Compositional variation in Fe-Ti-Nb-Ta oxides, South Mountain Batholith, Nova Scotia

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The South Mountain Batholith (~372 Ma) is a large, differentiated, peraluminous, granitic intrusion in southwestern Nova Scotia. Iron-titanium oxide minerals are rare in the batholith, but all polished thin sections prepared from thirty whole-rock samples covering the entire compositional range of the batholith contain oxide minerals. The two principal oxide minerals are: ilmenite-pyrophanite solid solution, occurring as prismatic, or blocky 0.05–0.90 mm grains in biotite, as well as larger, massive discrete grains along grain boundaries; and Nb-Ta rutile, occurring as massive, or blocky to acicular 0.03–0.70 mm grains in biotite. These textural relations suggest that the oxide minerals are primary magmatic. The ilmenite-pyrophanite solid solutions overall contain 3–23% MnO, with much of the compositional range occurring within single samples. The ilmenite cores have lower manganese contents (5–11% MnO) than the rims (7–14% MnO). The rutile grains consist of two types: (i) high Nb_2O_5 (up to 15 wt. %) with Nb_2O_5 / Ta_2O_5 ~ 4; and (ii) low Nb_2O_5 (less than 4 wt. %) with Nb_2O_5 / Ta_2O_5 << 4. The high Nb_2O_5 grains are mostly isolated grains, whereas the low Nb_2O_5 grains are more common as elongate grains parallel to cleavage in biotite. Normally, niobium and tantalum are incompatible elements with similar ionic radii, and charge (+5), which cause them to act together in the melt, but these two elements clearly fractionate strongly at the mineralogical level.

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