The influence of exsolved magmatic fluids in back-arc crust: Epidosites and base metals

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Epidosites are epidote-quartz rocks irregularly replacing diabase dykes in modern back-arc basins and SSZ ophiolites. Their sole occurrence in ocean spreading settings where magmas are more hydrated than MORB may suggest contribution of magmatic water into hydrothermal systems, hitherto considered as circulating pure seawater. Thermodynamic modelling indicates that the multi-variant assemblage of epidosites should coexist with magmatic volatile species like HCl and SO_4, which are necessary for removal of the mafic mineral assemblage in diabase.

Epidote in miarolites of plagiogranites, at the root-zone of the hydrothermal system in the Troodos ophiolite, Cyprus, was shown to be auto-metasomatic in origin, having been precipitated by magmatic fluids (Anenburg et al., 2015). Here, we show evidence for exsolution of plagiogranite-derived fluids through the upflow zone (sheeted dykes) to the seafloor (pillow lavas) by means of REE zoning in ubiquitous epidote. Epidotes from diabase-hosted epidosite in the vicinity of Chandria plagiogranite are progressively zoned from ΣREE-rich-Eu-poor core to ΣREE-poor-Eu-rich rim, resembling evolving REE patterns of hydrothermal epidotes in the adjacent plagiogranite. Amygdule-filling epidote from the upper pillow lavas show similar REE patterns, illustrating the prevalence of the magmatic signatures throughout the upper crustal section of the Troodos ophiolite. Chalcopyrite occurs in quartz-epidote veins within an epidotized diabase adjacent to the Spilia plagiogranite. The base metal sulphides appear to be confined to areas that are highly epidotized, while ΣREE contents of the epidote equal those of the miarolite 'magmatic-derived' epidotes. This association is repeated in amygdules of the upper pillow basalts where, Cu and Ni sulphides are precipitated synchronously with epidote. Mobilization of both base metals and REE in the hydro-thermal system in Troodos requires complexation by magma-derived species.