

New constraints on metamorphic history of Adirondack diopsides (New York, U.S.A.): Al and $\delta^{18}\text{O}$ profiles

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ABSTRACT

Detailed electron- and ion-microprobe analysis of diopsides extracted from a block of marble collected in the Mt. Marcy anorthosite massif (Adirondack Highlands, New York) shows that single crystals have preserved Al-Si zoning features from early contact metamorphism later modified by regional metamorphism. Diopsides show Al and Si complementary zoning from core to rim; 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. A $\delta^{18}\text{O}$ profile measured with the ion microprobe shows no zoning. Modeling of the Al-diffusion profiles affected by regional metamorphism of the Grenville orogeny shows that original Al zoning was sharp and corresponds to a rapid change of crystal-growth conditions during early contact metamorphism: (1) diopside cores crystallized with variable Al contents due to restricted fluid circulation or differing sedimentary composition, (2) then pervasive fluid infiltration crystallized the homogeneous rim of diopside, and (3) core to rim Al zoning was later smoothed by granulite-facies metamorphism. Homogeneity of $\delta^{18}\text{O}$ in core and mantle (near rim) of diopsides suggests that the crystals were isotopically homogeneous prior to and during regional metamorphism. Values of Al-Si diffusion coefficient deduced from modeling are in agreement with low-temperature extrapolation of experimental data.

Keywords: Diopside, zoning, granulite, diffusion, ion probe, oxygen isotopes, Adirondack