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Trace element mobilisation in garnet-phengite HP veins along a metabasite-micaschist contact: an example from the Ile de Groix, France

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Whole rock trace element and isotopic compositions of different HP–LT metamorphic rocks of the Ile de Groix, a late Palaeozoic HP terrane, characterize the geochemical processes during subduction and exhumation. Open system fluid-rock interactions during the early stages of subduction (hydrothermal alteration, metasomatism related to sediment-derived fluids) resulted in an increase of δ18O values, as well as K2O, Na2O, MgO, and large ion lithophile element (LILE) content, and a decrease of CaO content of metabasites. During the HP-LT event, fluid-rock interactions were of a closed system nature and most metabasites retained their early-subduction trace element and isotopic compositionsup to lower eclogite-facies P–T conditions.

However, rare eclogitic veins are multi-stage veins with a cumulate fluid flow at HP conditions (El Korh et al., 2011). They are phe-grt-ep-rt-ilm-qtz-ab-pg-ap bearing, dominated by garnet and phengite and are hosted in metasomatised eclogite facies metabasites with a grt-agr/jd-barr-gln-rt-ep-qtz-ab-chl-ilm-mt assemblage (peak conditions: $\sim$ 2.0 GPa; 450–550°C) in contact with metapelites.

The HREE and HFSE enrichments in garnet and rutile, as well as the LREE enrichment in epidote of the veins, result from a mass transfer from the host metabasite involving an internally-derived fluid during the first stage of vein formation. The fluid was able to mobilise the REE and HFSE on a small scale, but precipitation thereof within the vein minerals. During the second stage of vein formation, the fluid responsible for the formation of phengite, chloritoid, ilmenite and garnet rims contained LILE and REE. Addition of an external fluid is necessary to explain the LILE enrichment. The phengite content in the vein (20–25%) is too high to originate from the host metabasites (only 3–5% phengite), suggesting an input of a pelite-derived fluid from the neighbouring micaschists in addition to the metabasite-derived fluid.

The fluid δ18O values of 10.8–12.1‰ (relative to VSMOW) calculated in equilibrium with garnet and phengite from the vein suggest a mix between two sources, but does not allow the internal and external fluid inputs to be quantified as the two sources (host metabasites: 8.9–9.6‰ and near-by metapelites: 11.3–12.1‰ have isotopic values that are close ($\pm$ 3‰.

Eclogitic garnet-phengite veins along metabasite-metapelite contacts support local fluid migration and mass transfer from surrounding source rocks to veins. The vein provides evidence of a small-scale transport of LILE, HREE and HFSE. HREE and HFSE mobility requires intense fluid-rock interaction, and necessitates destabilisation of the prograde HFSE- and HREE-rich minerals (e.g. titanite, garnet) of the vein-hosting rocks.

REFERENCES

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