ALTERATION AND BRECCIATION OF A CALCIUM, ALUMINUM–RICH INCLUSION IN THE ALLENDE METEORITE

R. L. Ford and A. J. Brearley. Department of Earth and Planetary Sciences. University of New Mexico, Albuquerque, NM 87131, USA. E-mail: rford@unm.edu.

Introduction: The timing and location of alteration of CAIs within the Allende meteorite has been a subject of controversy. Both preaccretionary and parent body alteration arguments have been made [1-4]. One issue that has not been addressed in detail is the possible effects and timing of brecciation on the textural relationships between CAIs and the surrounding matrix, that add further complexity in assessing the environment of alteration for CAIs in Allende. Here, we present new observations from a highly brecciated, altered, compact type A CAI from Allende.

Results: Within the brecciated region, CAI clasts, mineral fragments, and chondrules are present. The brecciated region is a distinct, linear feature that extends across the thin section for 6.5 mm and is defined by a highly disrupted, array of CAI fragments that range in size from a 20 μm to 700 μm. The mineralogy and textures of these fragments indicates that they are pieces of a single, compact, Type A CAI. The primary mineralogy of the CAI fragments consists of melilite, Al,-Ti pyroxene, perovskite, spinel, and diopside. Asymmetrical rims of spinel, diopside, and Al,-Ti pyroxene enclosed the original CAI before brecciation, and are now present as partial rims around some of the fragments. Nepheline, andradite, secondary melilite, a platy phase with similar chemistry to margarite, and minor amounts of sodalite comprise the secondary mineralogy of the CAI clasts.

Textural relationships between the mineral phases within the CAI clasts indicate that the primary melilite altered sequentially to the secondary melilite, the platy phase, nepheline and sodalite. Spinel grains appear to be unaltered except for some minor Fe enrichment. Cross cutting relationships indicate that the platy phase formed before brecciation of the CAI occurred.

Element maps record elevated Na concentrations in the CAI fragments and adjacent matrix, compared to the matrix outside the brecciated region. Calcium X-ray maps show that the abundance of Ca-pyx-andradite nodules are slightly higher in the matrix directly adjacent to the CAI clasts, compared to typical matrix regions in the same thin section. In addition, distinct regions of matrix with little or no Na or Ca are present within the brecciated region. These regions may represent matrix clasts with a different history from matrix material directly associated with brecciated CAI fragments.

Conclusion and discussion: DIs studied by [5] clearly show evidence of post-brecciation interaction with Allende host. In the case of this CAI, we observed no evidence of such a process. Cross cutting relationships indicate that the alteration of the CAI happened prior to brecciation. Although the CAI-matrix relationships have been disturbed by brecciation, some CAI fragments still appear to have original matrix attached to them. This matrix is characterized by elevated Na and Ca signatures.