The West Moose River anorthosite, Cobequid Highlands, Nova Scotia

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The West Moose River anorthosite occurs as rare blocks (cm to m in size) in a gravel pit along the Cobequid Fault near West Moose River together with abundant blocks of magnetite/ilmenite rock (some of which show contacts with anorthosite). The abundance of anorthosite and magnetite/ilmenite blocks in the gravel pit and their absence in either outcrop or drift elsewhere in the region suggests that they are associated with, and restricted to, the Cobequid Fault zone. A prominent magnetic anomaly extends about 5 km along the Cobequid Fault zone in this area.

The anorthositic rocks consist of feldspathic anorthosite, gabbronorite and megacrystic gabbronorite with orthopyroxene and amphibole megacrysts. The orthopyroxene (matrix and megacryst) has a limited compositional range from En_{62}-En_{70}. The orthopyroxene megacrysts are very aluminous (up to 8.0% Al_2O_3). The matrix amphibole is ferroan pargasitic hornblende and the amphibole megacrysts are tschermakitic hornblende and magnesio-hornblende. A number of lines of evidence suggest original in situ growth for the megacrysts. The oxide rocks comprise coarse-grained magnetite (45%), ilmenite (40%), spinel (Mg-rich hercynite) (10%), and minor hematite and titano-magnetite (<5%), all of which show exsolution lamellae. The oxide rocks poikilitically enclose silicate mineral and sulfides. Feldspathic anorthosites have a corona texture at their contact with oxides, with a minimum temperature of formation of 600°C. The sulfides identified include: pyrrhotite, various types of pentlandite, chalcopyrite and some late pyrite.

A Nd-Sm isochron indicates that the anorthosites are unrelated to the Devonian-Carboniferous gabbros and are of Mesoproterozoic age. They thus provide further evidence for Mesoproterozoic basement slivers in the "outboard" terranes of the Appalachians. Various textural evidence and the assemblage of pentlandite, pyrrhotite, and Mg-rich spinel in the oxides all suggest a genetic link between the oxides-sulfides and the anorthosites. How was such a middle crustal rock assemblage brought to upper crustal levels? Three hypotheses are examined:

a) magmatic rafting in the Carboniferous. Given that the anorthosite occurrence comprises > 70% oxides with a high S.G., this seems improbable.

b) Carboniferous uplift in a strike-slip zone like that suggested for late Devonian-early Carboniferous mafic granulites at Clark Head, which formed at 9 kbar (25 km depth if pressure was all lithostatic) from a magma isotopically and geochemically similar to that of the Wentworth Pluton. Maximum uplift of Carboniferous granite plutons along the Cobequid Fault zone is estimated as 8 km for Pleasant Hills from amphiboles, of which perhaps 4 km is Triassic. The Clarke Head granulites might have a few km diapiric uplift in addition. The lack of higher grade metamorphic detritus in local Carboniferous basins is a problem if there were widespread vertical Carboniferous tectonic transport in the Cobequid fault zone.

c) Late Neoproterozoic uplift resulting from slab detachment or convective thinning of lower lithosphere. This process could account for the unusual formation of amphibole megacrysts and the 600°C coronas on the feldspathic anorthosites. This hypothesis would preclude a Grenville origin for the anorthosites.

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