IN SITU TRANSPARENT PLANETARY POLISHED THIN SECTION ROCK SAMPLE MAKER: PLAN ON HUNVEYOR EDUCATIONAL HUNGARIAN SPACE PROBE. Gy. Hudoba¹, M. Polgári²,³, P. G. Vizi⁴, Sz. Bérczi⁵, I. Gyollai⁶, ¹Óbuda University, Faculty of Electrical Engineering, Inst. Computer Technology, Székesfehérvár, Hungary (hudoba.gyorgy@amk.uni-obuda.hu), ²Institute for Geological and Geochemical Research, RCAES, HUN-REN, H-1112 Budapest, Budaörsi u. 45, Hungary, (rodokrozit@gmail.com), ³Eszterházy Károly Catholic University, Institute of Geography and Environmental Sciences, H-3300 Eger, Leányka str. 6, Hungary, ⁴EK-CER, HUN-REN H-1121 Budapest, Konkoly Th. 29-33, (vizi.pal.gabor@ek.hun-ren.hu), ⁵Eötvös University, Faculty of Science, Institute of Physics and Astronomy, Cosmic Materials Space Res. Group, H-1117 Budapest, Pázmány P. s. 1/a. Hungary, (bercziszani@staff.elte.hu)

Introduction, motivation: Earlier experiments focused on measuring planetary environment around Hunveyor [1-3]. Our new plan shows a mechanical instrument capable of producing polished thin sections in situ on planetary surface. Next step is to connect this thin section maker unit with an optical microscope in order to measure microtexture with high magnification, where the microbial life units (mineralized biosignatures) leave traces in minerals, which have been found on Earth, Moon, Mars and in chondritic meteorites [4-7]. The in situ discovery of planetary mineralized microbial microtextures in rocks would be of enormous importance.

Goal: Producing transparent rock sample in space (e.g. in microgravity, in vacuum, ... etc.) that can be examined with an optical microscope. The sample to be made:
- size max. ~ 1 cm
- thickness: 20 µm

The structure and main units of the transparent space rock sample maker:
- rotating sample holder fork
- workstations (blue hexagons)
- tools

The steps of the test procedure:
1. securing the rock grain to be tested (size ~0.5 – 1 cm)
2. thinning (grinding, sanding, polishing)
3. optical examination (transillumination, photography, analysis, ... etc.)
4. sample removal (possibly storage) and preparation for testing the next grain

The steps of the sample thinning:
1. securing of a rock grain in the sample holder
2. cutting a planparallel plate (tile)
3. rough grinding (thinning)
4. fine sanding
5. polishing

1. Securing the rock grain into the sample holder
Since cutting, grinding, sanding and polishing involve mechanical force, the grains must be fixed firmly enough in the sample holder and removed after the test so that the apparatus is suitable for receiving the next sample. The fixed sample should be processed from both sides, preferably so that the force effect on both sides is the same and no asymmetric lateral stress occurs, which would turn the sample out of the holder. Prerequisite: there is a manipulator capable of grasping the rock grain to be examined and placing it in the sample holder.

The sample holder:

The sample is fixed with a material that is pressed in from both sides, but does not stick to the fork and preferably hardens in a short time. The fixing embedding material can be either transparent or
opaque.) The fixing material wraps around the rock grain, but should not stick to the fork and retainers. The two retractable fixing studs (retainers) ensure that the sample remains in the fork during processing and that the sample can be removed together with the binding material by pulling it out after the test. The studs can be pulled out by pushing a wedge and the sample can be removed by pressing sideways.

2. Making tile

The diamond cutting discs will cut an approx. 2 mm thick planeparallell tile from the solidifying material stabilized sample.

3. Rough-grinding (thinning)

The central 5 mm diameter part of the 2 mm thick tile is thinned to about 50 µm by rough grinding with a rosette-like movement. The rapidly rotating grinding block is 3 mm in diameter and its center slowly rotates in a 2.5 mm diameter track. This ensures that the grinded area wears as evenly as possible and that a flat surface is obtained.

4. Fine sanding

Similar to coarse grinding, the 50 µm thick region of the sample is further thinned to 20 µm with a finer abrasive.

5. Polishing

The part thinned to 20 µm is polished to be transparent for optical examination (in the same way as was done for coarse and fine sanding).

Possible problems and their solutions:

- The dust generated during cutting and grinding does not settle in microgravity and can be electrostatically charged. The dust can be collected with an electric field or blown out using a gas stream.

Grinding and polishing usually takes place in a wet environment in terrestrial conditions. The purpose of moistening is partly cooling and partly to avoid the formation of airborne dust. In a vacuum, water is out of the question, and in microgravity, the use of some liquid (e.g. nitrogen) would result in splashing droplets. Some sort of paste-like substance is needed for polishing, even in vacuum and at the low temperatures of space. As a last resort, (at least) part of the sample holder fork must be placed in a closed space with the appropriate temperature and pressure to perform the job.

References: