UNIQUE LUNAR SOIL PROPERTIES FOR ISRU MICROWAVE PROCESSING. Lawrence A. Taylor (lataylor@utk.edu), Edward Hill, and Yang Liu; Planetary Geosciences Institute, Department of Earth & Planetary Sciences, University of Tennessee, Knoxville, TN 37996.

Introduction: Most materials for near-lunar and on-the-Moon constructions will necessitate the active use of the resources of the Moon, resources that can be derived from the regolith (soil). The soil has been produced by micro-meteorite impacts occurring over eons, with processes that have produced some newly discovered, unusual, and unique properties in the soil [e.g., 1-3].

Lunar Soil placed in your Kitchen Microwave will Melt at ~1200 ^{0}C BEFORE your Tea Water will Boil at 100 ^{0}C.

Discussion: This unusual and unpredictable property of lunar soil is due to the presence of the abundant nanophase metallic Fe (Fig. 1) that is prevalent on all the impact-produced agglutinitic glass and the vapor-deposited np-Fe present on most of the soil-particle surfaces (Taylor et al., 2001). These minute, yet separated, metallic Fe grains readily couple with the 2.45 GHz microwaves in a simple Sears microwave oven. The position of much of the Fe^0 on the surfaces of grains, imparts the unique ability for local high-temperature domains at grain boundaries, such that the sintering actually involves the production of melt at the interfaces. Microwaved, pre-compacted as well as hot-pressed forms are relatively easy to produce.

The unique np-Fe feature imparts certain properties to the soil that make it an excellent feedstock for numerous ISRU purposes. Among these is the production of finished structural and mechanical forms with high strength and relatively low density (~2.5 g/cc). As shown in the cartoon in Figure 2, *other products that microwave processing can result in are only restricted to the depth of one's imagination* – from microwave-formed roads, **to** large-smooth parabolic antennae, **to** fabrication of structural products, **to** gardening large masses of hydrogen from the lunar soil, **to** oxygen production, et cetera. All these products involve the microwave heating of the fine fraction of the lunar soil, recalling that 50% of the lunar soil is ~ <50 μm.

References:

[1] Taylor, L.A., Pieters, C.M., Keller, L.P., Morris, R.V., McKay, D.S., 2001, Lunar mare soils: Space weathering and the major effects of surface-correlated nanophase Fe. *Jour. Geophys. Lett. 106*, 27,985-27,999; **[2]** Taylor, L.A., and T.T. Meek, 2005, "Microwave Sintering of Lunar Soil: Properties, Theory and Practice," accepted for publication in *Jour. Aerospace Engr.*, July; **[3]** Taylor, L.A., H.H. Schmitt, W.D. Carrier III, and M. Nakagawa, 2005, The lunar dust problem: From liability to asset, AIAA, Proc. 1st Space Exploration Conf., Orlando, CD ROM 2043.

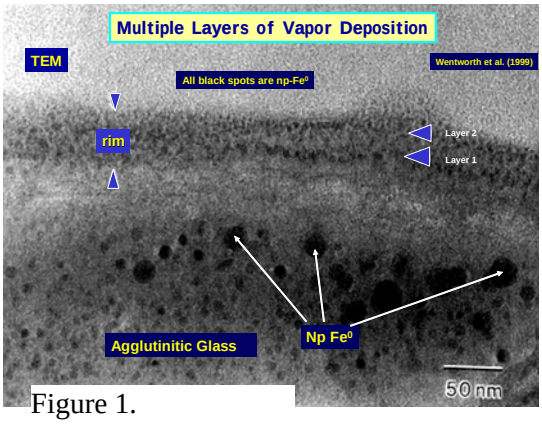

Figure 1.

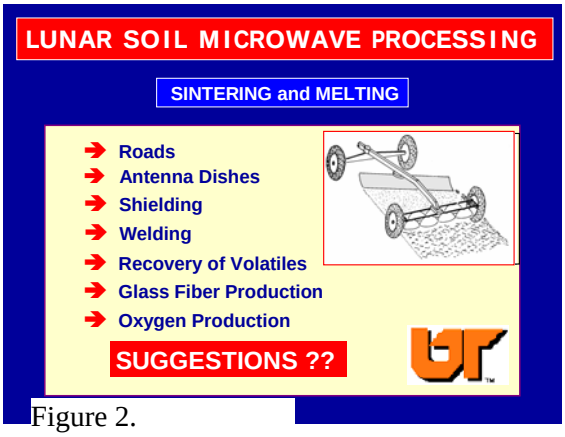

Figure 2.