2188
doi:10.1017/S1431927617011606
Microsc. Microanal. 23 (Suppl 1), 2017

Microanalysis of Geologic Materials Exposed to Surface Conditions on the Planet Venus

[1]Brandon G. Radoman-Shaw, [1]Ralph P. Harvey, [2]Gustavo C. C. Costa, [2]Nathan S. Jacobson, [3]Amir Avishai, and [2]Leah M. Nakley.

[1.] Department of Earth, Environmental, and Planetary Science, Case Western Reserve University, 10900 Euclid Avenue Cleveland, OH USA.
[2.] NASA Glenn Research Center, 21000 Brookpark Road Cleveland, OH USA.
[3.] Swagelok Center for Surface Analysis of Materials, Case Western Reserve University, 10900 Euclid Avenue Cleveland, OH USA.

Crust/atmosphere interactions are thought to play an important role in the Venus greenhouse climate [1]. Limited *in situ* analyses of the surface of Venus and minimal determination of major and minor constituents in the lower atmosphere provide inadequate insight into possible dominant solid/gas reactions that can occur. Prior experimental modeling provides conflicting hypotheses as to the importance and chemical stability of geologic mineral phases on the surface of Venus [2,3,4]. For this study, we exposed a matrix of geologic material including minerals, rocks, and glasses for 42 days to Venus surface conditions using the Glenn Extreme Environment Rig (GEER) at NASA Glenn Research Center.

We exposed a total of 35 phases in carefully prepared sample chips, which weighed on average 40 mg and were roughly 1 square cm in size. Two opposing faces of each sample were polished to create a common surface texture for pre- and post-exposure electron microscopy. These samples were then attached to 316 stainless steel mounts using gold wire. We verified the mineralogy and crystallinity of each sample through powder x-ray diffraction for structure and crystallinity.

The Glenn Extreme Environment Rig (GEER) at the NASA Glenn Research Center in Cleveland, OH, provides unparalleled high fidelity simulation of Venus atmospheric pressure, temperature and chemistry. The temperature and pressure for this experiment were kept at 460°C and 92 bar (1334 psi) for 42 days, thereby keeping the simulated atmosphere above the supercritical point for CO_2 and within accepted near-surface temperature and pressure conditions for Venus. The gas fill for the experiment included CO_2, N_2, SO_2, OCS, H_2O, CO, H_2S, HCl, and HF (in descending order of abundance).

We analyzed exposed and representative unexposed sample chips with secondary electron (SE) and electron backscatter imagery (BSE) on a FEI Helios 650 instrument along with an Oxford Inc. XEDS chemical analysis and FIB to determine if any alteration occurred. Each sample was removed from the stainless steel mounts and mounted with carbon tape to an aluminum SEM mount and coated with approximately 10 nm of palladium. The majority the alteration for the silicate phases was very minimal (on the sub-micron level) suggesting that if these phases are present on the surface of Venus, they apparently are likely slow to react and involved only in longer-term reactions.

The most common secondary minerals formed in our experiments are sulfur-bearing compounds, suggesting that although sulfur-bearing gases are relatively minor atmospheric components, they play an exceptionally active role in crust/atmosphere interactions. For the synthetic amorphous phases, including synthetic glass manufactured to mimic surface XRF chemical abundances from the Venera 13 lander

(Figures 1 and 2), the XEDS signature suggests a sodium phase on the surface and creation of crystalline material from originally completely amorphous material. This has major implications for chemical alteration of fresh volcanic material on the surface of Venus. Further discussion of the microanalysis conducted post-experimentation will be described at the conference.

References:

[1] AH Treiman and MA Bullock, *Icarus* **217** (2012), p. 534-54.
[2] B Fegley Jr., *Icarus*, **128** (1997), p. 474-479.
[3] NM Johnson and B Fegley Jr., *Adv. Spac. Res.* **29** (2002), p. 233-241.
[4] GL Hashimoto and Y Abe, *Plant. Spac. Sci.* **53 (**2005), p. 839-848.

