DSeis Report 3: Spatial variation in seismic velocity in downhole sonic log and core measurements for the mafic/ultramafic adjacent dikes accompanying aftershocks and hypersaline brine in deep and non-meteoric water environment

*kaoru fujita[1], Hiroshi Ogasawara[1], Yasuo Yabe[2], Yuhji Yamamoto[3], Team DSeis

1. Ritsumeikan University, 2. Tohoku University, 3. Kochi University

We report on the change in Vp, Vs, and Vp/Vs in a few-meter section in the ultramafic thin dyke just prior to the core-loss zone that hosted the aftershocks of the 2014 Orkney M5.5 earthquake at a depth of ~3.3 km from the surface. We processed the measured data using the core recovered from the dyke and the downhole sonic logging data. We also compared the seismic velocity for the dyke which strikes nearly the same orientation but did not host the aftershocks, while hosted hypersaline brine fissure (the Onstott dyke).

In the ultramafic dyke section, Vp and Vs varied from ~6 to ~5.8 km/s and ~3.7 to ~3.2 km/s, respectively. This change resulted in the variation of Vp/Vs from ~1.65 to ~1.75. This increase in Vp/Vs is consistent with the progressive alteration towards the core-loss zone, as our other report in this session (Oba et al. S-CG46) illustrates. In contrast, the velocity at the Onstott dyke was relatively higher, which is consistent with the chemical composition less ultramafic than the ultramafic dyke hosting the aftershock zone.

The paper's activity is part of the ICDP project, "Drilling into Seismogenic zone of M2.0-5.5 earthquakes in South African gold mines (DSeis; Ogasawara et al. Afrirock 2017)". The project accomplished drilling and downhole logging in 2018 (Ogasawara et al. Deep Mining 2019; ICDP Thrill to Drill). In 2019, we imported the critical section (a hundred and several tens of meters in total length) to Kochi Core Center.

The DSeis project
(1) targeted the seismogenic zones elucidated by the dense seismic monitoring networks in the forerunning project;
(2) successfully reached seismogenic zones in country rocks with density and Vp as high as those in rock mass in the upper crust (2.7 g/cm3 and 6 km/s, respectively), not seismic faults in sedimental covers or fault zones in unconsolidated formation (Vp<4 km/s);
(3) recovered full-core of a total of 1.6 km length with a wire-line NQ and BQ diamond drilling (with the drilling rigs underground; we used a 1.5m triple-tube for the most critical section).

In JpGU 2022, there will be some more reports apart from this poster, including an overview of the DSeis project (Session M-GI32) and a report on the differences in material between the ultramafic dyke hosting the aftershock zone and the Onstott Dyke (S-CG46 Oman Ophiolite session). At S-SS07, the other papers report on
(1) the stress localization,
(2) mesoscopic comparison between aftershock streaks, sills, and the seismic reflectors, and
(3) potential bias in the hypocenter location of the M5.5 Orkney earthquake.

The DSeis team consists of seismologists, geologists, geomicrobiologisits, rock mechanists, mining engineers from Japan, South Africa USA, Switzerland, Germany, India, and Australia. The DSeis project is

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