Hydrothermal circulation of REE in the Cobequid Shear Zone: The importance of timing and style of hydrothermal alteration

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The Cobequid Shear Zone, in mainland Nova Scotia, consists of a series of subparallel faults, which were active from late Devonian to late Carboniferous. The development of the shear zone is associated with a regional-scale magmatic event that resulted in the emplacement of substantial volumes of volcanic rocks and a number of plutonic bodies along the faults. The plutons consist principally of REE-enriched A-type granite and variable amounts of gabbro, whereas the volcanic rocks consist of chemically equivalent rhyolite and basalt. Different styles of hydrothermal alteration have been identified after the emplacement of the plutons, for over a period of millions of years, including sodic, potassic, and iron alteration. The REE-minerals found in one of the Wentworth plutons present a paragenetic sequence from magmatic to hydrothermal stages. However, the extent and nature of REE-enrichment in the rest of the plutons of the Cobequid Shear Zone was unknown. This study reveals that the REE were mobilized and introduced from the host granites to hydrothermal solutions across the shear zone. Textural relationships and mineral associations provide evidence of repeated REE circulation that resulted in the formation of several types and generations of minerals such as bastnäsite-(Ce), parisite-(Ce), synchysite-(Ce), cerite, thorite, hingannite-(Y), chernovite-(Y) and Nb-rich minerals. Bastnäsite-(Ce) and thorite were among the first REE-minerals to precipitate in epidote veins in the eastern part of the shear zone, under rather reducing conditions. The majority of the REE-minerals such as cerite, parisite-(Ce), synchysite-(Ce) and hingganite-(Y) are hosted in chlorite- magnetite and biotite veins in the central and western parts of the Cobequid Shear Zone. The highest abundances of hydrothermal REE-minerals are observed in late magnetite- rich veins, formed under strongly oxidizing conditions, in the central part of the shear zone close to the Cobequid fault. In such veins, chernovite-(Y) forms after the alteration of hydrothermal hingganite-(Y). The relative timing of fracturing and hydrothermal circulation, along with the type of circulating fluids, appears to be crucial controlling factors for the formation and distribution of post-magmatic REE-minerals across the Cobequid Shear Zone.

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