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ABSTRACT BOOK

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FLUID-INDUCED ALTERATION OF CHEVKINITE-(Ce) AND STRUCTURAL ORIENTATION RELATIONS AT THE PHASE BOUNDARY

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During hydrothermal alteration, the REE-bearing minerals of the chevkinite group (CGM) have the potential to release not only REE but also high field-strength elements and the actinides, into the fluid, such they can act as both a storehouse as well as a source of these elements in fluid-altered systems. A commonly observed alteration sequence in natural rocks is chevkinite → titanite plus a REE phase, such as allanite and bastnäsite. To provide quantitative information on such reactions, we have experimentally subjected a natural chevkinite-(Ce) from the Diamer District, Pakistan to fluid-induced alteration involving a $Ca(OH)_2$-bearing hydrous fluid. The experimental conditions were: temperature 600°C; pressure 400 MPa; duration 21 days. Natural albite and quartz were added to the charge to simulate natural rock-forming conditions more closely.

Significant reaction between the chevkinite-(Ce) and fluid occurred, with the formation of titanite and britholite-(Ce), plus minor hedenbergite. The nature of the reaction zones was very variable. Commonly, the rims of chevkinite-(Ce) were replaced by thin zones comprised first of britholite-(Ce) followed by titanite.

Electron backscatter diffraction (EBSD) within SEM allowed us to observe the crystal structure orientation of individual crystallites, and to distinguish their boundaries within one phase or on interphase border. Mutual orientations on the interfaces between chevkinite-(Ce) and britholite-(Ce), wollastonite and pyroxene; britholite-(Ce) and titanite, wollastonite and plagioclase were determined.

EBSD imaging also confirmed the presence of a rare fluoride, $Na(Ca,Ce)(Ce,Ca)F_6$. Its counterpart in nature is gagarinite-(Ce), a mineral known from only one locality, the Strange Lake pluton, Canada, where it occurs in a hypersolvus granite, and has never been recorded in association with CGM. Gagarinite-(Ce) was structurally identified using EBSD in order to confirm the WDS quantitative element composition. Sodium devolatilization was found to occur over time during WDS analysis. This caused an artificial increase in the apparent concentrations of the other elements in the gagarinite-(Ce), which resulted in an imbalance in the chemical formula. An alternative approach with multiple EDS measurements was established to correctly determine the gagarinite-(Ce) composition. It consisted of a reduction in the spot exposure to the electron beam by ca. 150 nA·s, and simultaneous analysis of all elements, which gave better counting statistics per element without damaging the sample.

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