer. Some angular to sub-angular basaltic boulders were observed. Push cores of sedimentary mud (YK21-07S-6K1586-PC1 and PC2), and basalts (YK21-07S-6K1586-R1 to R3) were collected from the muddy flat seafloor. The sediment was moderately bioturbated throughout the cores. YK21-07S-6K1586-PC2 included basalt pebbles. A brecciated basalt boulder and a peperite (YK21-07S-6K1586-R4 and R5) were collected from a bioturbated outcrop below a steep cliff. At a fragmented loose outcrop covered by a thin mud layer, other bioturbated basaltic boulders (YK21-07S-6K1568-R6 to R10, and R16) were sampled. A set of basaltic rocks (YK21-07S-6K1586-SC1) was taken using a scoop from a muddy terrace covered by numerous basaltic boulders and pebbles. The basaltic rock set was divided into two subsets, one of which was stored for a use of biological investigation (YK21-07S-6K1586-SC1-bio). Brecciated basaltic boulders and a peperite were recovered from a loose brecciated outcrop (YK21-07S-6K1586-R11 to R15, R17, and R18). On the summit of petit-spot knoll, meter-scale huge rock blocks (see Fig. 1c of Akizawa et al. [1]) are placed with a yellowish gray thin mud cover. A scoop of basaltic rocks (YK21-07S-6K1586-SC2) was taken at the summit. YK21-07S-6K1586-SC2 was divided into 8 basalt species (YK21-07S-6K1586-SC2-a to SC2-f, SC2-h-bio, and SC2-i-bio), and one set of basalts (YK21-07S-6K1586-SC2-g). Two basalts (YK21-07S-6K1586-SC2-h-bio and SC2-i-bio) were stored for biological investigation. After the rock and sediment sampling, topographical and sub-bottom data collection using a deep-sea multi-beam-echo-sounder (MBES) and sub-bottom profiler (SBP) with two ENE-WSW-directed tracks were conducted [1]. After the data collection, the dive traverses ended.

Unfortunately, YK21-07S-6K1586-R5 was lost during uplift from the sea to the deck on RV Yokosuka due to severe sway, but a piece of 10 cm-sized basalt was left in the same sample basket of DSV Shinkai 6500. This rock piece is considered as a fragment from the original rock body, and hence it is named YK21-07S-6K1586-R5-bio and stored for a use of biological investigation. A half of R07 was sampled as R07-bio.
Ethics Statements

All the authors declare that there are no ethical issues with the data presented.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data Availability

Sample photos and description of rocks and sediments from petit-spots in the northwestern Pacific (Original data) (Mendeley Data).

CRediT Author Statement

Norikatsu Akizawa: Conceptualization, Investigation, Writing – original draft; Naoto Hirano: Conceptualization, Methodology, Writing – review & editing; Shiki Machida: Conceptualization, Methodology; Akira Ishikawa: Investigation, Writing – original draft; Yuka Niwa: Investigation; Gen Shimoda: Investigation, Writing – original draft; Kazutaka Yasukawa: Investigation, Writing – review & editing; Kenji M. Matsuzuki: Investigation; Chiori Tamura: Data curation, Formal analysis; Junji Kaneko: Data curation, Formal analysis.

Acknowledgments

We express deep thanks to the shipboard scientific parties, captains, and crews of RV Yokosuka for their collaboration, kindness, and friendship during YK20-14S and YK21-07S cruises. This research was supported by JSPS KAKENHI Grant numbers 20H02003 (provided for NA), and 20K04098/18H03733 (provided for NH) (Japan).

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