CORRELATION BETWEEN OH CONTENT AND OXYGEN ISOTOPE DIFFUSION RATE IN DIOPSIDES FROM THE ADIRONDACK MOUNTAINS, NEW YORK

JOHNSON, Elizabeth A., and ROSSMAN, George R., Div. of Geological & Planetary Sciences, California Institute of Technology, Pasadena, CA 91125, liz@gps.caltech.edu; VALLEY, John W., Dept. of Geology and Geophysics, University of Wisconsin, Madison, WI 53706

The concentration of structural OH in diopside was determined for four granulite facies siliceous marble samples from the Adirondack Mountains, New York, using FTIR spectroscopy. These samples were characterized as having undergone wet (faster diffusion), dry (slower diffusion), or intermediate amounts of oxygen isotope exchange during cooling by Edwards and Valley (1998, GCA 62, 2265). We expect that a greater structural OH content will increase the oxygen diffusion rate in diopside, because the diffusion rate is faster in minerals at high $P(H_2O)$, and the incorporation of OH into anhydrous minerals also increases with $P(H_2O)$. Single-crystal polarized IR spectra in the three optical directions were measured on (100) and (010) sections of diopside for each sample. The number and relative intensity of OH bands in the 3700-3200 cm^{-1} region vary among samples. Total OH content in the diopsides ranges from 55 to 138 ppm H_2O by weight, calculated using the integral absorption coefficient of Bell et al. (1995, Am. Min. 80, 465). Because the difference in $\delta^{18}O$ between the largest and smallest grains of diopside ($\Delta^{18}O$(large-small)) in each sample is indicative of the degree of oxygen diffusive exchange, the OH concentration in diopside was plotted versus $\Delta^{18}O$(large-small) for each sample. The OH concentration in diopside increases monotonically with increasing $\Delta^{18}O$(large-small). There is no significant variation in OH content within a single diopside grain or among diopside grains from the same sample. For these Adirondack rocks, the hydrogen must have been present in the diopside structure during peak metamorphism (~750°C, 7-8kb) and initial stages of cooling. It is unlikely that water infiltrated these anhydrous granulites at the peak of metamorphism, and thus hydrogen in the diopside was probably inherited from the original sediments and retained because of charge balance constraints on hydrogen substitution in the crystal structure. This is the first study of natural samples to show a definite link between OH content in anhydrous minerals and oxygen isotope systematics, a separate indicator of fluid history.

Key words: diopside, OH-content, oxygen-diffusion, metamorphism, Adirondacks