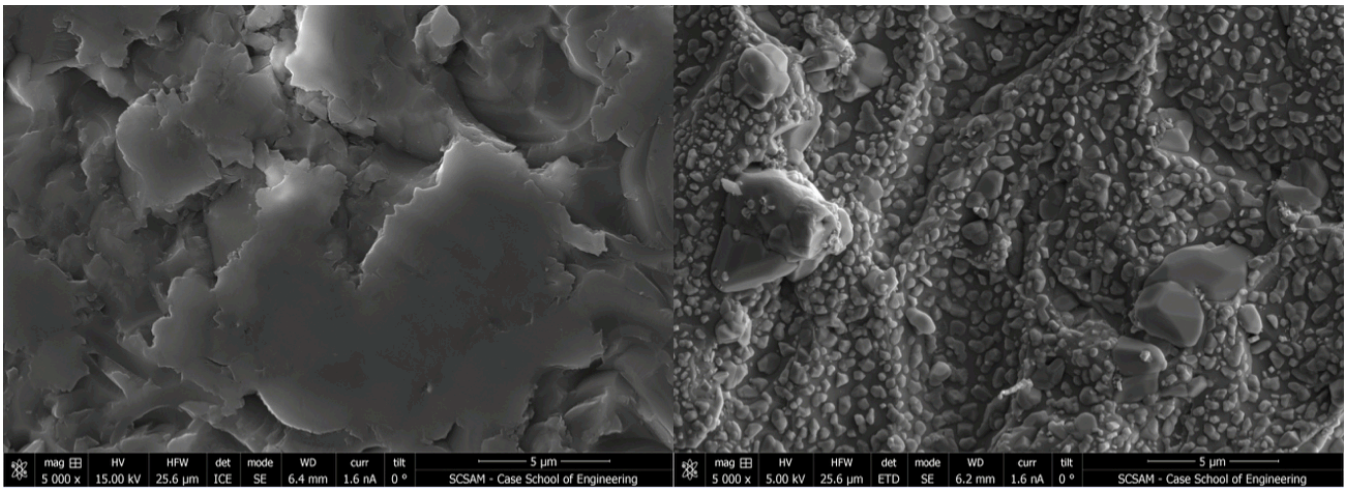

Figure 1. SEM images of the Venera 13 glasses pre (left) and post (right) exposure.

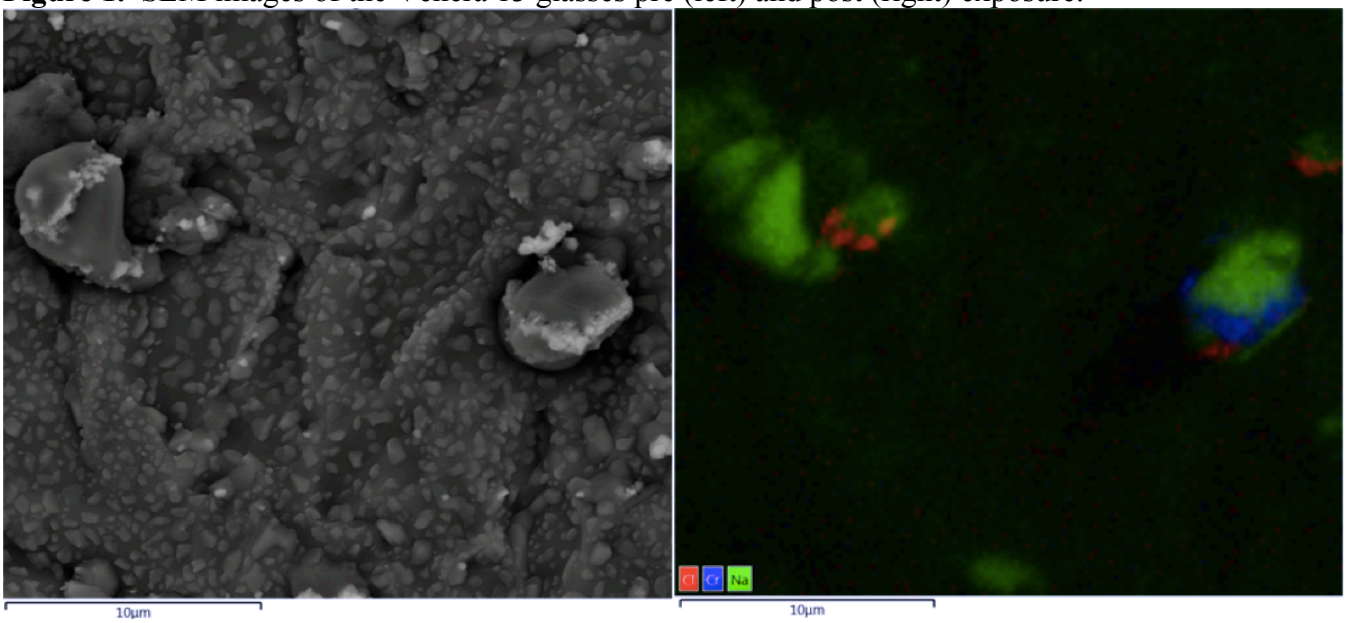

Figure 2. Backscatter electron imagery (left) of post exposure Venera 13 synthetic glass and the XEDS elemental map of the sample location showing chlorine (red) sodium (green) and chromium (blue).

https://doi.org/10.1017/S1431927617011606 Published online by Cambridge University Press