PLAGIOCLASE IN TYPE 4-6 ORDINARY CHONDRITES: AN INDICATOR OF METAMORPHIC PROCESSES. R. H. Jones and H. A. Kovach. Department of Earth and Planetary Sciences, University of New Mexico, Albuquerque, NM 87131. E-mail: rjones@unm.edu

Introduction: Plagioclase is understood to be a secondary mineral in metamorphosed ordinary chondrites (OC), resulting from crystallization of chondrule mesostasis that is present in unequilibrated chondrites [e.g. 1]. However, the development of plagioclase in type 4-6 OC has not been studied in great detail. Although coarsening of plagioclase grains is used as an indicator of petrologic type [2], this classification parameter has not been described quantitatively. Plagioclase is generally considered to be homogeneous in composition [1]. We considered the possibility that if plagioclase crystallizes from chondrule mesostasis, which shows a wide range of composition in petrologic type 3 [e.g. 1], we should be able to observe a progressive equilibration of plagioclase compositions with increasing metamorphic grade. This might have the potential to be a quantitative indicator of the degree of metamorphism that a chondrite has experienced.

Results: We identified relict chondrules containing plagioclase in several type 4-6 H and LL chondrites, and obtained EPMA analyses of plagioclase. Although plagioclase grains were harder to find in type 4 chondrites, we found grains >70 µm across in all chondrites, including H4 and LL4.

H chondrites. Plagioclase compositions in all the H chondrites studied (Avanhandava H4, Oro Grande H5, Richardton H5, Estacado H6, Nazareth(e) H6) are similar in composition, showing little variation with petrologic type and compositions similar to those summarized by [1], average $An_{12}Ab_{82}Or_6$.

LL chondrites. Plagioclase compositions vary significantly among three chondrites studied. In Bjurböle (LL4), plagioclase in individual chondrules shows a narrow range of compositions, but in individual chondrules mean compositions range from An_5 to An_{85}. In Tuxtuac (LL5), the spread of An contents is less, with means in each chondrule ranging from An_6 to An_{16}. In several chondrules we observe exsolution of K-feldspar, e.g. a K-feldspar composition of $An_3Ab_{18}Or_{79}$ associated with albite of composition $An_9Ab_{89}Or_2$. In St. Séverin (LL6), all plagioclase is albitic with an average composition $An_{10}Ab_{84}Or_6$.

Discussion: Plagioclase grain size parameters for type 4, 5 and 6 OCs [2] are not useful classification criteria. For the H chondrites, it appears that compositional equilibration of chondrule mesostases occurred before plagioclase grains grew. In contrast, in the LL chondrites, plagioclase appears to have crystallized before mesostases equilibrated. Although it appears that plagioclase shows progressive equilibration from petrologic type 4 to 5 to 6, this is not realistic under conditions proposed for metamorphism [e.g. 3] because diffusion of framework cations in plagioclase is very slow [4]. Instead, it appears that chondrule mesostasis had undergone varying degrees of equilibration at the time when plagioclase crystallized. Alkali feldspar exsolution in the type 5 LL chondrite but not the type 6 indicates slower cooling in the type 5, which is inconsistent with a simple "onion shell" model for the thermal history of the LL parent body.

References: [1] Brearley A. J. and Jones R. H. 1998. *Planetary Materials*, ed. J. J. Papike, RIMS vol. 36. [2] Van Schmus W. R. and Wood J. A. 1967 *Geochim. Cosmochim. Acta* 31, 747-765. [3] Bouvier A. et al. 2007 *Geochim. Cosmochim. Acta* 71, 1583-1604. [4] Grove T. L. et al. 1983. *Am. Mineral.* 68, 41-59.