MICROTEXTURAL STUDY OF FELDSPAR IN PETROLOGIC TYPE 3 LL ORDINARY CHONDRITES: A RECORD OF PARENT BODY METASOMATISM

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Introduction: Petrologic type 3 OCs [1] are subdivided into subtypes 3.00-3.9 based on properties including TL susceptibility [2] and olivine composition [3], because type 3 represents a wide range of mineralogical, chemical and textural variation. In type 3.0, chondrule mesostasis is considered to be unaltered but may contain minor feldspar crystallites [3]. By type 4, mesostasis has recrystallized into fine-grained albite which continues to equilibrate through type 6 [4,5]. However, in detail, development of feldspar in OCs is more complex. Some chondrules in OCs contain primary anorthitic feldspar [6] which must equilibrate to albitic compositions by type 4 [5]. Anorthite in several type 3.9 and 4 OCs records the effects of metasomatizing fluids, including albitization and nephelinization [6,7]. It is important to understand the behavior of fluids, which played a significant role during the early stages of metamorphism in OCs. We have carried out a detailed study of LL3 chondrites, focusing on the chemical and microtextural development of feldspar, to help understand the low-temperature evolution of the LL parent body(ies).

Methods: We studied feldspar within chondrules of five LL3 OCs: Semarkona (LL3.00), Bishunpur (LL3.15), Chainpur (LL3.4), Parnallee (LL3.6), and Bo Xian (LL3.9). We used BSE imaging and EDS analysis on an FEI Quanta 3D FEG-SEM. WDS analysis was conducted on a JEOL 8200 EPMA.

Results: Primary plagioclase occurs in ~10% of chondrules in Semarkona. Type I feldspar-bearing chondrules contain numerous laths of anorthitic feldspar ~5 µm wide. Type II chondrules contain primary albitic feldspar. Primary anorthitic feldspar also occurs in Bishunpur, Parnallee and Bo Xian, and is accompanied by increasing amounts of secondary albitic feldspar with increasing subtype. Primary feldspar in Semarkona and Bishunpur has not experienced any dissolution or replacement. Dissolution lamellae, micropores, nephelinization, and albitization are present in both Parnallee and Bo Xian. Alteration is dominated by nepheline in Parnallee and albite in Bo Xian, but the degree and type of alteration varies greatly between chondrules, and albite and nepheline do not occur together. Albitized anorthite also contains fine-scale K-feldspar exsolution.

Discussion: There are two sources of feldspar in chondrules of type 3 LL OCs: primary igneous plagioclase which is mostly anorthitic, and secondary albitic plagioclase that recrystallized from chondrule mesostasis, likely as the result of metasomatism. High subtype 3s show considerable metasomatism in the form of albitization, nephelinization, and dissolution of anorthite, indicating that fluids were present during metamorphism. Fine-scale exsolution in albite shows that the system cooled quickly.

References: [1] Van Schmus W. R. and Wood J. A. 1967. *Geochimica et Cosmochimica Acta* 31:747–765. [2] Sears D. W. et al. 1980. *Nature* 287:791–795. [3] Grossman J. N. and Brearley A. J. 2005. *Meteoritics & Planetary Science* 40:87–122. [4] Huss G. R. et al. 2006. Meteorites and the Early Solar System II. pp. 567–586. [5] Kovach H. A. and Jones R. H. 2010. *Meteoritics & Planetary Science* 45:246–264. [6] Lewis J. A. and Jones R. H. 2014. Abstract #1661. 45th Lunar & Planetary Science Conference. [7] Jones R. H. and Brearley A. J. 2010. Abstract #2133. 41st Lunar & Planetary Science Conference.