THE GEOMORPHIC SIGNIFICANCE OF TORS OF THE WEST SUDETES

Popular science summary

Most landforms – the subject matter of geomorphology – are ubiquitous but inconspicuous, not easy to capture attention of non-specialists. However, there are exceptions and among these are tors, once defined by Linton (1955) as *'solid rock outcrops as big as a house rising abruptly from the smooth and gentle slopes of a rounded summit or broadly convex ridge*'. They are curious elements of landscape, often of imposing dimensions, strange shapes, seen from a distance to crown mountain summits and interrupting otherwise smooth slopes. Locally they are associated with further intriguing features such as deep clefts and tunnels, circular hollows known as weathering pits, block fields. Folk tales and legends are associated with many tors, testifying to early attempts to explain why tors occur. The West Sudetes in SW Poland are an area particularly abundant in tors which occur in different rock types (granite, gneiss, greenschist, hornfels, conglomerate), at different altitudes (from less than 400 m a.s.l. to nearly 1500 m a.s.l.) and in different landscape contexts (summit, crest, slope, valley side). A few researchers in the past, such as Alfred Jahn and Andrzej Martini in the 1960s, attempted to solve the mystery of tors and offered conceptual models of their origin, but their studies were of local rather than regional significance and their wider applicability is yet to be tested.

In this project we intend to shed new light on the old problem of tor occurrence and significance, encouraged by newly available datasets, tools and techniques, and advances in general hillslope geomorphology experienced in the past few decades. Among them are high-resolution digital elevation models from laser scanning of the Earth surface which allow tor recognition even in poorly accessible forested terrain. The use of these elevation data will allow, for the first time, to provide a complete picture of tor distribution across the region. Furthermore, having all data in digital format, we will be able to apply modern technologies of Geographic Information Systems to examine regularities in tor distribution and answer the question whether they are random features or quite to the contrary. Using portable devices we will be able to measure how strong and resistant are the rock which build tors and whether there are correlations between rock hardness and tor shape and size. We will apply geophysical techniques to investigate the thickness of loose material in the vicinity of tors at selected localities, in order to test conceptual models of tor origin. We will measure discontinuities in the rock mass to see how much they control tor shapes. We will also analyse the distribution of tors in relation to the inferred extent of Pleistocene ice sheets, joining the discussion whether tors can survive the passage of ice and what they tell about the power of glacial erosion.

Our project has two components. One involves desk study and aims to show how tors are really distributed across the region. High-resolution digital elevation models and methods of spatial statistics will be used to arrive at an objective picture. The other component is field work and will involve tor mapping, description, measurements, and geophysical investigations. For field work we selected five test areas within the region, representative for tor phenomenon. These are the east-central part of the Karkonosze Mts (granite), the northern part of the Rudawy Janowickie ridge (granite too, but at much lower elevation), the north-eastern part of the Izerskie Upland (granite-gneiss, partly within the limits of an ice sheet), the Okole ridge in the Kaczawskie Mts (greenschist) and the eastern part of the Rudawy Janowickie ridge (conglomerates).

There are several reasons why it is important to study tors. First, studies of this sort allow us to better understand the relationships between geology and landscape. Second, tors are important indicators of how mountain slopes develop. Third, tors have a history and may have witnessed important environmental changes in the past, to be deciphered from tor appearance and characteristics of rock materials in their surroundings. Fourth, tors are valuable parts of Earth heritage, worth explanation and protection. In the end, we may strip the tors of part of the mystery that surrounds then, but we believe that the better understood they are, the more appreciated they will be as part of local natural, but also cultural heritage.

The project, aimed at comprehensive region-wide analysis using geoinformation techniques, will not only improve our understanding of geomorphology of the West Sudetes, but will be a valuable addition to general geomorphology too since quantitative studies of tors at such a broad spatial scale, involving different lithologies and the range of topographic settings, have been very rare.