

ANALOG PLANETARY MATERIAL STUDIES OF IGNEOUS ROCKS IN FIELD TRIPS AT HUNGARIAN SITES OF NORTH-BALATON AND MECSEK MOUNTAINS WITH UNIVERSITY SPACE PROBE MODELS HUNVEYOR AND HUSAR. *S. Hegyi¹, B. Drommer¹, A. Hegyi¹, T. Biró¹, A. Kókány¹, Gy. Hudoba², Sz. Bérczi³.* ¹Pécs University, Dept. Informatics and G. Technology, H-7624 Pécs, Ifjúság u. 6. Hungary, (hegyis@tk.pte.hu) ²Budapest Polytechnic, Kandó Kálmán College of Engineering, H-6000, Székesfehérvár, Budai út, Hungary, ³Eötvös University, Department of General Physics, Cosmic Materials Space Research Group, H-1117, Budapest, Pázmány P. s. 1/a, Hungary (bercziszani@ludens.elte.hu)

Introduction: We used the educational lander Hunveyor and rover Husar units of Pécs and Székesfehérvár Colleges to visit the North-Balaton and Mecsek Mountains where igneous rocks of basalt tuff and phonolite rocks are exposed.

Szentbékálla: North of Szentbékálla village the basaltic tuff and rocks were erupted from the Sátormahill and Boncostető 3 Myears ago. The tuff contains various inclusions from the strata penetrated by the eruption. Of the inclusions the peridotite xenolithic series with several types is the most important for planetary analog studies because they are far counterparts of Martian shergottites.

Most peridotite inclusions can easily be recognized by their green color given by the olivines. Hunveyor and Husar models were used to carry out filed investigations of the rocks, they recognized and distinguished the various inclusions.



Fig. 1. Lherzolite xenolith inclusions in basalt tuff from Szentbékálla, North-Balaton Mountains, Hungary.

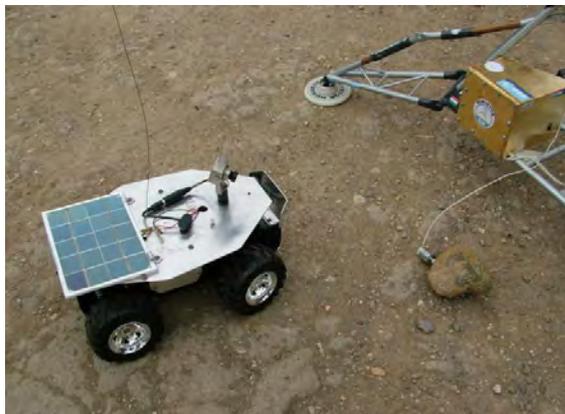


Fig. 2. Hunveyor-8 and Husar-2b works on the naked basalt tuff surface of Szentbékálla, North-Balaton Mountains, Hungary.



Fig. 3. Husar-2 manipulates a lherzolite sample on the basalt tuff surface of Szentbékálla, North-Balaton Mountains, Hungary.

Hegyesztű: Not far from Szentbékálla a beautiful basalt peak with left query can be visited as Mining Museum. There the basalt flow formed hexagonal columns and a landscape where broken hexagon prisms can be seen is very similar to sites where Spirit studied Gusev crater plain in the first quarter year.



Fig. 4. Hunveyor-4 studies columnar basalt flow environment at Hegyesztű, North-Balaton Mountains, Hungary.

Hosszúhetény: In Hungary Mecsek Mountains is the only place where phonolite can be found at Hosszúhetény. They are counterparts for Venus-rocks according to the Venera compositional measurements.



Fig. 5. Hosszúhetény, fonolite mine in Mecsek Mountains, Hungary.

Husar-2b for 12K students: The development of the Husar-2b focus on the basic planetary surface activities. This rover contains a camera and a solar panel on its board placed on a model-car chassis. The drive is on the back wheels by electric engines, movements are controlled by the camera view through a wireless connection to the computer. Husar-2b was used by 12K age students for roving between rocks and observing their surfaces. The camera transmits images with 30 frame/sec, and it has wireless connection with the computer (1200 MHz). Onto the impact-defense plate surface chemical molecule sensors are planned made by students (Husar-2b on Fig.2.)

Husar-2a for university students: The development of this larger rover focus on program-controlled direction of the rover. On a larger chassis Husar-2a has independent driving on all the four wheels. This fact allows a special movement direction. The rover can turn in a very narrow arc which is important to move to side direction objects. The wheels in one axis are connected by differential. The structural framework, the driving and the direction all have a left- and right-hand side symmetric structure (Husar-2a on Fig.3.)

The movements are directed through servo engines, which were originally designed for analogous direction, however, even 8 of these servos can be computer directed by a microcontroller. This microcontroller gets the position of the servo motors through RS 232 port of the computer.

The brain of the rover is a HP-PDA computer which contains a WIFI card and which is in contact with the terrestrial control computer through internet. The computing capacity of the PDA is enough for the autonomous tasks. During rover motion the coordinates of the target is given and the rover choose the track to it.

If the rover moves on a free test field then its position can be determined by a differential GPS. The receiver of the differential GPS is placed in the territory of the Pécs University. This position is given through the server of the geologists of the University.

If the rover moves in the working room, or can not see the satellite, a transformed optical mouse can give increments to the DPA according to the rover motion.

Instruments: On the board of the rover the most important instrument is the robotic arm which has three degrees of freedom. The maximal length of extension is 30 cm, and the arm can lift up 500 g load at the most extended state. The arm has commutable tools. It will carry out a) measurements of soil strength, b) measuring the distance of the target rocks, and c) dust collecting package for Martian studies.

There are 2 cameras on board of the Husar-2 rover with VGA resolution. They were placed on the two sides of the rover. Both can be rotated separately toward discrete target objects but if they are moved simultaneously, panoramic stereo images can be made with them, too. Such operation of eyes occurs in nature at cameleon's eyes.

Husar-4 for college students in Székesfehérvár:

The development of this rover focus on the Ice-Hunveyor program, planned to the winter Balaton Lake. The rover has different sized front and back wheel pairs. Smaller back wheels are pulled only, the larger front wheels has drive by stepping motors. The rover will have T measuring sensor and ultrasound distance measurement. When move farther from Hunveyor-4 on the ice to observe micro-fissures it will contact with it by radio waves. (Hunveyor-4 is on Fig.4.)

Summary: Various Hunveyor and Husar rover constructions were tested on field trips at the North-Balaton Mountains and at the Mecsek Mountains. The college robots were operated for studies of various planetary analog rocks. We continue this work on other Mars analog sites as Gánt (red weathered rocks), Fülöpháza (moving sand dune) and Bér (andesite rocks in columnar development).

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