

Fluid-assisted destabilization of accessory minerals in the granitic rocks of Veporic basement (Western Carpathians, Slovakia)

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A variety of accessory mineral breakdowns were identified in host Variscan orthogneisses and associated Permian aplites from the pre-Alpine basement in the Veporic Unit, Western Carpathians, Slovakia. Chemical U-Th-Pb dating of monazite I and xenotime I reveal their primary magmatic Ordovician age (472 ± 4 to 468 ± 6 Ma) and/or metamorphic-anatectic Variscan (Carboniferous) age (345 ± 3 Ma). One important alteration comprised the formation of uraninite inclusions in altered xenotime II most likely resulting from dissolution-precipitation between early crystallizing xenotime I and late-magmatic granitic fluids. Partial to full monazite I breakdown stems from at least two-stage hydrothermal activity. Related fluids released REE, Th and P from former monazite I, and also Ca, Fe, Al, Si and F from adjacent biotite, primary apatite I and plagioclase, to form the apatite II + ThSiO₄ phase and the allanite II-clinozoisite coronas. The formation of secondary S-rich monazite II ± barite most likely results from interacting of higher greenschist facies metamorphic fluids rich in S under low pH and high $f(\text{O}_2)$ conditions. In contrast, the circulation of more alkaline and lower T , CO₂-rich metamorphic-hydrothermal fluids led to REE carbonate formation at the expense of primary allanite I, former minerals in secondary monazite coronas and alteration of base-metal sulfides to cerrusite and carbonate-bearing phosphohedyphane-“hydroxylphosphohedyphane”. Finally, calcite is the youngest secondary mineral crystallized in vugs and fissures.

While earlier impact of post-magmatic fluids originated probably from Permian acidic volcanic and microgranitic veins crosscutting the orthogneisses, another fluid-rock interaction event most likely occurred during Late Cretaceous metamorphism in the Veporic basement and covering rocks. This stage indicates carbon-bearing fluids precipitating the carbonate minerals and derived from metamorphosed carbonates at shallower exhumation level.

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