Crustal Architecture of the EMARK Oceanic Core Complex

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Oceanic core complexes are domal structures uplifted and exposed at the sea floor by long-lived slip along deep-seated, low-angle, detachment faults. This is an important process of crustal accretion, exposing large sections lower crust and upper mantle material at the surface, as well as for the formation of hydrothermal ore deposits. Oceanic core complexes have been observed in ultraslow and slow-spreading mid-ocean ridges, especially along the northern Mid-Atlantic Ridge, however most studies of oceanic core complexes and their associated hydrothermal activity focus on mature complexes in late to end stage development. Research herein examines a young, early-stage oceanic core complex called the EMARK (East Mid-Atlantic Ridge Kane) at approximately 23°N, just south of the Kane Fracture zone on the Mid-Atlantic Ridge and east of the mature Kane oceanic core complex.

In collaboration with Schmidt Ocean Institute, high-resolution bathymetry, remotely operated vehicle dive observations, and sampling at EMARK have uncovered this large, in-situ crustal section in detail. Results from remote predictive geologic mapping illustrate the crustal architecture of the EMARK oceanic core complex from the uppermost paleoseafloor basaltic flows to sheeted dyke complexes to gabbroic sills and mainly gabbroic dome to serpentinites at the exposed fault surface. Active black smoker hydrothermal chimneys were also discovered on an adjacent off shoot of the spreading axis. The abundance of gabbro sampled in addition to local high-temperature hydrothermal venting, suggest robust magmatism during the development of the oceanic core complex, in contrast to the general model of detachment faulting during periods of relatively low magmatism. Furthermore, these findings indicate that oceanic core complex development may increase potential for hydrothermal ore formation providing fluid pathways, even in early stages. This work has implications for the understanding of oceanic core complex evolution, controls on the formation of hydrothermal ore deposits and future exploration of these deposits.