The geodynamics of oceanic core complexes: would subduction occur at ridge-transform intersections?

Yossi Mart
Haifa University, Maritime Studies, Haifa, Israel (y.mart@research.haifa.ac.il)

Oceanic core complexes are lithological assemblages of peridotites and serpentinites, embedded in the basaltic oceanic crust at active or dormant intersections of several slow-spreading oceanic accreting rifts with fracture zones. These occurrences are presumed to derive from the upper mantle, emplaced by low-angle and large-throw normal detachment faults. The abundant serpentinites are attributed to alteration of the ultramafic peridotites during its long ascent from the upper mantle. However the absence of both high-pressure lithologies in the oceanic core complexes and the rareness of earthquakes generated by low-angle normal faulting cast doubt on the validity of this conventional model. Alternately, analog tectonic experiments showed that subduction is a probable process for the generation of oceanic core complexes, because it could develop between two juxtaposed tectonic slabs if their density contrast will exceed 200 kg/m$^3$ with no lateral converging pressure, if the friction between the slabs were low. Indeed oceanic core complexes occur in unique oceanic domains where two basaltic slabs of contrasting densities are juxtaposed across a weakness zone of low friction. Density of fresh basalt at the accreting ridge is approximately 2700 kg/m$^3$ and that of the older basalts, juxtaposed across the fracture zone, is ca. 2900 kg/m$^3$. Slow spreading rates of some ridges would set slabs of significant density contrast across the fracture zone even if the transform offsets are not large. Furthermore, the thermal gradient under the ridge is some 130$^\circ$/km, enabling the metamorphism of the oceanic basalts either to serpentinites or to peridotites at similar P-T constraints, depending on the availability of water. Therefore, it seems that the serpentinites are not secondary products of source-rock alteration, but genetic equivalents to the peridotites. It is presumed therefore that the pliable serpentinite would ascend diapirically through cracks in the over-riding basaltic slab and reach the seafloor, carrying along large blocks of peridotite to produce the serpentinite-peridotite petrology, that lithological association of oceanic core complexes.