Towards a complete profile of hydrothermal alteration in the lower oceanic crust and uppermost mantle; Insights from the Oman Drilling Project and ChikyuOman2017 and 2018

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Drilling a continuous section through the lower oceanic crust and into the uppermost mantle has been an unfulfilled scientific ambition for more than 60 years since before the development of plate tectonics. Although an imperfect analogue of in situ, intact ocean crust, the 96 Ma Samail ophiolite of Oman is the largest and best preserved on-land exposure of ancient ocean crust that formed in some type of fast spreading ocean ridge, in the Tethyan ocean shortly before its obduction on to the Arabian margin. Offset drilling by Oman Drilling Project has now sampled critical intervals of the mid to lower oceanic crust and the uppermost mantle preserved in the Samail ophiolite. In a series of 400 m-deep diamond-cored boreholes the Oman Drilling Project has made with near 100 % rates of recovery, continuous objective observations from the lower sheeted dikes and the dike-gabbro transition zone (Hole GT3A), the mid-crustal transition from foliated to layered cumulate gabbros (Hole GT2A), deep layered gabbros including mineralised fault zones (Hole GT1A), and across the crust-mantle transition from layered gabbros through dunites into residual harzburgites of the Samail upper mantle (Holes CM1A and CM2B). Observations of drillcore, complemented by instrumental (e.g., X-ray CT, Infrared scanning) and geophysical wireline logging, now provide the opportunity to objectively quantify the conditions and extent of seawater-rock exchange in the mid to lower oceanic crust and uppermost mantle. These new observations will lead to better understand the role and influence of deep hydrothermal circulation on the accretion of the lower oceanic crust and the improved quantification of geochemical and isotopic exchanges between the oceans and new crust formed at mid-ocean ridges.

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