CHEMICAL RESULTS FOR MINERALS REACTED IN MARS AQUEOUS LABORATORY SIMULATIONS M. J. Nelson and H. E. Newsom [1], Mark Bullock[2], and Jeffery Moore[3] [1] Institute of Meteoritics, University of New Mexico, Albuquerque 87131. MEL14@unm.edu., [2] Southwest Research Institute, Department of Space studies, 1050 Walnut st. Suite 426, Boulder, CO 80302, [3] NASA Ames Research Center, Space Sciences Division, M/S 245-3, Moffett Field, CA 94035

Introduction: Researchers at NASA Ames Research center and the Southwest Research Institute conducted an experiment in which basaltic minerals were allowed to react in experimental vessels with acidic solutions simulating what may have been an earlier Mars atmosphere [1, 2]. Before reacted, researchers washed these minerals in 5% HF, and $1NH_2SO_4$. 50 g of minerals were put in 250ml chambers with 100 ml water, and a headspace containing CO_2, about 100 ppm each of SO_2 and HCl, and about 10 ppm NO_2. Samples were collected at 1, 21, 42, 84, 168, and 336 days [1, 2]. By imaging and elemental analyses, this study analyzed minerals of unaltered controls, and experimental mineral grains collected after 1 and 168 days that were reacted at 3˚C by JEOL SEM, and JEOL 8200 electron microprobe at the University of New Mexico. The purpose was to detect any element mobility or alteration features that occurred as a result of the experiment to determine what sort of alteration may have occurred in an acidic martian environment.

Analytical Findings

Unaltered samples- Alteration features on unaltered samples were minimal and included typical terrestrial alteration features. Surface features were sometimes suggestive of clay minerals, or in augite, possible serpentinization, but most features were small, submicron in size (Fig.1). Chemical analyses by SEM and microprope revealed no S, Cl, Fe, Mg, Na, K, or Cl anomalies.

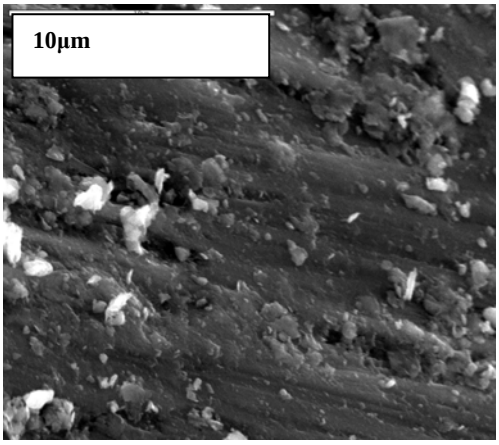

Fig. 1. Small surface features on unaltered augite.

Day 1 samples- Representing an experimental control, these samples contained small spherules (<1µm), most notably on the surface of forsterites and ilmenites, and dusty, cubic features most notably on the augites and andesines. Spherules on ilmenite had no detectable chemical differences, but contained slightly elevated F in the forsterite. Cubic features contained slightly elevated F in andesine. No chemical differences were detected in other surface features.

Day 168 samples- Spherules are ubiquitous in forsterites and ilmenites (Fig.2), and spherical features also exist on augite surfaces. Interestingly enough, forsterites did not contain chemical anomalies in these samples. Ilmenites are heavily pitted (Fig.3b), and globules on ilmenite surfaces contain highly elevated S. Augites contain globular alteration features suggestive of clays or precipitates. Some of these features have elevated F and S. Ilmenites and augites both contain an easily discernible coating (Figs. 3 and.4). In ilmenite, this coating is highly elevated in S, Fe, but contains little Ti. In augites, this coating contained elevated S (4a, b).

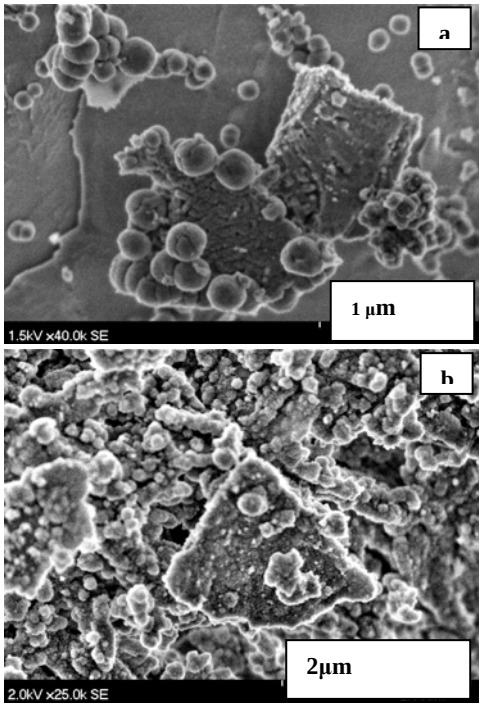

Fig. 2 a, b. Spherical alteration features on surfaces of a) ilmenite and b) olivine after 6 months.

