

Thermal stress and topography control on the exfoliation of spheroidal granite boulders in Pricopan Ridge, Macin Mountains, Romania

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Exfoliation is one of the most frequent processes of granite landforms shaping, its intensity being usually associated with the cumulated action of thermal stresses. Although exfoliation microforms are present on granite landforms in most of the warm-climates, the controlling factors of this process are not yet well defined. Within this study, we investigated the distribution pattern of the exfoliation microforms identified on the surface of 40 rounded granite boulders mapped on the western slope of Pricopan Ridge (Macin Mountains), in a semi-arid temperate environment (Northern Dobrogea, Romania). Continuous rock near-surface temperature measurement on a reference boulder over a four years period allowed us to evaluate the frequency and intensity of the rock thermal oscillations, taking into account (as control factors) (i) the fast temperature changes generated by convective summer rain events, (ii) the day-night temperature variations and (iii) the occurrence of freeze-thaw oscillations during winter. The relative rock strength at the rock surface was determined by Schmidt Hammer tests, which highlighted a reduced resistance of the boulder areas oriented towards South (mean rebound values of 27-33) compared to the North-exposed ones (mean rebound values of 43-50). Over a North-South profile of the boulders, the lowest resistance of the rock surface corresponds to their gently sloping southern faces (at slope values of 0-45 degrees ($^{\circ}$)), which indicates a higher susceptibility of these sectors to be affected by weathering processes. These specific areas (gently-sloping faces of the rounded granite boulders) overlap the sector of high frequency and intensity of the investigated thermal-stress inducing processes, all three of them reaching the highest peak on the South-face of the boulders at slopes of 20 $^{\circ}$ -30 $^{\circ}$. Correspondently, the exfoliation microforms mapped and morphometrically described in this study are developed most frequently in the area delimited by the top of the boulders (starting from the North face at a slope of 5 $^{\circ}$) and their 45 $^{\circ}$ slope south-sector, covering thus the upper-half of the South-exposed face of the boulders. The correlations obtained between the maps of frequency and/or intensity of the thermal stress generating processes and the map of exfoliation microforms distribution frequency indicate the complementary action of the summer fast temperature changes and day-night amplitudes in the sub-aerial formation and evolution of the exfoliation microforms by directional thermal stress, in a similar way to the occurrence of meridional cracks on rocks from both warm and temperate arid environments.