CHONDRULE MESOSTASIS CATHODOLUMINESCENCE AND COMPOSITION: IMPLICATIONS FOR (1) METAMORPHISM AND AQUEOUS ALTERATION IN LOW TYPE 3 ORDINARY CHONDRITES AND (2) SELECTION EFFECTS IN CHONDRULE STUDIES. Derek W.G. Sears and John M. DeHart, Cosmochemistry Group, Department of Chemistry and Biochemistry, University of Arkansas, Fayetteville, AR 72701.

Evidence for aqueous alteration in type 3.0-3.2 ordinary chondrites are observations of calcite and smectite in Semarkona (1,2). 'Consistent' and relevant observations are that (i) water released by step-wise heating has extreme deuterium enrichments (3); (ii) hydrothermal annealing treatments cause 10-fold decreases in TL sensitivity (4); and (iii) there is a weak inverse correlation between deuterium enrichment and TL sensitivity for individual Semarkona chondrules (5).

In terms of mesostasis CL and composition there are two types of chondrule in Semarkona (6), one whose mesostasis luminesces brightly and is plagioclase normative (type A, 60% of chondrules, generally type I of refs. 7,8), and one which does not luminesce and is quartz/orthoclase normative (type B, 40% of chondrules, generally type II). Compositional data make it clear that these two chondrule types are not related to each other through aqueous processes, but represent differences in chondrule formation conditions (peak temperatures and post-formational cooling rates); differences in formation location might also be involved. Ref. 9 used olivine data to come to a similar conclusion. This being so, what can be learned from the TL sensitivity/deuterium data?

The compositional difference between the two chondrule mesostasis types is best demonstrated on CaO-Na_2O plots. As Fig. 1 shows, while 60% of the chondrules observed in thin section are type A, only < 12% of the chondrules physically separated for isotopic work are of this type. (The 12% figure may be over-estimated, since some CAI may be included.) It seems unlikely that a selection effect is present in the thin section data, since these studies were systematic in nature and the same results found independently in three other meteorites. Rather, it seems that type A chondrules are less capable, than type B, of surviving the gentle disaggregation necessary for physical separation. Thus it is only type B chondrules that are represented in the data responsible for the deuterium-TL sensitivity trend. We conclude that (1) while aqueous alteration is not the process responsible for the major variations in chondrule properties, it may be playing a secondary role (i.e. causing variations in TL sensitivity within the types A and B); (2) studies based on chondrules separated from type 3 ordinary chondrites by handpicking are not dealing with representative samples.

1 Nagahara (1984) GCA 48, 2581. 2 Hutchison et al (1988) GCA 51, 1875. 3 McNaughton et al (1981) Nature 294, 639. 4 Guimon et al (1988) GCA 52, 119. 5 Sears et al (1988) LPS XIX 1051. 6 DeHart et al (1989) GCA submitted. 7 McSween (1977) GCA 41, 477. 8 Scott and Taylor (1983) Proc. 14th LPSC B275. 9 Jones and Scott (1989) Proc. 19th LPSC 523. Supported by NASA grant NAG 9-81.

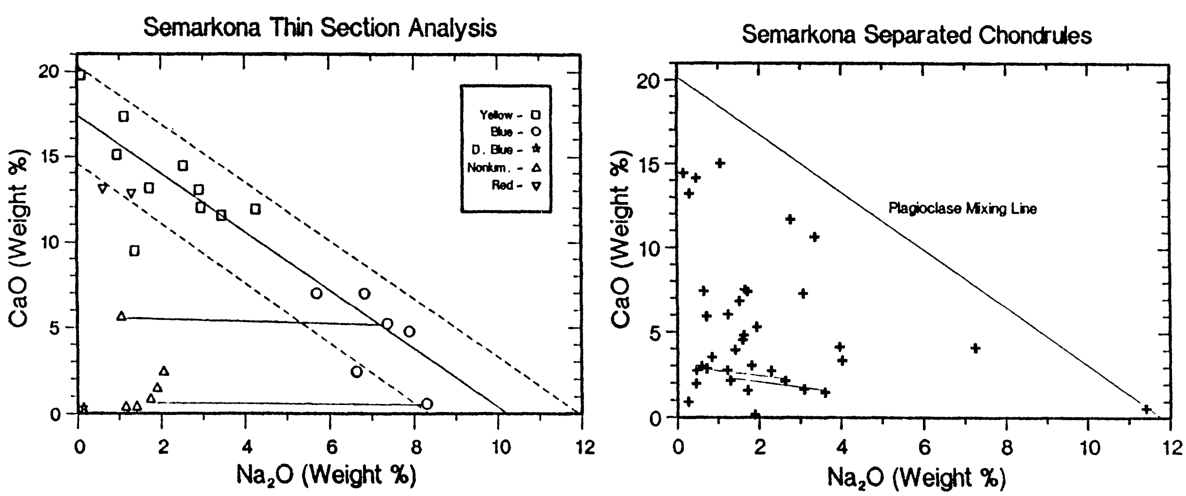

Fig. 1. CaO vs Na_2O for the mesostasis of chondrules in the Semarkona type 3.0 ordinary chondrite. Left, data obtained from a thin section (6); right, data obtained for physically separated chondrules (5).