A HYDRATED CLAST IN THE MOKOIA CV3 CARBONACEOUS CHONDRITE: EVIDENCE FOR INTENSIVE AQUEOUS ALTERATION IN THE CV PARENT BODY

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We report the discovery of a highly hydrated clast in the Mokoia CV3 carbonaceous chondrite that contains eight chondrules and one amoeboid olivine inclusion (AOI), embedded in a matrix dominated by hydrous phyllosilicates. Anhydrous silicates in the chondrules and AOI were extensively replaced by phyllosilicates (mostly saponite with minor phlogopite). The mineralogy and texture indicate that the clast resulted from intensive aqueous alteration of a precursor equivalent to the host Mokoia meteorite, and it can be regarded as the CV2-type lithology.

This clast reveals abundant evidence of progressive and dynamic aqueous alteration processes. The chondrules were replaced inward from their margins, and the alteration products were disaggregated and mixed into the matrix; as a result, the chondrules increasingly became smaller in size and irregular in shape. Some of the chondrules were separated into pieces. The results indicate that a major proportion of the matrix materials were produced by the alteration of chondrules and inclusions and that there was a process in which the alteration products and the original matrix material were extensively and uniformly mixed together.

The matrix of the clast has a composition intermediate between saponite and serpentine and contains abundant framboidal magnetite, being similar to the matrix of the CI chondrites. The results suggest that more advancing alteration of the clast leads to a CI1-like lithology and raise the possibility that the CI1 chondrites could have resulted from aqueous alteration of a precursor that had a type 3 lithology (which consists of chondrules and inclusions set in a matrix) under conditions similar to those for the alteration of the Mokoia clast.

The results indicate that there was a highly wet region within the Mokoia parent body, where intensive aqueous alteration occurred, and that this clast escaped subsequent thermal metamorphism. The past studies of CV dark clasts [e.g., 1–3] and the present study of the Mokoia clast suggest that the CV parent body had a heterogeneous distribution of water and that various degrees of aqueous alteration, thermal metamorphism, and shock metamorphism took place in different regions. These inferences imply that the CV parent body was dynamic in terms of the physical and chemical processes.

The presence of the clast supports the previously proposed model [4], which suggests that the aqueous alteration in the chondrules/rims in Mokoia occurred in a wet region (or regions) different from where the host meteorite was finally lithified and that these aqueously altered chondrules/rims were afterward mixed with anhydrous matrix grains by brecciation on the parent body.

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