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NanTroSEIZE Site C0012 における海洋底玄武岩最上部の変質パターンと沈み込みプレート境界断層のレオロジー
Alteration pattern of ocean floor basalt at NanTroSEIZE Site C0012: implication for the rheology of subduction thrust

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The IODP Expedition 333, a part of NanTroSEIZE project, was operated during December 2010 to January 2011. To recover cores of oceanic crust as the material of subduction input, three holes were drilled at Site C0012, located at the top of Kashinozaki Knoll on the Philippine Sea Plate just before subduction in the Nankai Trough. Basalts are recovered from 525.7 to 626.44 m CSF in Hole C0012G. They are composed of pillow lavas and massive lavas. Plagioclase and pyroxene (clinopyroxene) phenocrysts in altered volcanic glasses with various amounts of vesicles show intergranular to subophitic textures. Alteration is entirely strong: i.e., olivine phenocrysts were completely replaced by saponite, and groundmasses (volcanic glasses) were mostly altered to saponite and celadonite. Moreover, plagioclases were replaced by zeolites and clay minerals in some places. Green- and orange-colored alteration halos develop along red-colored Fe-oxyhydroxide veins below 563 m CSF. The green and orange alteration halos were overprinted by pyrite precipitation accompanying with strong saponitization (occurs in 525.7 to 563, 601, 613 to 615 m CSF). The two stages of alteration reflect the changes in fluid redox state. Fe-oxyhydroxide veins with orange alteration halos might be formed by near-axis open-system oxidizing fluid circulation, whereas strong saponitization with pyrite might be formed by closed-system reducing fluid circulation after oceanic crust was covered with sediments and separated from seawater (Alt, 2004).

Strong saponitization encountered in the topmost 40 m of ocean floor basalt may play important role for the rheology of subduction thrust, especially stepping-down of the decollement. Saponite releases water in response to temperature rise, and is progressively converted to chlorite (Kameda et al., submitted). In subduction zones, this dehydration reaction can build up high fluid pressure within highly saponitized part of oceanic crust so that can reduce effective strength at the topmost part of subducting basalt. If this mechanism works efficiently, inversion of effective strength between sediments and oceanic crust occurs at some depth of subduction zone. Here we point out the possibility that such strength inversion result in the step-down of the decollement to oceanic crust, which is figured out by seismic profiles of modern subduction zones (e.g. Park et al., 2002; Kimura et al., 2010) and geology of on-land accretionary prisms (Kimura and Ludden, 1995). A compile of metabasalts in on-land accretionary complexes indicate that oceanic crusts are often underplated to accretionary prism as slab-like bodies with thickness of less than 300 m (mostly <100 m) (Kimura and Ludden, 1995). This characteristic thickness could be controlled by the thickness of saponitization just below the sediment. Although seismic fault rocks have been discovered from basalts in on-land accretionary complexes (Ujiie et al., 2007), frictional properties of altered basalt are not very much considered so far. Experimental investigation on altered basalt is needed to quantify the role of subducting basalt in seismogenic zones.