Landform development in granitic terrain

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ABSTRACT

The development of landforms in crystalline rock is complex and extends over long geological time periods. The resulting landforms in different scales form as a consequence of an interaction between endogenic and exogenic processes, climate change and plate tectonic movements during their formation. The general aim of this thesis is to judge qualitatively and quantitatively the significance of different exogenic processes for shaping relief in granitic bedrock and their relation to structures in the bedrock.

Two reference areas were chosen for comparative studies in granitic terrain, namely an area with Precambrian bedrock in south-eastern Sweden and the southern part of the Mesozoic Sierra Nevada batholith in western U.S. Large scale landforms were interpreted from aerial photographs and topographical maps in selected parts of the study areas. Field works were carried out classifying small, 0.1-10 m, to medium, 10-100 m, scale landforms according to their process of formation. Schmidt hammer tests were performed on surfaces affected by different geomorphological processes.

Schmidt hammer tests performed at 50 sites on different rock surfaces suggest that the method is uncomplicated and reliable when evaluating the degree of influence exerted by exogenic processes on the landforms as well as confirming the type of process. Hence, statistically significant differences were demonstrated between surfaces affected by different geomorphological processes.

Investigations of 79 A-tents and blisters in central Sierra Nevada suggest that their formation is a young phenomenon, developed after the latest Pleistocene glaciation. Orientations of A-tents, joints and bornhardts point at the stress field or compression imparted to the bedrock during emplacement of the granite.

The interpretation of aerial photographs in combination with the collected field data from the Sierra Nevada and southern Sweden allowed the identification and characterization of structural patterns over larger areas. The bedrock forms were then assessed in relation to other controlling factors such as weathering, fluvial erosion, and glacial erosion. Remnants of saprolites and their relation to characteristic landforms for example tors, joint valleys, and steep slopes, shows that periods of deep weathering has exerted strong influence on the relief in both areas. The deep weathering systems were reactivated due to Cenozoic uplift and different stripping mechanisms such as fluvial, glacial and glaciofluvial erosion have exposed an irregular weathering front.

The study confirms earlier studies suggesting that the bedrock structure is decisive for the landform development and can be seen in all scales in the landscape. Early drainage and former glaciers have utilized ancient fracture systems. Large to medium scale landforms such as bornhardts and domical hills are closely connected with lineaments which delineate these. Minor tor formations and corestones stand in line following a principal fracture pattern. Etch forms with only minor glacial reshaping dominates the investigated areas of southern Sweden. The results of the study suggest that glacial reshaping of bedrock forms is minor in southern Sweden, exposed to ice sheet erosion, than in parts of Sierra Nevada where alpine glaciation have prevailed during most of the glacial periods.

Keywords: *Landforms; granite; exogenic processes; Schmidt hammer test; A-tent; drainages; fractures; saprolites; structures; Sierra Nevada, California; southern Sweden.*