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Weathering and pedogenesis in the Sila Grande Massif (Calabria, South Italy): From field scale to micromorphology

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Abstract

Weathering and soil features in the upland landscapes developed on granitic terrains of the Sila Grande Massif (Calabria, South Italy) have been studied in this work. The attempt to link field scale and micromorphological observations in order to better understand the main weathering processes and their controlling factors is revealed to be very powerful. Six soil profiles in the area around the Cecita Lake, representative of different geomorphological units, were characterised by field work, optical microscopy and SEM-EDS analysis. A strong influence on weathering and pedogenesis by micro-scale features of primary minerals and parent rock fabrics is shown. Key roles are played also by relief, in the development and preservation or stripping of regolith + soil mantles in relation to natural and man-induced phenomena; by time, controlling rates and degree of development of the main weathering features; by climate, in terms of type and intensity of dominant processes.
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1. Introduction

Weathering of crystalline rocks and soil features of the Sila Grande Massif, in the Calabria region (South Italy), have been widely investigated with special emphasis on granular, in situ disintegration of granitoid/gneissic rocks (grus production) and soil management, respectively. In more detail, previous papers dealt with the description of typical weathering landforms, the interpretation of their formational factors and processes, and their distribution (Matano and Di Nocera, 1999; Le Pera and Sorriso-Valvo, 2000a). The evaluation of micropetrographic indices has permitted (i) quantification and comparison of different degrees or stages of weathering (Le Pera et al., 2001b), (ii) assessment of their effects on rock stability and landslide phenomena (Critelli et al., 1991; Cascini et al., 1992), and (iii) application to provenance studies linking siliciclastic sediments in fluvial catchments to source rocks (Le Pera et al., 2001a). Petrographic and mineralogical analyses performed by Mirabella et al. (1996) on parent rock materials and secondary clay minerals, respectively, indicated connections between weathering and pedogenetic processes. Other works report data concerning detailed soil survey, taxonomy and mapping, mainly to estimate soil sensitivity to degradation under different land management, for agriculture purposes (seed-potato crop suitability), pasture and forestry, or to test soil conservation measures (Lulli et al., 1992; Costantini, 1993; Lulli and Vecchio, 1996, 2000).

Nevertheless, published studies lack an integrated approach to weathering and pedogenesis, as well as any climatic interpretation or soil age assessment. This paper attempts to address these questions and some wider issues in weathering studies. The major factors responsible for weathering of crystalline rocks are widely reviewed and discussed by Whalley et al. (1982), Twidale (1986), Migoń and Lidmar-Bergström (2001), Migoń and Thomas (2002), where also the importance of linking different scales of observations (Viles, 2001) to interpret weathering processes and landforms is highlighted. The present work approaches this issue, scaling from field investigation to micromorphological analysis, and combines both weathering and pedogenetic features, in order to have a more complete understanding of their driving processes and to interpret them in terms of environmental conditions and landscape evolution. In addition, the controversial issue about relative roles of physical and chemical factors in grus production is discussed.

Six selected soil profiles, representative of the main soil types (Umbrisols, Cambisols and Luvisols, e.g. Lulli and Vecchio, 2000) associated with the major landforms surrounding the Cecita Lake (central sector of the Sila uplands) are considered in this paper, with a special focus on Late Quaternary soil evolution, the most recurrent patterns of weathering, their degree of development and the main alteration products. Both in situ granite weathering and soil development on granitic fluvial deposits are taken into account, in order to include a variety of features and consider weathering in its widest meaning. Physical, chemical and biological processes operate changes on parent materials exposed to atmospheric agents at or near the Earth's surface, whether they consist of basement rocks, rock fragments, sediments, colluvia or single minerals (cf. Butzer, 1976; Govett et al., 1992; SSSA, 2001).

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