INDICATORS OF MULTIPLE PARENT-BODY PROCESSES: CHONDRULES AND FINE-GRAINED RIMS IN THE MOKOIA CV3 CHONDRITE

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Introduction: Fine-grained rims surrounding chondrules in chondrites are widely believed to have formed by direct accretion of dust onto the surfaces of chondrules in the solar nebula [e.g., 1, 2]. However, some authors suggested that they were formed by parent-body processes [e.g., 3]. Here we present the results of our mineralogical and petrological investigation of chondrules and fine-grained rims in the Mokoia CV3 chondrite. Mokoia is one of the rare CV3 chondrites that contain abundant hydrous phyllosilicates [4].

Results: We studied a total of 112 chondrules >400 μm in diameter, in ~272 mm^2 area of six thin sections, of which 86 (77 %) were enclosed by fine-grained rims. 63 of the rims (73 %) consist mainly of olivine and phyllosilicates, and the remainder 23 (27 %) consist mainly of olivine. In this paper, we focus on the former type of rims.

All the chondrules contain <5−30 vol% of phyllosilicates, which are mostly saponite and minor amounts of phlogopite. Saponite has been formed by replacing enstatite, and phlogopite has been formed by replacing anorthite. Olivine and diopside remain unaltered. The degree of alteration differs in a wide range among the chondrules. In some chondrules, phyllosilicates constitute 80 ×60 μm in area.

The rims range in thickness from 20−300 μm, and most of them partly enclose their interior chondrules. The rims consist mainly of fine grains of olivine (<1−10 μm in size) and saponite, resembling the host matrix except that the rims contain higher amounts of saponite. The relative volume proportion of olivine and saponite differs in a wide range among the rims, and has a tendency to decrease with the increasing degree of alteration within the interior chondrule. The rims commonly have a characteristic vein-like feature, consisting of Fe-rich olivine, magnetite, and Fe-Ni sulfide. The veins emanate from the chondrule/rim interface and terminate at the rim/matrix interface.

Discussion: Both the chondrules with and without rims show abundant evidence of extensive aqueous alteration. In contrast, the matrix surrounding them largely remains unaltered [4]. These observations suggest that the chondrules with and without rims have not experienced aqueous alteration in the present setting. We suggest that they are actually clasts transported from a precursor material during brecciation on the meteorite parent body, and the rims are fragmented remnants of an interchondrule matrix of the precursor material. The precursor material was probably located in a more extensively aqueously altered portion than the location where the present meteorite was. These observations and interpretations are consistent with the results reported from the study of the chondrules and their rims in the Vigarano CV3 chondrite [3].

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