NOT JUST FRESH AND ALTERED BASALT: SHOCKED SOIL AND SHOCKED BAKED ZONES PROVIDE INSIGHT INTO THE COLLECTIVE EFFECTS OF ALTERATION AND SHOCK

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Summary: In addition to (bedrock) basalts shocked to a range of shock pressures [1], pre-impact soils and baked zones at Lonar Crater, India were involved in the impact process along with altered basalts with secondary mineralization.

In the field: Clasts of shocked basalts in a fine-grained matrix make up a ~1 m thick impact melt- bearing breccia unit overlying a ~8 m thick lithic breccia unit composed of relatively unshocked basalt clasts [1]. Local clasts (perhaps 1 in ~10,000) in the lithic layer of the ejecta blanket are redder in color, indicating iron oxidation. From comparison to nearby stratigraphy ~15-20 km away from the impact site , these are suggested to be remnants of pre-impact "baked zones" where ~65 Ma basaltic lavas thermally metamorphosed underlying soils, sediments, and perhaps slightly older (by ~1000 years) basalt flows. These red clasts are found in the impact melt-bearing ejecta layer (aka "suevite") as Class 2 shocked basalts containing maskelynite [1]. Also found are the higher classes of shocked basalt (Classes 3-4-5 [1]) and very rare, gray, low-density, frothy, pumiceous samples described below. Shocked soil clasts in the upper unit mirror "rip up clasts" of soil in the lithic breccia [2].

In the lab: Light gray, frothy samples were imaged with back-scattered electrons (BSE) on the SEM (Figure 1) . Unshocked soils were imaged for comparison. In the shocked soil, BSE images reveal inclusions of unmelted, remnant unshocked soil with a desiccation texture (two inclusions in center of Figure 1) amidst a schlieren texture of vesiculated impact glass. Layers of soil horizons of carbon (likely calcite) and silica are apparent in the hand sample. Hand samples of suspected baked zones are frothy and lower in density. Petrography of these are comparable to that of iron oxide-rich baked zones, but with a texture resembling hornfels (contact metamorphism of basalt) that fits with its geologic history of being baked by an overlying lava flow.

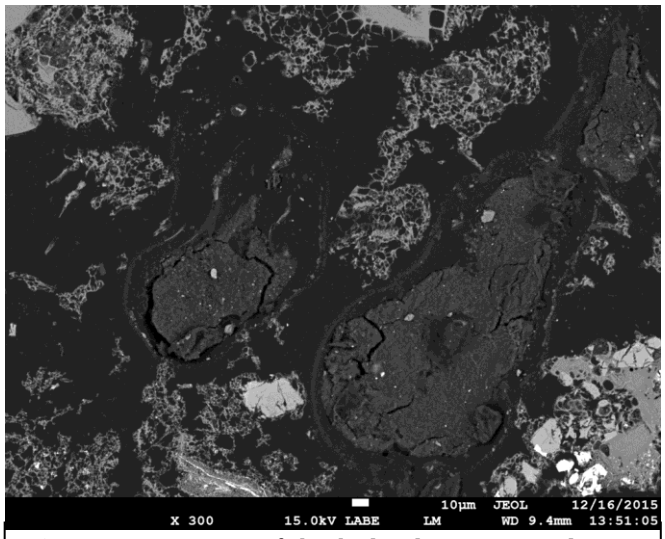

Figure 1. BSE image of shocked soil. Note two relic inclusions of unshocked soil with a "halo" of flow texture surrounded by vesiculated glasses. The inclusions of unshocked soil have a dessicated texture indicating clay.

Implications for planetary surfaces: With Lonar Crater being a rare impact site into basalt and also just ~570 ka, these materials are still preserved and are thus excellent analogs. Impactites have not yet been identified at older terrestrial impacts into basalt [1,2]. Alteration minerals found in altered basalts and Deccan soils mirror those found for Mars: chlorite, serpentine, smectite, zeolite, hematite, silica, and calcite.

MetSoc poster: Petrography and BSE images of a wide range of shocked basalts, from fractured grains (Class 1) [1]) through maskelynite, flowing labradorite glass, and vesiculated labradorite glass (Classes 2 to 4) and complete impact melts (Class 5) will be shown for fresh and altered basalts. These same data and hand samples will be shown for shocked soils and shocked baked zones along with their unshocked complements. Other instrumental data (XRD, some XRF) will be shown to confirm the alteration in altered basalts and shocked altered basalts. Suggestions for the criteria for finding a post-impact hydrothermally altered sample and differentiating this from an altered and/or contact metamorphosed ("baked") sample will be discussed on the poster.

References: [1] Kieffer et al., (1976) LPSC, pp 1391-1412 [2] Maloof et al. (2010) GSA Bulletin, doi: 10.1130/B26474.1