

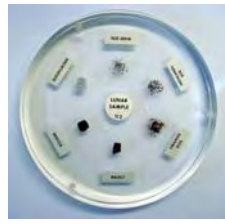
HOW WE USED NASA LUNAR SET IN PLANETARY AND MATERIAL SCIENCE STUDIES: EXPERIENCES OF 10 YEARS OF STUDIES IN EÖTVÖS UNIVERSITY, HUNGARY. *Bérczi Sz.^{1,2}, Gál-Sólymos, K.², Gucsik A.³, Hargitai H.¹, Józsa S.², Szakmány Gy.², Kubovics I.², Puskás Z.²*, ¹Eötvös University, Institute of Physics, Dept. G. Physics, Cosmic Materials Space Res. Group, H-1117 Budapest, Pázmány Péter sétány 1/a. Hungary, ²Eötvös University, Dept. Petrology and Geochemistry, H-1117 Budapest, Pázmány P. s. 1/c. Hungary, ³University of West Hungary, Bajcsy-Zs. u. 4., Sopron, H-9400, Hungary, ⁴Hungarian Geological Survey, H-1146 Budapest, Stefánia út 14. Hungary. (bercziszani@ludens.elte.hu)

Introduction: After one year of preliminary use in 1994 we began to study NASA Lunar sample set from 1996 continuously for 10 years on Eötvös University, Budapest, Hungary, till today. Various programs on the set were reported on the LPSC conferences. Here we summarize the highlights of the programs. 1. **Petrographic studies:** overview of lunar rocks, and comparisons with a) terrestrial rocks, b) meteorites, c) Martian SNC samples, d) industrial materials. 2. **Educational materials preparations:** a) films, b) CD on lectures and reports, c) concise planetary atlases, d) planetary maps. 3. **Complex studies triggered by NASA set:** a) analog studies, b) space robotics (Hunveyor-Husar models), c) theoretical studies [1-4].

Petrographic studies: The NASA set of lunar samples gives overview of lunar rocks: basalts, breccias, anorthosite, norite, soil samples [5].



NASA Lunar Set No. 4.



Lunar Disc No. 112.

Among them the first two groups were represented with greatest number of samples: basalts and breccias. Although 4 basaltic samples (74220, 12002, 70017, 12005), there are fragments in breccias, too (14305, 68501, 72275) and these samples allow textural reconstruction of a lava column in a lava flow on the lunar surface, where various samples represent textures from different depths. Their comparison with a) terrestrial rocks (i.e. ophiolite) with texture, cooling rates, (pillow lava boulder) b) chondrules, cooling rate sequence of the chondrule types c) nakhlites, as deeper layers of thick flow, earlier existed on Mars and Theo's flow. The Both types were also shown in terrestrial samples: pillow-lavas for the quenched outer crust of the lava column and Theo's flow's piroxenites for nakhlites. For comparison the cooling rate sequence of the chondrule types were also involved in the comparison.

Parallel sets developed: Analog rock thin sections were collected and prepared to use them as counterparts to lunar samples in comparisons (i.e. Szarvaskő,

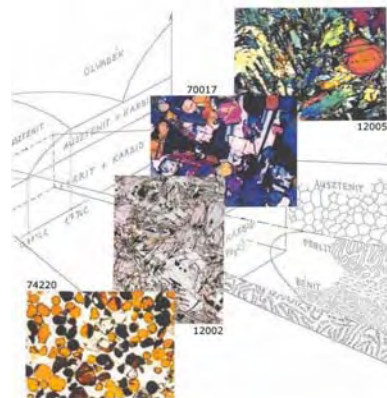
gabbro with high Ti content, basalt, picrite and komatiite, basalt of Disco-Island with reduced iron grains, boninite for high Mg counterpart), impact breccias (i.e. Ries, Mien, Siljan impact breccias), industrial analog materials (i.e. various ceramics with breccia-like textures).

Educational materials preparations: The first step was to prepare a lecture note series booklet on Lunar samples [6] and related lunar and planetary stratigraphy studies. We also recorded a videofilm first on the thin sections, than on lectures related our studying NASA Lunar Set and other planetary materials [7-9]. We involved blocks to introduce students on lunar stratigraphy, formation of lunar anorthosites, and layers of basalts by their textures.



Booklet: Lunar samples and on planetary surfaces.

Units of the film, (video, CD) were selected to correspond to the units of the booklet for students to observe textures in petrologic microscopy and work them in the booklet pages. Our film on technologies and materials helped to compare processes in industry and in planetary geology, explaining that industrial material science has various relations parallel with lunar textures. This way materials structures in planetary science and technology products in factories can be learned parallel.



Cooling rate sequence and the corresponding textures: NASA set basaltic samples (12005-70017-12002-74220) and the perlite, baenite, martensite tempered steel textural series in its TTT diagram.

Planetary maps: Further extension of our studies was the planetary map preparation: Moon, Venus, Mars, Mercury. Lunar textures were involved in the lunar map, which was prepared in 6 languages [10-11].

Complex studies triggered by NASA set: The branching of our NASA Lunar Set studies were a special extension of the planetary science education by robotics. A Surveyor like planetary lander space-probe construction began and together with the construction of the lander we studied details of the field works and scientific goals during the joint activity [12-13].



Atlas Surveyor-Hunveyor Hunveyor model

Lunar and planetary analog test field for Hunveyor: Further extension of the analog studies was a test field as if Hunveyor were landed on a planetary surface. The most important rock types from the Solar System rocky bodies were arranged around it. On the sandy surface Husar rover moved between the rock samples imaging their surface textures [14-15].



Rover's works concise atlas Rock samples on test field.

Summary: Ten years of NASA Lunar Samples were the source of joyful learning in Hungarian Universities. Not only education but wider audience could observe lunar thin sections in microscopes in more than 25 towns in Hungary. The concise atlas booklet series were distributed in more than 200 schools. Hunveyor is constructed in 5 colleges and universities. When summarize the effect of NASA Lunar Samples in Hungary we may tell that it was a fruitful present from NASA and we hope that other new programs will begin in the next 10 years, giving the possibility to further space and planetary science education in Hungary and in Central Europe.

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