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STABLE ISOTOPIC CHARACTERISTICS and MAGMATIC HISTORY of META-IGNEOUS ROCKS, ADIRONDACKS NY

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The Adirondack Highlands contain dominantly meta-igneous rocks including the anorthosite-granite association and a wide variety of unrelated orthogneisses from gabbroic to granitic composition. The internal variation of oxygen isotopes within Adirondack meta-igneous suites related to the Marcy anorthosite shows that elevated $\delta^{18}O$ is a compositionally dependent characteristic of the protolith. Analysis of $\delta^{18}O$ in previously unsampled compositions in this suite has led to a stable isotopic, petrographic and major element description of a continuous range of rock types from two-pyroxene, oxide rich monzonitic gneiss to mesoperthite, quartz rich granite gneiss within the Tupper and Saranac sheets on the NW margin of the Marcy anorthosite. This expanded data set has allowed the formulation of a semi-quantitative model, based both in thermodynamics and mass balance, for the AFC magmatic evolution of this suite. A sampling traverse of the Snowy Mountain dome anorthosite and related halo of granitic gneiss in the southern Adirondack Highlands shows the concentric spatial distribution of $\delta^{18}O$ in granites around anorthosite, constrains the extent of interaction between anorthosite and granite, and provides an additional example of crustal interaction in the magmatic evolution of this suite. This evidence, combined with previous work (Morrison and Valley, 1988), documents extensive crustal interaction in region-wide anorthosite-granite plutonism prior to the peak of Grenville metamorphism.

This suite's compositional and isotopic continuity is in sharp contrast with data for a variety of other Adirondack Highlands lithologies currently defined as orthogneisses. Values of $\delta^{18}O$ for charnockites, hornblende and fayalite granites, and gabbroic rocks range from +6.5‰ to +12.1‰, and show little or no relationship to composition. We consider this to reflect the diverse origins of the protoliths, which may include metasediments in some cases.

Qtz, Fsp, Mt, Px and Hb mineral separates from a broad range of the samples in this study record consistently discordant isotopic temperatures ranging from Mt-Fsp of 490 °C to Qtz-Fsp of 1000+ °C. Calculations after the method of Giletti (1986) show that mineral separate data are consistent with closure of minerals with respect to diffusion on cooling. Order of closure appears to have been (from first to last) Qtz, Px, Hb, Mt, Fsp. This is taken as evidence that these rocks were a closed system during their high temperature history, and that post-metamorphic infiltration/alteration did not significantly effect bulk mineral $\delta^{18}O$. Relatively low closure temperatures for pyroxene needed to fit the data may reflect the short-circuiting of diffusion distances by fine scale exolution. It is concluded that stable isotopes provide detailed evidence of the protolith characteristics, scale of metamorphic exchange and cooling history of Adirondack orthogneisses.