PSI HX: A NEW SERIES OF MARTIAN SOIL SIMULANTS. Jiang Wang[1,2], Hansheng Liu[1], Jiannan Zhao[1], Jiawei Zhao[1], and Long Xiao[1], [1] Planetary Science Institute, State Key Laboratory of Geological Processes and Mineral Resources, China University of Geosciences, 430074 Wuhan, China (j.wang@cug.edu.cn), [2] Hubei Key Laboratory of Critical Zone Evolution, School of Earth Sciences, China University of Geosciences, 430074 Wuhan, China.

Introduction: Martian soil is a kind of fine weathering material widely distributed on the Martian surface, which can be used as raw material for in-situ resource utilization in the future. As there are no returned Martian soil samples in the Martian explorations of human beings during the past fifty years, Martian soil simulants are extensively applied in relevant research and engineering tests as substitutes. More than forty kinds of Martian soil simulants have been developed [1]. However, the investigations show that the primary materials for Martian soil simulants are restricted to fresh basalts and volcanic ashes, which cannot fully represent the different components of the Martian soil formed in the complex geological environment of Mars.

Source and Preparation: The primary materials of PSI HX are mined from Cenozoic basalt with different degrees of weathering, located at the Wenchang City in the Hainan Province. The main components of the basalt are plagioclase, pyroxene, and some clay minerals. These primary materials are dried before crushed, and then screen out materials below 1mm as the simulant. According to their composition, they can be divided into six types, namely PSI HX-1 ~ PSI HX-6 (Fig. 1). Among them, PSI HX-1 to PSI HX-5 are basalts with different degrees of weathering, and PSI HX-6 is laterite.

Figure 1. The series of PSI HX Martian soil simulants.

Results: Here we have a brief description of their composition, spectrum features, mechanical and physical properties.

Mineralogy and Chemical Composition. XRD analysis shows the main components of PSI HX-1 ~ PSI HX-4 are plagioclase and pyroxene, with some differences that the PSI HX-1 contains some olivine, while the PSI HX-2 ~ PSI HX-5 are enriched in clay minerals, and the composition of the PSI HX-6 is mainly kaolinite, which is laterite formed by extensive weathering of basalt. Compared with Martian soil, the major-elements compositions exhibit that the content of MgO in PSI HX-1 is higher than the known Martian soil; the PSI HX-2 and PSI HX-3 simulants are similar to the soil at Mars Pathfinder landing area; the average composition of PSI HX-4 and PSI HX-5 simulants are very similar as regolith within Gusev Crater and the average composition of Mars soil; and the PSI HX-6 has been heavily weathered, which is similar to Martian surface dust.

Spectrum Features.

The visible to near-IR spectra of PSI HX, JMSS-1, and JSC Mars-1 are shown in Fig. 2 [2-4].

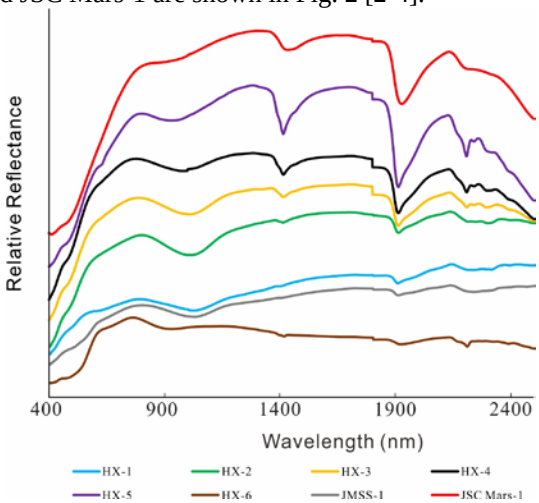

Figure 2. The relative reflectance of PSI HX, JMSS-1, and JSC Mars-1

Mechanical and Physical Properties.

The particles of the PSI HX are angular to subangular in shape, which are similar to the JMSS-1, JSC Mars-1, and MMS sand (Fig.3). The average specific gravity of PSI HX particles ranges from 2.41 g/cm^3 to 2.83 g/cm^3, and the mean bulk density ranges

from 0.85 g/cm^3 to 1.20 g/cm^3. These values, compared to the particle density, infer a porosity range from 71% to 76 %. The angle of internal friction of PSI HX are 31.85°~35.88°, and the cohesion of PSI HX are 0.03 ~0.73 kPa.

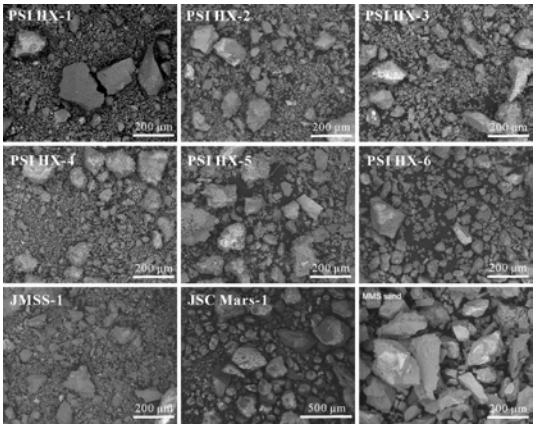

Figure 3. Back-scattered electron image of PSI HX, JMSS-1, JSC Mars-1, and MMS sand [2-5].

Future works: These samples may be used for 3D printing, ISRU and engineering tests in the future.

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