Post-basin impact modification of the lunar highlands recorded by Apollo 16 impact splash coats

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Understanding the timing, sources and causes of impacting projectiles helps to shed light on Solar System dynamics and the mechanisms of delivery of volatiles to the Earth-Moon system [1]. Such impactors may have changed through time from the late veneer, to the late heavy bombardment, to the types of material being transported throughout the inner Solar System at the present day. The Moon provides a key archive of the temporal diversity of such projectiles [1], and here we investigate post-basin-formation impact episodes.

Methods: We investigated several glassy impact 'splash coats' that drape Apollo 16 (A16) rocks and conducted argon-argon age dating of 14 small (0.3-1.8 mg) neutron irradiated samples. Chemistry of the glasses was determined using EMPA and LA-ICP-MS to constrain the diversity of delivered exogenous volatiles and siderophile elements.

Summary: The composition of the splash coat glasses are dissimilar from local A16 soils, and the rocks they coat [2] [3]. Halogen and trace element chemistry will be presented at the meeting to discuss the diversity of impacting projectiles.

The glasses typically exhibit partial resetting of their argon isotope age records at low temperature, indicating degassing by secondary impact derived shock/thermal metamorphism. All the impact splash coats were formed after the Imbrium basin-forming event (~3.92 Ga), and prior to North Ray (50 Ma) and South Ray (2 Ma) craters local to the A16 landing site. High temperature steps in ten of the samples record apparent age minimum events at between ~0.4-2.7 Ga, consistant with ages previously measured by [4], indicating a range of post-basin impact episodes. Exposure ages vary from ~13-200 Ma. The splash coat exposure ages are always less than their apparent argon high-temperature release (formation) ages, indicating that the splash coats were formed on host rocks, and then buried below the near surface environment, prior to being transported back to the lunar surface. Such burial and exhumation may have happened several times, throughly mixing delivered volatile and siderophile species throughout the lunar regolith.

[1] Joy et al. (2012) *Science,* **336**, 1426-1429. [2] Borchardt et al. (1986) *J. Geophys. Res.* **91**, E43-E54. [3] Morris et al. (1986) *J. Geophys. Res. **91**, E21-E42. [4]* See et al. (1986) *J. of Geophys. Res.* **91**, E3-E20.