Geophysical Research Abstracts, Vol. 7, 01056, 2005
SRef-ID: 1607-7962/gra/EGU05-A-01056

New constraints on metamorphic history of Adirondack's diopsides (NY, USA): Modeling of Al and ^{18}O diffusion profiles

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A detailed electron and ion microprobe analysis of diopside single crystals extracted from a block of marble (Cascade Slide xenolith) collected in the Mt Marcy anorthosite massif (Adirondack Highlands, New York) shows that crystals have preserved zoning features from early crystallization history later modified by regional metamorphism. Diopsides show systematic Al and Si complementary zoning, average Al concentration in rims is constant (0.11 pfu) but values in the cores vary with crystals from 0.06 to 0.14 pfu. We measured a single ∂^{18}O profile along the same path as an Al profile; it exhibits a correlated zoning. We are doing more detailed ∂^{18}O profile analyses in order to confirm this result.

Modeling of Al and ^{18}O diffusion that affected the crystals during the regional metamorphism of the Grenville orogeny suggests that original zoning was sharp and corresponds to a rapid change of crystal growth conditions: (1) cores crystallized from different local environments leading to different cores' compositions (2) a pervasive event abruptly changed the growth conditions of grains leading to uniform average concentration in rims. A strong decrease of ∂^{18}O from 20 ‰ to less than 18 ‰ is observed within the first 125 microns at the edges of diopside. The profiles and low values of ∂^{18}O in the core of the crystal cannot be explained by post-metamorphism cooling, it suggests that ∂^{18}O concentration of surrounding calcite changed during metamorphism probably linked to extended fluid infiltrations during contact metamorphism.