



Pleistocene periglacial cryogenic mounds (lithalsas) on basalt plateaus in the western Pannonian Basin

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On some basalt plateaus of the western Pannonian Basin, Hungary, fields of circular depressions occur. They are traditionally called „basalt karst” and their formation has been attributed either to collapse over karstifying rocks or to anthropogenic action (quarrying); however, both of these theories are questionable.

The depressions are situated between elevations of 350-500 m a.s.l. and are characteristically surrounded by circular raised rims or ramparts. They measure a few m-s (up to ~10 m) in diameter, the ramparts emerge 0.5-1.5 m above the surrounding level ground and encircle a depression of 1-2 (-3) m deep in the middle. Depressions cluster in well delineated, high-density groups, with individual fields containing several dozens of these forms. Neighbouring ramparts are tightly packed, often interfere and depressions can thus coalesce creating composite forms. The ramparts are composed of coarse (dm-sized) basalt blocks, whose material is identical to that of the surrounding terrain and seems to originate from the depression. Many of the depressions host ephemeral ponds.

Raised rims exclude formation of these landforms by any karstic processes. The anthropogenic theory is opposed by the lack of the remains of any facilities (e.g. roads), of tools and by the very illogical distribution and geometry of depressions from the point of human use. On the contrary, we interpret these ramparted depressions as being of periglacial origin, remnants of cryogenic mounds. The central depression and the emergent rampart can be well explained by the ice core raising the overlying rock and by the radial downsliding of this material on the ice core to the margins. Within cryogenic mounds, clustering and size of the forms fits the characteristics of perennial frost mound without peat cover, i.e. lithalsas or minerogenic palsas.

Cryogenic mounds are important paleoclimatic indicators. Based on modern analogs, these lithalsa scars indicate the former presence of discontinuous or scattered permafrost, a mean annual temperature of -3 to -6°C and a maximum for the mean temperature of the warmest month around 10°C. Frost mound formation could be promoted by high water content in the weathered surficial zone of the basalt and by the removal of insulating snow cover by strong wind action, already documented in the area for the Pleistocene. These are the southernmost lithalsa scars reported in Europe.

Work has been supported by the OTKA project K 106197.