IMPACT MELT (AGGLUTINITIC GLASS) OF LUNAR REGOLITH: A "VOLATILE RECORDER" OF THE LUNAR SURFACE.
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Introduction: Lunar regolith is an important repository of volatiles from exogenous (solar wind, cosmic rays, meteorites) and endogenous sources.

Recent studies have demonstrated that water is present in different forms (OH, H_2O, and H_2O ice) on the surface of the Moon [1-4]. Direct analysis of samples showed that H is bounded in impact melts of soils [5], or locked in igneous samples (volcanic glass and minerals) that are indicative of the interior of the Moon [6-14]. Particularly, we demonstrated that solar-wind implanted H in lunar soils can be transferred and locked in the impact melt (agglutinitic glass) of the regolith [5]. Considering the diverse mineralogy and petrology of lunar regolith and the evidence of meteorite inputs [15], the agglutinitic glass could have potentially assimilated different sources of volatiles. Therefore, the *study of agglutinitic glass in the lunar regolith of different ages could provide new insights on the interactions among airless terrestrial bodies, the Sun, and the interplanetary medium*. The knowledge of the interactions obtained from the lunar soils is also extremely useful in the large context of recent discoveries of water (H) in the north pole of Mercury [16-17] and on the surface of 4 Vesta [18], which substantiate the requirement of a better understanding of meteorite inputs as well as solar-wind radiation effects.

Most of the data in Liu et al. [5] was derived on one lunar soil 10084 and only H was analyzed. In order to fully utilize agglutinitic glass as the lunar surface volatile recorder, we are studying multiple volatiles in lunar regolith of different composition, maturity, and ages.

Methods. Sample preparation was similar to Liu et al. [5, 19]. Samples before and after SIMS analysis were examined using a Hitachi SEM. Major-element compositions of samples were obtained using a JEOL JXA-8200 electro microprobe. Volatile contents and H isotopes were obtained using a Cameca 7f-Geo SIMS, following analytical protocols as in Chen et al. [20].

Results: The agglutinitic glass from different soils contains H up to 470 ppmw equivalent H_2O, whereas the measured δD values range from large negative (-830 ‰) to large positive (~+5500 ‰). With the limited aggltuinates extracted from the ancient regolith breccias, our data suggest the ranges of H contents in agglutinitic glass are comparable between lunar soils and ancient regolith breccias.

The agglutinitic glass and other glass components from soils and ancient regolith breccias contain 13 to 156 ppm F and up to 18 ppm Cl. The F contents are much higher than those in nominally anhydrous minerals [21], but comparable to melt inclusions [11, 14]. In the preliminary dataset, about 20% of the Cl data are > 7 ppm, the upper end of Cl in volcanic glass beads and melt inclusions [6, 11,14].

Discussion: Direct use of δD as an indicator of H sources is complicated by the cosmic-ray generated D, particularly at low H contents. In order to assess the cosmic-ray generated D, we will use Li-isotope values as recommended in [22]. However, higher Cl contents of the agglutinitic glass may also indicate non-solar-wind exogenous sources. The generally high F contents also reflect sources other than igneous minerals. Thus, correlated Cl, F, H_2O and δD may help to discern different volatile sources in the agglutinitic glass.

The development of agglutinitic glass as the surface "volatile recorder" will provide a new way to examine lunar surface samples. The MoonRise concept plans to return regolith samples from the South-Pole Aitken (SPA) basin, which have recorded exo-lunar inputs during the late-heavy bombardment period. Study of the SPA agglutinitic glass can provide new insights on water and organic deliveries to the Earth-Moon system.

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