Hydrothermal alteration in the Clarke Head Fault Zone, Nova Scotia, Canada

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At Clarke Head on the north coast of Minas Basin, Upper Devonian–Lower Carboniferous igneous and sedimentary rocks outcrop in a fault zone megabreccia. The hydrothermal alteration at Clarke Head is compared with that elsewhere in the Cobequid Highlands in order to better understand its origin and age. The Cobequid Shear Zone was a group of faults active during the latest Devonian–early Carboniferous. It was then reactivated in the middle Carboniferous, as part of the Minas Fault Zone, which led to brittle deformation that is displayed at Clarke Head. At Clarke Head, distinctive types of hydrothermal alteration occur in both sedimentary and igneous rocks. Hydrothermal veins and alteration were documented in the field and the petrography of igneous and hydrothermal samples was studied by SEM and electron microprobe. Rocks lithologically similar to the lower Horton Group are cut by veins of albite ± quartz ± chlorite. Younger rocks of the Windsor Group and West Bay Formation are cut by veins with the following sequence of minerals: quartz + chlorite → calcite + ankerite → Feoxides + TiO_2 → barite + xenotime. Sodic alteration occurs elsewhere in the western Cobequid Highlands in granite plutons and the lower Horton Group, where it is dated at ~355 Ma. The assemblage of ankerite, Fe and Ti oxides, barite, and xenotime is characteristic of mineralization along the Minas Fault Zone with an age of ~ 327–310 Ma.The igneous rocks of Clarke Head include blocks of gabbro granulite, which has been previously investigated and is not included in this study. The gabbro consists of hornblende, K-feldspar, ilmenite, and Fe-oxides, with secondary epidote, and small patches of analcime, scapolite, and albite. The diorite consists of K-feldspar, amphibole, and Fe-oxides, with secondary scapolite, analcime, and quartz, and has an igneous contact with Horton Group siltstone. The syenite consists of magmatic K-feldspar, albite, titanite, rutile, and a small amount of quartz, but is highly altered. Scapolite almost fully replaces K-feldspar, analcime occurs in multiple generations replacing perthitic albite and possibly occurring interstitially, and titanite and rutile occur as both primary and secondary phases. Potassium released during this alteration may be represented by widespread biotitization in some Cobequid fault zones around ~345 Ma. Clarke Head thus demonstrates the full extent of hydrothermal alteration in the Cobequid Highlands, in sedimentary rocks and igneous rocks.

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