Poster presentation | S3: Rheology and Material Transfer in Mantle and Crust (Special Session)

Thu. Sep 11, 2025 12:30 PM - 2:00 PM JST | Thu. Sep 11, 2025 3:30 AM - 5:00 AM UTC Poster (Room No. 16)

S3: Rheology and Material Transfer in Mantle and Crust (Special Session)

[S3-P-01]

Olivine microstructures from the petit-spot peridotite xenoliths along the Japan Trench: insights on deformation fabrics at the lithosphere-asthenosphere boundary

*Dyuti Prakash SARKAR[1], Hanaya Okuda[2], Yuto Sato[2], Yuka Niwa[3], Akira Ishikawa[3], Katsuyoshi Michibayashi[4], Jun-ichi Ando[5], Masako Yoshikawa[5], Shiki Machida[6], Naoto Hirano[7], Norikatsu Akizawa[5] (1. Yamaguchi Univ. Sci., 2. Kochi Institute for Core Sample Research JAMSTEC, 3. Tokyo Tech., 4. Nagoya Univ. Sci., 5. Hiroshima Univ. Sci., 6. ORCeNG, Chiba Institute of Technology, 7. CNEAS, Tohoku Univ.)

[S3-P-02]

Preliminary results on the crystallographic preferred orientation of Bridgmanite obtained from high temperature and pressure large strain deformation experiments using rDAC

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Keywords：Petit-spot volcano、Olivine slip systems、Sub-grain boundary analysis、LAB

Petit-spot volcanoes were first identified as small volcanic knolls (~1 km^3 in volume) on the Pacific Plate, formed due to plate flexure along the outer rise near the Japan Trench (Hirano et al., 2006). These volcanoes erupt vesicular alkaline basalts containing fresh peridotite xenoliths and are transported trench-ward by plate subduction. In this study, we examine peridotite xenoliths collected by the Human Occupied Vehicle (HOV) Shinkai 6500 during scientific cruises YK20-14S, YK21-07S, and YK24-10S. The sampling areas for YK20-14S and YK24-10S are located at Site A, one of the petit-spot locations reported by Hirano et al. (2006). The xenoliths range in size of 1 cm ~ 5 cm, and modal their composition ranges from harzburgite to lherzolite. The contacts of the xenoliths with the host basalt suggest limited reaction along boundaries, with a few samples exhibiting spongy margins. Olivine compositions are characterized by high forsterite number (Fo ~92), and pyroxenes range from enstatitic orthopyroxene to diopsidic clinopyroxene. Both spinel- and garnet-bearing peridotites were identified among the samples. To investigate internal structures of the xenoliths, we employed X-ray computed tomography (CT). Observation of the xenolith thinsections in petrographic microscope, indicate presence of subgrain boundaries in olivine grains of the preserved coarser relict grains. Electron backscatter diffraction (EBSD) was also used to determine crystallographic preferred orientations (CPOs) and quantifying subgrain boundaries. For smaller xenoliths 1-3 cm, only single thinsections were prepared. However, in case of larger xenolith samples ~5 cm, two perpendicular sections were prepared for EBSD analysis. Subgrain boundary analysis allowed us to infer the dominant olivine slip systems even in samples with weak overall fabric. Additionally, Fourier-transform infrared (FTIR) spectroscopy using the protocol of Sato el al. (2023) indicate that olivine grains in these xenoliths are dry (5-13 wt. ppm H_2O). The crystallographic data and water content measurements provide insight into the active slip systems in the xenoliths and their implications for deformation processes at the lithosphere–asthenosphere boundary (LAB) beneath the northwestern Pacific.

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[S3-P-02] Preliminary results on the crystallographic preferred orientation of Bridgmanite obtained from high temperature and pressure large strain deformation experiments using rDAC

*Bunrin Natsui[1], Shintaro Azuma[1], Keishi Okazaki[2,3], Kentaro Uesugi[4], Masahiro Yasutake[4], Saori Kawaguchi[4], Steeve Gréaux[5], Ryuichi Nomura[6], Kenji Ohta[1] (1. Science Tokyo, 2. Hiroshima Univ., 3. JAMSTEC, 4. JASRI, 5. Ehime Univ., 6. Kyoto Univ.)

Keywords：Lower mantle、Bridgmanite、Deformation Experiment、X-ray diffraction、Crystallographic preferred orientation

地震波観測より、アフリカと南太平洋地下の下部マントル中部から最下部マントルにかけてS波速度が遅い領域（LLSVP：Large Low Shear Velocity Provinces）が存在することが確認されている。さらにその縁部分では地震波速度が地震波の進む方向によって異なる地震波異方性が報告されている。地震波異方性は鉱物の結晶軸が特定の方向に並ぶ結晶方位選択配向（CPO：Crystallographic preferred orientation）の発達によって生じている可能性があり、その領域における構成鉱物の変形とCPO発達の関係を調べることで重要な知見が得られる。本研究では下部マントル主要構成鉱物であるBridgmaniteの多結晶体について、下部マントル圧力条件での大歪変形実験を行い、変形に伴うCPOの発達とすべり系を調査し、LLSVPの地震波異方性との関係を考察することを目的とする。　本研究では、回転式ダイヤモンドアンビルセル（rDAC）を用いて、 Bridgmaniteの多結晶体のねじり変形実験をSPring-8 (BL47XU)にて行った。加圧システムにはメンブレンガス圧加圧装置を用い、加熱システムにはイメージ炉を用いた。変形前の試料には、板状のPtマーカーを試料回転軸に平行に配置しており、変形実験前後のX線ラミノグラフィー法によるPt歪マーカーの観察、および変形実験中のその場X線回折(XRD)測定を行った。X線ラミノグラフィー法から得られた再構成断面像から試料の歪を決定し、1角度（回転軸に対して60°方向）XRDより変形実験中の鉱物のCPO決定を試みた。CPO決定のための組織解析にはMaterial Analysis Using Diffraction（MAUD）による結晶方位分布関数（ODF）が組み込まれたRietveld解析を行った。　圧力 <60 GPa、温度300-850 K、歪速度一定の条件でBridgmaniteの変形実験に成功した。予察的な結果ではあるが、 ～60 GPaの変形実験においてBridgmaniteは(010)面が支配的なすべり面である結果を示した。