ICDP DSeis: spacial variation in mineral assemblage and alteration at the lamprophyre dike that hosts the aftershocks zone of the 2014 Orkney M5.5 earthquake, South Africa.

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In JpGU2022 in this session, we reported on the chemical and physical properties of the lamprophyre dike that hosted the aftershocks of an M5.5 earthquake and the adjacent mafic dike (Oba et al. SCG46-P05; Fujita et al. SCG46-P06). The dike sample was recovered by the ICDP project "Drilling into Seismogenic zones of M2.0-5.5 earthquakes in South African gold mines" (DSeis; Ogasawara et al. AfriRock 2017). We present a follow-up report here.

By 2018, through the ICDP DSeis project, two boreholes intersected near the upper margin of the 2014 Orkney M5.5 earthquake aftershock zone 2.9-3.4 km below the surface of the Moab Khotsong gold mine in South Africa.

In 2019, the DSeis team imported the most crucial part of the core, more than a hundred meters in length, to the Kochi Core Center. At the Center, we carried out MSCL and CT scans. In the most critical part of the lamprophyre dike that hosted the aftershock zone, Yokoyama (MSc thesis 2020 Osaka Univ.), Miyamoto et al. (2022), and Mngadi et al. (2022) performed bulk powder XRD analysis and found that talc exceeds 20 wt% and that accompanying minerals such as amphibole and biotite. Miyamoto et al. (2022) conducted friction experiments and found that dry powder samples with high talc content had a low coefficient of friction and velocity-strengthening properties. Yabe et al. (JpGU 2023 SSS-09) report on the friction coefficients of powder samples smaller in wet friction experiments.

The XRD analysis of Yokoyama and Miyamoto et al. for the lamprophyre dike section were bulk analyses of powder made from 1 cm thick discs cut at approximately 1 m intervals. To see more detail, we sliced the sides of the core to have a plane for the XRF scan at 0.5 cm intervals axially. For the locations suitable for characterizing spatial variations in mineral assemblage and alteration, we made polished thin section samples from the sliced thin plate. For the polished samples, we mapped X-ray intensity with EPMA for nine elements (Al, Ca, Fe, K, Mg, Na, Si, S, Ti). We classified minerals with the machine-learning MATLAB toolbox XMapTools V4 Lanari et al. (2014, 2019) developed. At the selected 100 points, we carried out SEM-EDS to check the performance of the machine-learning mineral classification of major and accessory minerals. We also checked the presence of elements other than the nine elements and the quantification of each element. The results showed that the machine-learning mineral classification was generally correct and depicted spatial variations in mineral combination and alteration toward the core loss zone within the lamprophyre dike.

Please refer to Ogasawara et al. (JpGU2023 M-GI28) for the ICDP DSeis plan for FY2022 and other activities and results.

The DSeis team consists of seismologists, geologists, geomicrobiologisits, rock mechanists, mining

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