**ORDINARY CHONDRITE PYROXENE THERMOMETRY - ONE MORE TIME,** Michael T. Colucci and Roger H. Hewins, Dept. of Geological Sciences, Rutgers University, New Brunswick, N.J. 08903

**Introduction** The equilibration temperatures of type 6 ordinary chondrites are important parameters of models of the thermal history of their parent bodies. Analyses of orthopyroxene and augite in H6, L6 and LL6 chondrites were previously interpreted as all recording the same temperature (1,2), but pyroxene thermometry has recently undergone major revisions (3,4). The new thermometer has here been applied to the original data set (2) to redefine the apparent metamorphic temperatures of the equilibrated chondrites.

**Results** Temperatures were derived by the Lindsley method (3,4) for all augite and orthopyroxene analyses available (2) except for two anomalous augite analyses (one very Ca-poor, one very Na-rich). Fig. 1 shows two portions of the pyroxene quadrilateral with isotherms. Recalculated end-member compositions for 2-3 grains of each phase in 6 H6s, 7 L6s and 6 LL6s are plotted in Fig. 1.

Orthopyroxene temperatures derived graphically are imprecise, since the orthopyroxene limb of the miscibility gap is very steep. (1 mole % Ca approaches 200°). Orthopyroxene temperatures average about 740°C for all equilibrated chondrites. Augite temperatures are preferable for comparing H, L and LL chondrites since the graphical error is negligible. Temperature estimates for one rock from augite compositions are usually within 50° and always within 100°, unlike those from orthopyroxene. Augite appears reasonably well equilibrated. Augite temperatures are 867°C (s.d.=42, n=15) for H6s, 907°C (s.d.=34, n=15) for L6s and 905°C (s.d.=35, n=15) for LL6s. The non-quadrilateral components in all groups are the same (about 4.8%).

The generally lower temperatures for orthopyroxene than augite were noted for metamorphic rocks by Lindsley (2) and attributed either to imprecise calibration of the thermometer or a variety of problems with the sample history and analysis. We believe that the augite temperatures are more accurate, since (a) for chondrites they are close to the 947°C temperature derived from oxygen isotopes (5) and (b) for terrestrial metamorphic rocks they are closer to temperatures obtained by other techniques.

**Discussion** The present results show significantly lower temperatures for H6s than for L6s, because of the higher calcium content of H6 augite. This conclusion could not be changed without making drastic modifications to the slope of the isotherms in the quadrilateral or very many more probe analyses of chondrite pyroxenes. (The latter test is definitely desirable). The lower temperature for H6s was not expected from previous thermometry (1) but is in accord with certain theoretical predictions. Miyamoto et al. (6) modelled the thermal history of the H and L parent bodies assuming internal heating by 26Al decay and predicted an H6 temperature about 75° lower than for L6. This model is attractive because it works with the duration of thermal metamorphism obtained from chondrite radiometric data. The present finding of a lower augite temperature for H6s than for L6s tends to support this internal heating model.
References


Figure 1. Parts of the pyroxene quadrilateral showing isotherms and Lindsley compositions of augite and orthopyroxene in H6 (circles), L6 (triangles and LL6 (squares) chondrites