CHEMICAL IMAGING OF CARBONATES IN MARTIAN METEORITE ALH 84001 USING TIME OF FLIGHT SECONDARY ION MASS SPECTROMETRY. C. M. Corrigan[1], E. P. Vicenzi[2], R. P. Harvey[1], T. J. McCoy[2]. [1]Dept. of Geological Sciences, Case Western Reserve University, 10900 Euclid Avenue, Cleveland, OH 44106-7216, USA, [2]Dept. of Mineral Sciences; National Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560-0119, USA.

Introduction: Carbonates in ALH 84001 offer our best clues to ancient fluid-rich environments on Mars, particularly due to the scarcity of hydrous silicates. Trace element analyses of these carbonates have typically been collected using magnetic sector ion microprobes [1-3], often hindered by the lack of applicable standards. Time of Flight Secondary Ion Mass Spectrometry (ToF-SIMS) analyses, as performed by [4], provide complementary information as to the spatial distribution of trace elements, including organics [4], that may aid in the better understanding of formation mechanisms for the carbonate minerals.

Methods: Ion images were collected from unique carbonate occurrences in ALH 84001 [5, 6] using ToF-SIMS at the Smithsonian Institution. Images were collected using a sub-micron Ga primary beam in an ion optical mode that is an optimal combination of spatial and mass resolution.

Results: Major element images (Ca, Mg, Mn, Fe) are consistent with previous analyses using the electron microprobe [5, 6]. Si is concentrated in silica glass located between Ca-rich carbonate and magnesite. As expected, Sr follows Ca within the carbonate. We also find Ti, Cr, and Al within the carbonate, with Cr concentrated in the early-formed, Ca-rich carbonate and Ti found only in the magnesitic carbonate inferred by [6] to be a later generation. Although the incorporation and partitioning of these elements in carbonates is poorly understood, Ti and Cr are not particularly mobile elements and the occurrence of Al and Ti preferentially in the magnesitic carbonates supports a second-generation origin.

Of particular note are Na, Li, H and OH secondary ion distributions, all of which represent volatile elements and can be detected within carbonate slabs. The H and OH images support previous suggestions for the incorporation of martian hydrogen [7, 8], probably from a water-rich fluid. More extensive ToF-SIMS imaging should help elucidate the siting of H as well as variations in concentration between different generations of carbonate. This will significantly increase our understanding of the relationships between the carbonate generations and the interpretation of H isotopic data obtained from these minerals. Equally important, the association of Li and Na may provide important constraints on the nature of the fluid, as we would expect evaporative brines to be enriched in these elements while we have no *a priori* expectation for hydrothermal fluids to contain these elements. We suggest that our data support the evaporative brine model previously postulated for ALH 84001 [8-10] and the nakhlites [11, 12].

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