ICDP DSeis project: an overview of the 2020 research activity

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The ICDP DSeis project (Ogasawara et al. 2017 AfriRock) has accomplished drilling and down-ole logging at the seismogenic zones in deep gold mines in South Africa. In this presentation, we will review the research activity of the FY2020.

On a mining horizon, Naoi et al. (2013 Pageoph, 2015 JGR, Tectonophysics, etc.) successfully elucidated that the microfracturings evolve planarly ahead of mining faces. The host rock, fractured materials and fracture structures of a tens of meter sized fracture zone were very well recovered with a BQ triple tube 1.5 meter long. With the recovered materials and host rocks, friction experiments at the Kyoto University Tsutsumi Laboratory was conducted. Comparison of frictional properties between gouge and rock-to-rock was published in Mngadi et al. (2021 Int. J. Rock Mech. Min. Sci.).

Below another mine, we have accomplished the core recovery with a total length of 1.6 km in NQ size from the upper fringe of the seismogenic zone of the 2014 M5.5 Orkney sinistral earthquake, (Ogasawara et al. 2019 Deep Mining; ICDP 2019 The Thrill to Drill). In FY2020, we conducted compilation of borehole logging, core logging at Kochi Core Center, and recovered core information (Yoshida 2021 Ritsumeikan MSc thesis; Ogasawara et al. 2021 JpGU), integrated analysis of core stress measurement stress (Higashi 2021 Ritsumeikan MSc thesis), aftershock DD relocation (Tadokoro 2021 Ritsumeikan MSc thesis), and analysis of 3D seismic reflection data (Suzuki et al. SSJ 2020 and AGU 2020). It is now becoming clear that the host rock of the seismogenic zone, which has density and velocity comparable to those of the upper crust, is greatly influenced by the altered mafic intrusive rock (density and velocity comparable to those of the lower crust), and that it also defines the streak distribution of aftershocks.

At the intersection of the Dolerite Sill and another mafic dyke, teams of microbiologists from the U.S., Germany, and other countries have also found brine fissures and gases (similar to those near hydrothermal vents at oceanic ridges?) that are non-meteoric and rich in dissolved organic hydrocarbons of non-biogenic origin (Wiersberg et al. 2019 EGU; Rusley et al. 2018 AGU; Nisson et al. 2019 AGU). Warr et al. (2020 AGU) made progress in isotope analysis.

The ICDP team consists of researchers from Japan, South Africa, USA, Germany, Switzerland, India, Israel, Australia, and practitioners from the mining industry in South Africa. The core members include Y. Yabe and T. Ito (Tohoku Univ.), J. Mori (Kyoto Univ.), T. Hirono (Osaka Univ.), Y. Yamamoto (Kochi Univ.), B. Liebenberg (Moab Khotsong mine), T.C. Onsott (Princeton Univ.), T.L. Kieft (New Mexico Tech), T. Wiersberg and M. Zimmer (GFZ), R.J. Durrheim (Wits Univ.). Durrheim (Wits Univ.), J. Castillo (Free State Univ.), M. Ziegler (ETH, Zurich), and their students.

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