Pathways of hydrothermal fluids in fast-spreading oceanic crust: Insights from remote sensing of 1000 km^2 of upper-crust in the Oman ophiolite

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Hydrothermal transformation of basalt to epidosite (epidote + quartz + titanite ± Fe-oxide) in the oceanic crust marks the focused passage of vast quantities of hydrothermal fluid and the liberation of ore metals (Cu, Zn, Au) which may ultimately be deposited in volcanogenic massive sulphide (VMS) deposits on the seafloor. Exposures of epidosites in ancient oceanic crust (e.g. ophiolites) can thus provide insights into the geometries of sub-seafloor fluid pathways and potentially aid exploration for VMS deposits [1]. Here we utilize ASTER-satellite short-wave infrared imagery to map epidosites across the northern Oman ophiolite. One of the challenges of this task is to construct a seamless and consistent mosaic of infrared images to detect all major epidosite occurrences. We describe the steps used to generate and calibrate such a radiometrically-normalized mosaic and how it is processed and thresholded to match test areas of field-mapped epidosite. This permits epidosites outside the test sites to be mapped with confidence.

The resultant alteration map covers ~1000 km^2 of exposed upper-crust and it reveals the abundance of epidosite alteration in Oman. The mapped epidosites indicate that a diversity of hydrothermal fluid pathways exist in fast-spreading ocean crust. These pathways are occasionally narrow and fault-controlled, but more often they have thick strata-bound or pipe-like geometries with cross-sections up to km^2. Flow through these huge replacement bodies is dominantly via the porous rock matrix rather than via fracture porosity.

[1] Gilgen *et al*. (2016) *Lithos* 260, 191-210.