HOW TO FIND CARBONATE ROCK METEORITE CANDIDATES IN THE ANTARCTIC ICEFIELDS BY EDUCATIONAL ROVER ROBOTICS: EXPERIMENT OF THE HUSAR-5 ROVER OF THE SZÉCHENYI HIGH SCHOOL, SOPRON, HUNGARY. Lang Á.[1], Szalay K.[1], Horváth T.[1], Prajczer P.[1], Láng M.[1], Lobenwein M.[1], Bérczi Sz.[2], [1]Széchenyi István Gimnázium High School, H-9400 Sopron, Templom u. 26. Hungary (mmecurie95@gmail.com), [2]Eötvös University, Institute of Physics, Dept. Materials Physics, H-1117, Budapest, Pázmány Péter s. 1/a. Hungary (bercziszani@ludens.elte.hu).

Introductionduction: The new experiment for the Husar-5 educational space probe rover consists of steps of the technology of procedure of finding carbonate specimens among the rocks on the field. 3 main steps were robotized: 1) identification of carbonate by acid test, 2) measuring the gases liberated by acid, and 3) magnetic test. This method can be used in the icefields on Antarctica if the shape of the rock specimen is meteorite-like.

Background: The triggering sources for this experiment are the following. Spirit has found carbonates (by APXS measurements) at Comanche Spur rock comprised from magnesite, siderite, calcite, and rhodochrosite components. Also the Sipirt, the mini-TES measurement of Saupitty showed lines of the carbonates (Morris et al, 2010) [1]. Earlier carbonates were identified in the Martian dust spectra of TES (Bandfield et al, 2003) [2]. And also carbonates were found in the vicinity of Isidis Basin at regions in Nili Fossae by Ehlmann et al (2008) [3], Wray et al (2011) [4] and Viviano et al (2012) [5]. Finally the discovery of the carbonate meteorites focused our attention to this type of rocks for identification by robotics methods on planetary surfaces, especially first on Antarctica.

Experimental technology steps: It is known that dropping acids produce rather quick reactions with carbonate rocks. This is the first robotic work to realize by electronics. The CO2 gas produced will be observed by gas sensors. This is the second act to be robotized. Of the carbonates some are paramegnetic, especially siderite (iron-carbonate). This results in a third step: magnet contact and attraction of siderite by magnet.

Construction of the experiment: The basis of the robotic realization of the experiment is a romote-controlled rover which can move on the field. Onto this rover the mechanism of the experiments were built from Technics LEGO elements and we used LEGO-motors for making move these experiments. The operation was coordinated by an NXT-brick which was suitable to programming. Fort he acetic-test the drops should be passed to the selected area.

Passing a drop to a locality: From the small holder of the acid using densified gas we pump some drop onto the selected rock. We promote this process by pumpig the atmospheric gas into another small gas-container, so we have another higher pressure gas there. This is pumped into the acid-holder.

The effect of the reaction is observed by a wireless onboard camera, which transfers the image to the lander, and to the terrestrial control. In order to identify that the surface acid is bubbly we need human observation, because we could not automatize it.

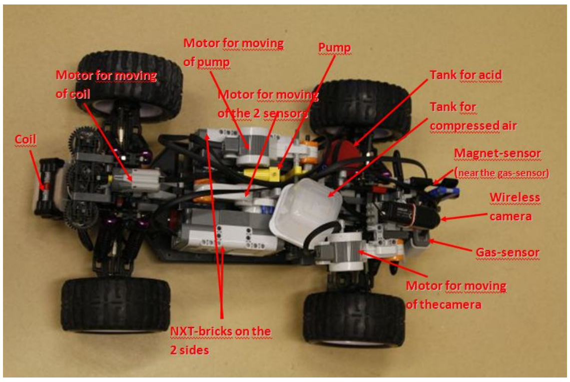

Fig. 1. The Husar-5 rover with the Carbonate experiment instruments.

In the next step we can identify the the liberated gas by the gas sensor. This is not a typical LEGO-sensor, but it is a gas sensor measuring by the electric resistance change. LEGO compatibility was reached by soldering it into the box of the LEGO-sound-sensor. This way we could attach it to one of the sensor-ports of the NXT. (to that port, where originally the microphone was planned, because the operation of that instrument was also based in measuring the resistance). Using our gas sensor we can confirm the liberation of the CO2 gas without outer observer.

The third step is the controll of the paramagnetic properties. Paramagnetic magnetism means that the body exhibits magnetic features by the effect of an outer magnetic field. In measuring this feature a LEGO-compass is our instrumentation. If we carry a permanent magnet, however, then our sensor will fix a direction from which our magnetized siderite can not move out the LEGO-compass. That is why we use a electric current generated magnet. The magnetic test has the following operations int he measuring procedure: first the program gets the position of the compass-sensor (this is angle) and this value is stored in the memory. Then we close the circuit of the coil by a relay. Opening the circuit we read the position of the compass-sensor simultaneously with the circuit opening.

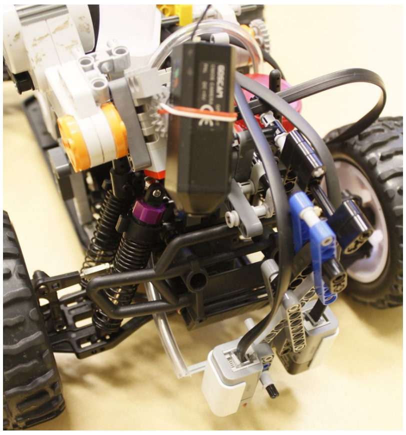

Fig. 2. The Husar-5 rover with the Carbonate experiment when gas-sensor is in lowered position.

The program calculates the difference between that position and the initial position and places this value into another list. Then the rovers turns a little and repeats this measuring process. (After rover rotation the coil remain in an almost identical position over the rocks sample. This turning process is repeated 2-3 times. Calculating the average of the differences the program compares it with a given limit, and decides that the sample has paramegnetic property, or not.

Fig. 3. The Husar-5 rover with the Carbonate experiment when coil of the magnetic experiment is in lowered position.

During the measurements both the coil and the gas-sensor should be positioned to be near to the surface. This means, that a lowering and an uplifting machinery should be constructed. Without this machinery the motion of the rover over the undulating surface should bulldoze the measuring instruments.

Summary: The sequence of the measurement is the following. 1) the camera – after giving panorama images – turns toward the soil surface, 2) the dropping onto the rock surface 3) at the same time the gas-sensor starts to move down above the rock 4) the compass sensor also moves down on the arm which holds both the gas-sensor and the compass-sensor 5) evaluation of the gas-sensor data 6) if CO2 is present the magnet-test begins, therefore the rovers moves forward into a good position for the coil lowering 7) after magnetization the rover moves backward in order to be in the position that the compass-sesnsor can measure the angle. 8) the last 2 operations are repeated in a small turned position of the rover 9) final calculation of the paramagnetic measurement 10) summary of the 3 tests.

Application and future test in Antarctica: In principle siderite (and any carbonate) meteorite search by a rover may be a useful collecting test in Antarctica. Robotic way of collecting great number of carbonate samples makes it possible that from the carbonate samples the baked rimmed pieces can be selected [6]. This needs only a sawing them to two part in order to the darker baked rim become visible. Collecting by robots, sawing the collected carbonate samples in the laboratory is process which opens the possibility of discovery of several other carbonate meteorites within reasonable time.

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