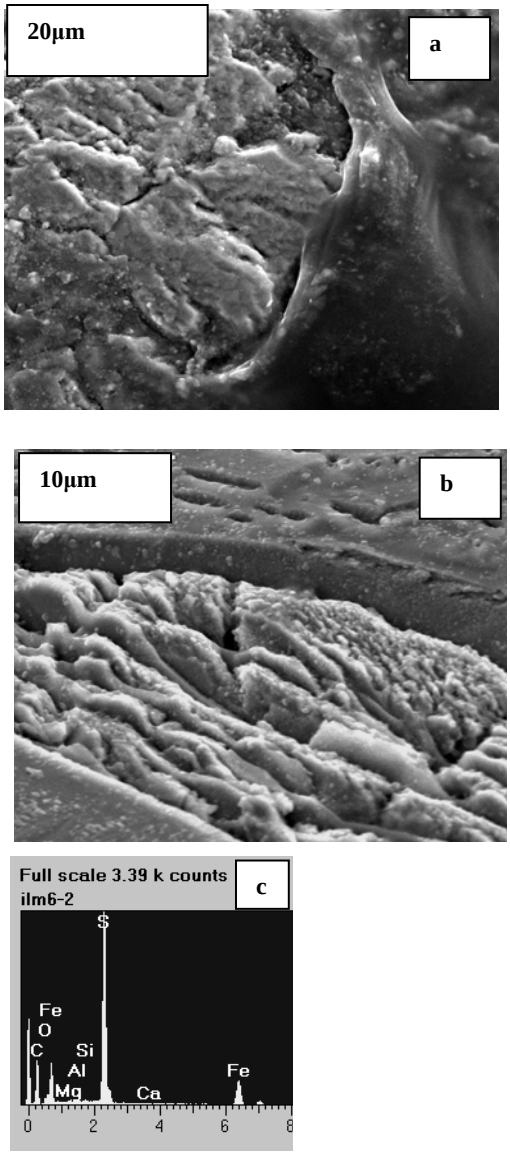

Fig. 3 a, b, c. (a)Ilmenite with coating, and (b) dissolution textures, also with coating. c) spectra of coating revealing high S content

Discussion and Conclusions: Although elevated S at first glance is intriguing, the elevated F is likely a result of acid washing conducted before the samples were reacted in a chamber. It does appear that there was further reaction in the chamber with time, by the result of chemical analyses of chamber solutions in the previous studies [1, 2], the noticeable coating on the augite and ilmenite after 6 months, and an even higher S content in some surface features after 6 months compared to 1 day. The presence of F indicates that some of the elevated S in surface features is surely from acid washing, although it is still interesting that distinguishable alteration features were formed at all. As these experiments did not reach equilibrium [1, 2], one one might only expect dissolution features. The formation of spherules containing S and Fe on ilmenite, and S, F coatings on ilmenite and augite means that alteration products can be produced in a short amount of time, and do not necessitate the system reach full equilibrium. This would imply that alteration products could have formed on Mars in a very short period of time, or during short periods of hydrothermal or volcanic activity, and some may even be responsible for chemical variation in the Mars soil detected by MER and previous missions [3, 4]. Further experiments are currently being conducted to resolve some of the ambiguous results of this study.

References [1] Bullock, M.A. et al., 2004 *Icarus*, **170**, 404-423. [2] Bullock, M.A., and Moore, J.M (2004).. *Geophys. Res. Letters*, **31**, L14701, doi: 10.1029. [3]Newsom, (2006) *Nature* **438** 570-571. [4]Nelson et al., 2005. *Goechim. et Cosmochim.* **69** no10 2701-2711. *Acknowledgements*- Funding was provided by NASA MFRP

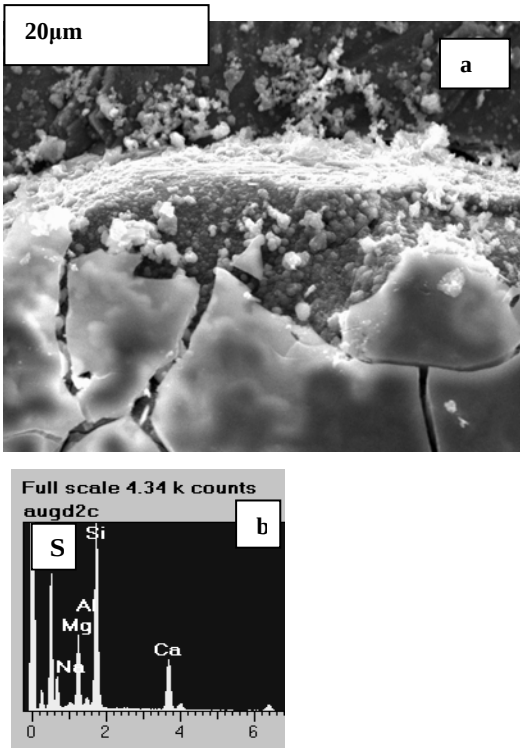

Fig 4a, b. a). Image of augite grain with high S coating. b). Elemental spectra on coating showing high S. Spectra off coating does not reveal elevated S