CLASSIFICATION OF PORPHYRITIC, PYROXENE-RICH CHONDRULES IN THE SEMARKONA ORDINARY CHONDRITE. Rhian H. Jones, Institute of Meteoritics, University of New Mexico, Albuquerque, NM 87131.

Semarkona (LL3.0) is one of the least equilibrated ordinary chondrites. Chondrules in this chondrite have suffered minimal secondary alteration since their formation in the solar nebula, and thus preserve a record of the conditions and environment of chondrule formation. Careful characterization of chondrules in unaltered chondrites serves two purposes: (1) to interpret solar nebular processes and conditions, and (2) to use as a basis for investigating the effects of metamorphism in chondrites of higher petrologic types [e.g. 1]. A chondrule classification scheme based on textural properties is of considerable value because compositional properties are commonly closely related to textural characteristics [2,3].

Previous studies have characterized porphyritic, olivine-rich (PO) chondrules in Semarkona [2,3]. Olivine-rich chondrules are described as either type I (FeO-poor) or type II (FeO-rich), based on textural properties [4]. Scott and Taylor [5] suggest the subdivision of FeO-poor, type I chondrules into types IA, IAB and IB, based on the relative ratios of olivine and pyroxene present. However, no corresponding scheme has been proposed for FeO-rich (type II) chondrules, and the term "type II" has been applied to porphyritic olivine chondrules in which no pyroxene phenocrysts are present. I have carried out a survey of porphyritic, pyroxene-rich chondrules in Semarkona and have observed several chondrules which are texturally similar to type II porphyritic olivine chondrules, but which contain pyroxene phenocrysts. It is therefore appropriate to extend the "type II" classification to incorporate the textural description of FeO-rich, pyroxene- and olivine-bearing chondrules. Such a subdivision raises the question of whether there is a continuum of textural and compositional properties among all porphyritic olivine/pyroxene (POP) chondrules, or whether distinct bulk compositions and/or formation conditions can be determined for each textural type.

Textural characteristics. 27 chondrules were selected for detailed study in two thin sections of Semarkona. All these chondrules contain pyroxene phenocrysts, and olivine phenocrysts account for less than 50% of the phenocryst assemblage in each case.

Type IB. 10 of these chondrules fit closely to the description of type IB chondrules as defined by [5]. They are generally small (0.3-1.0 mm across) and well-rounded. Euhedral, tabular pyroxene phenocrysts of twinned low-Ca pyroxene are the predominant mineral phase. Small (-25 pm), rounded olivine grains are commonly observed poikilitically enclosed in pyroxene. Glassy or finely microcrystalline mesostasis is usually in low abundance. Small, rounded blebs of Fe,Ni metal are a minor constituent.

Type IAB. 11 of the chondrules may be described as type IAB [5] (Fig. 1a). Textures are very similar to type IB chondrules, but olivine is more abundant. Two distinct occurrences of olivine are present: larger, euhedral phenocrysts, and small, rounded olivines poikilitically enclosed in pyroxene (similar to those in type IB chondrules). A continuum of textures exists between type IAB and type IB chondrules, and this continuum may also be extended to olivine-rich type IA chondrules [5]. Low-Ca pyroxenes in type I chondrules are commonly rimmed with a thin overgrowth of Ca-rich pyroxene (augite). The augite is sometimes observed optically, but is more easily observed in back-scattered electron images (BSEI).

Type IIAB. Several (5) of the chondrules studied are texturally distinct from the type I definition, and are more closely associated with type PO II chondrules (Fig. 1b). They are larger than type I chondrules (0.8-2.0 mm across). Pyroxene and olivine phenocrysts are generally larger than those in type I chondrules, and there is a higher proportion of mesostasis. Olivine crystals are usually rounded, and common have hopper or skeletal morphologies. Pyroxene crystals are commonly elongate and tabular, and show polysynthetic twinning on (100). Olivine and low-Ca pyroxene grains are intergrown, but olivine poikilitically enclosed in low-Ca pyroxene is rare. Round blebs of Fe,Ni metal are present in low abundance. Ca-rich pyroxene rims are observed on low-Ca pyroxene grains. Because these chondrules show textural relationships to type II PO chondrules, it is appropriate that they should be described as type IIAB.
Type IIIB. One of the chondrules studied contains no olivine, but consists of low-Ca pyroxene grains with very little mesostasis. In keeping with the above definitions, it is appropriate that it should be defined as a type IIIB, porphyritic pyroxene chondrule.

Compositional properties. A preliminary study of compositional characteristics of each chondrule type has been carried out. Figure 2 shows a plot of mean wt% CaO vs. mean mole% Fs in low-Ca pyroxene for individual chondrules. Type I chondrules, as expected, are low in FeO (2-10 mole% Fs in low-Ca pyroxene). In general, low-Ca pyroxene in type IAB chondrules is more FeO-rich than that in type IB chondrules, although there is some overlap between the two types. Type IIAB chondrules are generally richer in FeO, consistent with their textural association with type II PO chondrules. Mean Fs contents in low-Ca pyroxenes range from 10-20 mole% in this group. The one chondrule that may be classified as type IIIB is also FeO-rich (16 mole% Fs). CaO contents are very similar in the type IAB and type IB chondrules, between 0.1 and 0.3 wt% CaO. There is an apparent trend of increasing CaO with increasing FeO in the low-Ca pyroxene of the type IAB and type IIIB chondrules.

Summary. A proposed complete classification scheme for porphyritic olivine/pyroxene chondrules is summarized in Table 1. It appears that there is a continuum of textural variation within both the FeO-poor (type I) and FeO-rich (type II) groups, with continuously varying proportions of pyroxene and olivine phenocrysts. The two groups appear to be texturally distinct. Porphyritic olivine chondrules that have previously been referred to as type II should perhaps more accurately be defined as type IIA. Further work will determine whether the textural continuum in each group is also reflected by compositional properties of individual minerals, and bulk compositions [6].


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