HOW WE USED NASA LUNAR SAMPLES IN LUNAR ANALOG FIELD TRIP AT THE TAPOLCA BASIN BASALT FLOWS, BALATON-HIGHLANDS, HUNGARY IN COMPARISONS WITH APOLLO 15 LAYERED OUTCROP AND APOLLO 12 BASALT SAMPLES.

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Introduction: The 40 years anniversary of the Apollo-11 and -12 lunar landings focused our works on planetary analog field works and use of the NASA Lunar sample set in using in petrographic studies. We selected a region in Hungary, which contains mountains built up from basaltic rocks in the North-Balaton region, surrounding the Tapolca Basin. They were formed from alkaline basaltic lavas in the form of maar, tuff and lava flow volcanic eruptions in the Pliocene. We visited the site with Hunveyor and Husar space probe models and studied these sites with 3 main fields for comparisons: 1) Geological setting, stratification of the eruptions 2) textural comparisons of terrestrial and lunar basalts 3) field work practice and measurements with the Hunveyor-4 and Husar-5 space probe models on the basalt analog sites.

Observations at Tapolca Basin basalt mountains: The Tapolca Basin Basalts are members of a basaltic-basanitic volcano group in the Bakony–Balaton Highland Volcanic Field, in the Trans-Danubian Region, West-Hungary. They were studied earlier [1-3] and mined during the last 150 years (Fig. 1.). They were formed in the Pliocene and flowed on the sediments in pathches and flows with lateral extent of some kilometers to 10 kilometers distances. They frequently formed a "layer cake-like" magma emplacements which formed individual spots, the multiple layers did not overlap each other. The first eruptions formed undulating contacts with the sediemnts of the Pliocene plane. Later only some succession of the basalt sheet layers stratified.

Pliocene desert winds later eroded the original height of the plane but the hard rock covered plateaus gradually emerged from the plane as weathering-resistant witness-mountains. The edges of the plateaus gradually eroded in basalt-orgel form columns, and took their recent shape with cliffs at the edge of the basaltic layers extending some 10 meters (generally 40 meters, maximum 70 meters)

Apollo-15 basalt layers at Hadley rille wall: The lunar mare plains were emplaced in several successive flows over a long time During the Apollo expeditions had one spectacular observation of the thick basalt layer flow at the Apollo-15 landing site field trips, along the Hadley-rille walls. The rille was suggested to have been a lava tube and steep slopes could not hold thick talus of surface regolith fragments. (Fig. 2.) [4-5]

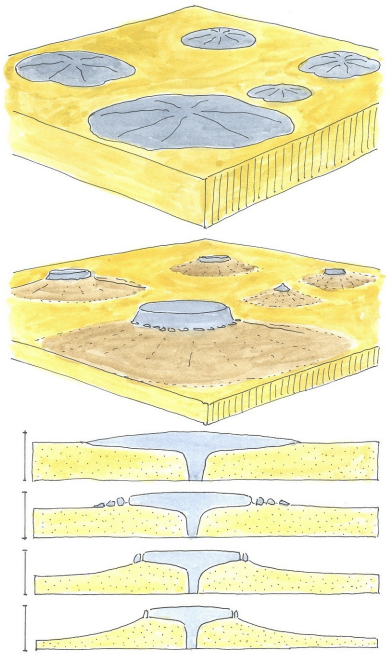

Fig. 1. Basalt mountains in the Tapolca Basin, development till their recent witness mountain form. The five are: SztGyörgy, Haláp, Badacsony (center), Gulács, Csobánc.

Fig. 2. The Hadley Rille, southwest wall, outcrop of the layered bedrock. Apollo 15 imaging: AS15-89-12104 and AS15-89-12157 (detail).

Apollo basalt samples in the set: Earlier we arranged the lunar set textures in a lunar basaltic lava flow according to their cooling rate: **74220,** the orange soil of Apollo-17 was the sample with the greatest cooling rate, forming glass spherules ([6-10]) by quenching cca. 1000 C/min. cooling rate [11]. Over smaller fragments in the breccias the **12002** basalt of the Apollo 12 with porphyritic sample represented a slower initial cooling rate (large olivine grains) and later higher cooling rate (variolitic laths of clinopyroxenes and plagioclase feldspars). (some degrees C to 2000 C/hour [12]. Although in the breccia **14305** an intergranular clast occurred, (hundred degrees C/week) and in the breccia **72275** a subophitic clast was found, the next thin section in the NASA set was the **70017** poikilitic sample with occurrence of sector zoned clinopyroxenes. (plus ilmenites making dark the thin section). The slowest cooling rate specimen was the **12005** poikilitic sample of the Apollo-12 collection. [11]

Tapolca basalt petrology: The basaltic rocks in Tapolca basin form both pyroclastic layers and lava flows. Rock samples from different basalts show closely similar petrographic features. The finegrained, fast cooled groundmass contains small plagioclase lath with intergranular clinopyroxene (augite) and in some cases altered olivine grains among them. Moreover there are different amount of glass and some ilmenite in the groundmass. Coarse grained porphyric olivines and augites had been formed during earlier, low cooling rate stage of crystallization. Upper mantle originated xenocrysts and xenoliths together with rock inclusions picked up by the upcoming lava from the lower and upper crust have also been found.

Fig. 3. Hunveyor-4 and Husar-5 rover at the quarry of Hajagos Mountain. Husar rover measures the natural radioactivity of the rocks (left). In the quarry of Hajagos Hunveyor-4 observes the talus of the inner strip pitby camera imaging (right).

Similarities and differences: Apollo 12 basalts are picritic in composition and originated in deep lunar mantle [13]. Tapolca basalts has also mantle origin (containing matle xenoliths, upper mantle) but they are alkaline rich. Both basalts were emplaced in thin lava flows (10 meters depth). However, the vast quatity of lunar mare flows is far larger extent than the spots in the Tapolca basalts flows. Emplacement geology was compared between Apollo 15 Hadley wall layered outcrops and the quarry wall layers at Hajagos, Hegyestű and Ság mountains. Terrestrial counterparts were far more gas-rich and water-rich resulting in more variable accessory mineral content in Tapolca basalts.

Summary: In our planetary science educational program we visited lunar analog sites in the Tapolca Basin. We compared basalt flow stratification of the Tapolca basalts and that of the Apollo 15 Hadley rille wall. We concluded the larger mass of lunar lava flows and the textural differences in cooling rate, composition between the two basalt types. However, the collected samples will be studied in the lab for lunar simulant use of the Taploca basalt material.

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