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Hydrothermal fault zones in the lower oceanic crust: An example from the Samail ophiolite, Oman

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Hydrothermal circulation is a key process for the exchange of chemical elements between the oceans and the solid Earth and particularly for the extraction of heat from newly accreted crust at mid-ocean ridges. However, due to a dearth of samples from intact oceanic crust, or continuous samples from ophiolites, there remain major short comings in our understanding of hydrothermal circulation in the oceanic crust, especially in the deeper part. In particular, it is unknown whether fluid recharge and discharge occurs pervasively or if it is mainly channeled onto discrete zones such as faults. Here, we present a description of a hydrothermal fault zone that crops out in the layered gabbro section, of Wadi Gideah in the Samail ophiolite in Oman, which might be a channel of enhanced fluid flow. Field observations reveal an approximately one meter-thick chlorite - epidote normal fault with heavily altered gabbro clasts in the center. In places there is copper mineralization within the chlorite – epidote zone. In both, the hanging and the footwall the gabbro is heavily altered and veined, mainly with amphibole, epidote, prehnite and zeolite veins. Even though the fault zone is within the layered gabbro section, and perhaps only 1 km above the crust-mantle boundary, the gabbro around the fault zone shows highly variable textures.
Preliminary strontium isotope whole rock data yield $^{87}Sr/^{86}Sr$ ratios of $\sim$ 0.7046, which are considerably more radiogenic than “fresh" gabbro from the Oman ophiolite ($^{87}Sr/^{86}Sr$ = 0.7026 – 0.7030), and similar to black smoker hydrothermal signatures based on epidote, measured elsewhere in the ophiolite.