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Rocks prone to stress-controlled weathering and erosion - examples, indicators, testing and limits for extrapolation from sample to field scale

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Gravity-induced stress is the stress generated in any rock by the Earth's gravity field. On rock outcrops, such stress is commonly way below the compressive strength of given rock and is generally neglected when dealing with weathering and erosion (with exception of mass wasting).
As was recently clearly demonstrated, erosion of some sandstone types caused by rain, flowing water, salt precipitation and frost action is strongly reduced, if confining stresses occur (in the laboratory conditions and in the field).
Physical erosion/weathering experiments with locked sands, numerical modeling of stress distribution and numerical modeling of erosion showed that stress field is capable to orchestrate erosion/weathering in an unprecedented way. As a result, the perfect-shaped arches, balanced rocks, pillars, overhangs, arcades are landforms are created due to principle of negative feedback between stress and erosion. Owing to the pronounced effect of stress on the weathering and erosion processes, it is important to distinguish rocks (materials), which are prone to stress-controlled weathering and erosion (SCE-rocks/materials).
For uncemented material it is possible to apply a simple field test and compare behaviour of this material under uniaxial or radial compression with the behaviour in an unconfined state. For cemented material it is necessary to apply a laboratory cyclic weathering test performed on small specimens of the material under various uniaxial compressions lasting typically weeks to months. It was shown that the Na2SO4 salt weathering tests provide the fastest results. Presence of arcade forms, rock pillars and absence of dead-ended protrusions on outcrops are the best indicators of SCE-rocks.
Tests and field observations performed in the last years showed that many locked-sands/friable sandstones, as well as some cemented sandstones, quartzites, tuffs and strongly weathered granites fall into the category of SC-rocks. On the other hand, there are other rocks, including various sandstones, whose weathering pattern indicates that they do not fall into the category of SCE-rocks. Therefore, attention should be paid to whether the given material is SCE-rock or not when considering its weathering response to stress and weathering pattern in the field.
As discontinuities in rocks occur in various scales and as they generally limit the effect of stress-controlled weathering, caution is needed when extrapolating the results of laboratory tests with small samples to outcrop scale. Field study is necessary to confirm the stress controlled erosion at outcrop scale.
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