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Weathering and exhumation history of the Sila upland plateaus, southern Italy: a geomorphological and pedological perspective

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The Sila Massif (southern Italy) represents a tectonically active area in a typical upland Mediterranean environment. It is characterized by old planation surfaces on top (about 1500-1600 m asl), bordered by steep slopes, where granitic spheroidal boulders occur as wide boulder fields or along bedrock ridges. These boulders formed by chemical and physical weathering at depth, followed by further weathering processes and exhumation at surface, with progressive removal of loose disintegrated material by erosive processes.
On the basis of the main geomorphological and pedological features and an extensive, multidisciplinary literature available for the study area, a possible reconstruction of its weathering and exhumation history is proposed, as well as an estimation of long-term erosion rates.
Recently published results of river longitudinal profile and cosmogenic nuclide (10Be content in modern fluvial sediments) analyses highlighted the occurrence of two major knickpoints along the main river valleys, which permit to separate three key phases of landscape evolution: (i) a middle Miocene emersion of the Sila Massif, (ii) the development of the present upland plateaus under conditions of prolonged geomorphic and tectonic stability during the late Pliocene and early Pleistocene, followed by (iii) important uplift (with a marked change in regional uplift rates at about 400-300 ka) and progressive isolation of these landforms since the middle Pleistocene, coupled with severe erosion.
The development of spheroidal weathering which led to the formation of the boulders at depth was likely related to the period of geomorphological stability, when the high-standing flat landforms were shaped, and probably also the corresponding soils formed close to the surface. Some chronological constraints to this phase are given by: (i) the lack of exposed spheroidal boulders on paleosurfaces younger (mid-Pleistocene in age) and located at lower elevations than the top ones; (ii) the presence of a late Pleistocene paleosol with typical Last interglacial features (important rubification and clay illuviation), in turn buried by a soil partly developed on late Pleistocene to Holocene volcanic ash (< 42 ka), on fluvio-lacustrine terraces that postdate the paleosurfaces. This volcanic soil represents a widespread pedomarker (geosol) in the area and covers the base of some exposed boulders on the topmost planation surfaces. This feature clearly indicates that boulders had been already exhumed before the volcanic input and corresponding soil formation. Moreover, it confirms an essentially middle Pleistocene age for the inset of a relevant phase of erosion, presumably enhanced by tectonic uplift and increased local relief.
An attempt to roughly estimate long-term regional denudation rates was finally achieved on the basis of the surface area covered by boulder fields (over a total area of about 20 km2), along with presumed depths of boulder formation before their exhumation and presumed thicknesses of the overlying soil profiles. Different scenarios were thus reconstructed, also taking into account different time ranges since the middle Pleistocene.