LUNAR REGOLITH SIMULANT CUG-1A. X.X. He[1], L. Xiao [1], J. Huang [1], C.H. Wan[1], T. Wu[1], R. Gao[1], S.W. Yan[1], Q. He[1]; [1]Faculty of Earth Sciences, China University of Geosciences, Wuhan, 430074
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Introduction: Lunar regolith simulant is very significant for lunar science and engineering researches. Due to lack of real lunar regolith, in order to satisfy large requirements, several lunar regolith simulants, such as JSC-1, MLS-1, FJS-1, MKS-1 were produceed for different research purposes and most of them have been used up. A new simulant, CUG-1A, has been produceed under the sponsors of China University of Geosciences (Wuhan). The CUG-1A is developed specifically for engineering studies on Lunar surface in support of future human activities on the Moon. We studied partical size distrbution, specific gravity, angle of internal friction and cohesion, as well as the geochemistry properties of the CUG-1A lunar regolith simulant.

Starting materials: The starting material is basaltic volcanic scoria collected from Huinan County, northeast China. The scoria is usually black and brownish with several meters thick, and forms a huge pyroclastic sheet over large areas. Previous studies pointed out that this low-Ti basaltic scoria was formed 1600 years ago [1][2].

Methods: The basaltic scoria was air-dried for several weeks before analysis, and then crushed in an impact mill. Milled fine particles were grounded to pass the 20 mesh, 40 mesh, 150 mesh, 250 mesh sieve subsequently. They are assembled with a certain percentage to make the particle size distribution approach to the Apollo lunar soils. Finally, the mixture was packed and placed into storage.

Results: Several hundred kilograms of lunar regolith simulant CUG-1A has been produced. Their physical and chemistry properties are generally similar to Apollo 14 soil.

The major crystalline mineral phases of CUG-1A are plagioclase (9% wt) , pyroxene (20% wt) and olivine (48% wt) , and glass (23% wt%). The main elements were analyzed by XRF. They are similar to Apollo 14 soil [3], except the contents of Na_2O and K_2O (Table 1).

The results of physical and engineering properties of the CUG-1A are listed in Table 2. The partical size distrbution is between 10μm and 750μm. The median partical size and mean partical size are 80μm and 92μm respectively. It's average specific gravity is 2.88g/ cm3. The angle of internal friction is approximately 20°, and the cohesion value is 5-21Kpa. These results of CUG-1A are also similar to Apollo 14 samlpe.

Table 1：Major Elements Compositions of CUG-1A and comparison with Apollo soils [3].

Samples	A11	A12	A14	A15	A16	A17	CUG-1A
SiO2	42.2	46.3	48.1	46.8	45.1	43.2	48.32
TiO2	7.8	3	1.7	1.2	0.54	4.2	2.38
Al2O3	13.6	12.9	17.4	14.6	27.3	17.1	16.01
FeO	15.3	15.1	10.4	14.3	5.1	12.2	12.5
MnO	0.2	0.22	0.14	0.19	0.3	0.17	0.15
MgO	7.8	9.3	9.4	11.5	5.7	10.4	6.95
CaO	11.9	10.7	10.7	10.8	15.7	11.8	7.39
Na2O	0.47	0.54	0.7	0.39	0.46	0.4	0.19
K2O	0.16	0.31	0.55	0.21	0.17	0.13	2.12
P2O5	0.05	0.4	0.51	0.18	0.11	0.12	0.54
LOI	0.12	-	-	0.03	0.06	0.07	0.19
Total	99.9	99.11	99.83	100.73	100.71	100.05	99.8

Table 2: The engineering properties of CUG-1A and comparison with Apollo [4].

Parameter	Apollo soil	CUG-1A
Size Distribution, μm	40~ 800	10~ 750
Specific Gravity, g/ cm^3	2.9~ 3.2	2.88~ 2.88
Density, g/ cm^3	1.50 1.75	1.45 1.90
Friction Angle, deg	25 50	20 21
Cohesion, Kpa	0.52 3.0	5 21

Conclusions: The properties of lunar regolith simlant CUG-1A are similar to Apollo 14 soils. It is an additional simulant for lunar soil chemistry and engineering studies. However, it has a quite disparity in cohesion and friction angle comparing with Apollo soils.

Now, more studies are underway to characterize CUG-1A' s engineering and thermal properties, such as gas evolution, electric conductivity, density variations, cohesion and friction angle.

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Referances: [1] Luo, Z.H. (1984) Earth Science 1, 81-86. [2] Liu, R., Q., Zheng, M., Li, N. (1999) Science in China (D) 28, 226-231. [3] McKay, D.S., Heiken, G., Basu, A., Blanford, G., Simon, S., Reedy, R., French, B.M., and Papike, J. (1991) Lunar Sourcebook, 736. [4] Perkins, S.W. (1991) Thesis, University of Colorado.