FELDSPATHIC GLASS AND SILICA IN ALLAN HILLS 84001. G. McKay[1], C. Schwandt[2], and T. Mikouchi[3], [1]Mail Code SN2, NASA Johnson Space Center, Houston TX 77058, USA (Gordon.McKay@jsc.nasa.gov), [2]Lockheed-Martin, 2400 NASA Road 1, Houston TX 77058, USA [3]Mineralogical Institute, University of Tokyo, Tokyo 113, Japan.

Introduction: ALH84001 is the well-known martian meteorite in which evidence for possible biogenic activity has been reported [1], especially in the carbonates. Understanding the origin of these carbonates is a key to resolving the controversy surrounding this issue. However, such understanding has proved elusive, in part because this sample has had a complex history involving multiple impacts [e.g., 2,3,4,5], granulation, pervasive fracturing, and shock melting of one or more components. We are studying ALH84001 using petrographic, SEM, and microprobe techniques to elucidate the relative timing and possible genetic relationships between carbonate formation and shock events.

[6,7] proposed that ALH84001 carbonates and silica veins formed from impact melts. Elsewhere in this volume, [8] report shock recovery experiments that appear inconsistent with this idea. Here we address characteristics of feldspathic glass and silica in ALH84001 that may bear on the origin of the silica veins and their relationship to the carbonates.

Results and Discussion: Analyses of feldspathic glass in ALH84001 tend to be nonstoichiometric (e.g., [2]). For example, our own feldspar analyses can be modeled in terms of added silica and, in some cases lost Na. (Na loss can usually be prevented by using gentle analytical conditions, but feldspars that been subjected to elemental mapping analysis are usually Na-deficient.) High-contrast BSE images reveal the source of the excess silica: much feldspathic glass shows a pervasive network of SiO_2-rich material (Fig 1, [5]). Random microprobe analyses would overlap this material to varying degrees resulting in apparent excess silica. High-resolution SEM images show this network to be a set of web-like veins occupying the interstices between feldspar fragments [5]. Fig. 1. shows such a region of feldspathic glass. It is clear that the feldspar has been granulated, with textures and grain sizes similar to granulated pyroxene. The interstices have been filled with SiO_2 subsequent to granulation. The origin of the interstitial SiO_2 is uncertain. [7] proposed that SiO_2 veins in pyroxene are shock-injected melts. However, SiO_2 is ubiquitous throughout granulated regions of the sample, suggesting that the source material should be common. Yet abundant primary magmatic SiO_2 has not been reported in ALH84001. Moreover, non-overlapping analyses of SiO_2 yield Al_2O_3 contents below 0.1 wt%, suggesting low-temperature origin, whereas primary igneous silica in other martian meteorites is typically a high-temperature polymorph with much more Al_2O_3. Furthermore, the delicate and pervasive nature of the SiO_2 vein networks seems more consistent with deposition from fluids percolating through fractures created by the granulation event than with injection of shock-melted primary igneous SiO_2. Based on radial fractures around feldspar grains and the lack of fractures in feldspar (in contrast with all other phases in the sample), [9] proposed that the feldspar glass was completely melted by shock.. Yet it clearly must have consisted of solid fragments at the time the SiO_2 was deposited. Thus it is likely that subsequent to deposition of the SiO_2, the sample was subjected to an impact strong enough to melt the feldspar, and possibly the interstitial SiO_2. However, the sharp boundaries between the SiO_2 veins and the feldspathic glass [5] indicate that heating was too brief for significant diffusive mixing. It may have been this impact that fractured and disrupted the carbonate globules [3].

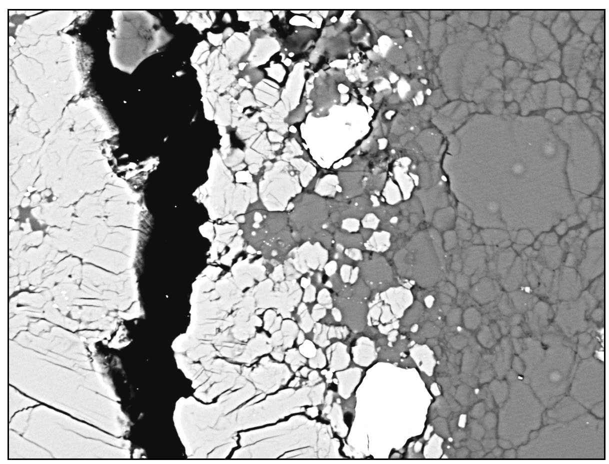

Fig. 1. High-contrast BSE image of ALH84001. Dark gray = feldspathic glass, medium gray = orthopyroxene, white = chromite. Dark veins between granulated feldspar fragments are SiO_2. Width of field is 150 µm.

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