

Trace element and isotope characteristics of core samples from the Japan Trench Fast Drilling Project (JFAST)

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The Integrated Ocean Drilling Program (IODP) Expedition 343 drilled three holes through the plate boundary near the Japan Trench to investigate the cause of very large fault slip during the 2011 Tohoku-Oki earthquake. In this paper, we report trace element and Sr-Nd-Pb isotope compositions of core samples, including plate-boundary fault rocks, recovered from Hole C0019E.

The rocks in C0019E are lithologically subdivided into seven units (Chester et al., 2013): Units 1 to 3, wedge sediments of upper plate; Unit 4, plate-boundary fault; Units 5 to 7, sediments of lower plate. The clay-rich plate-boundary fault rocks (Unit 4) are characterized by elevated concentrations of rare earth elements (REE) and some refractory metals, and are distinct from any other JFAST samples in terms of trace element characteristics. Brown mudstones of the lower plate (Unit 5) show trace element characteristics (e.g. REE pattern) roughly similar to those of the upper plate sediments (Units 1 to 3), but they are still distinguishable from each other. Pelagic sediments in the lower plate (Unit 6) show highly varied trace element compositions with a large Ce anomaly. The Sr, Nd and Pb isotope data show variations that are essentially consistent with trace element characteristics observed for each unit.

The clear relationship observed between lithological units, trace element and isotope compositions and radiolarian ages of the JFAST samples provides a key for understanding the origin of the shallow fault zone of the Tohoku-Oki earthquake and the frontal wedge at the Japan Trench. Geochemical characteristics of the JFAST samples will be discussed along with those of sediments from DSDP site 436, which is a nearby input site, for elucidating the origin of the JFAST rocks and for evaluating coseismic/interseismic processes possibly recorded in the plate-boundary fault rocks.

Keywords: Earthquakes, Fault rocks, Trace elements, Isotopes, IODP