

Biotic and Abiotic Processes on Granite Weathering Landforms in a Cryotic Environment, Northern Victoria Land, Antarctica

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ABSTRACT

A multidisciplinary study was carried out to understand the interactions between biotic and abiotic processes in granite weathering in ice-free areas of Northern Victoria Land, Antarctica. Examples of tafoni, pits and grooves were analyzed, focusing on their morphometry, infills, weathering rind types and vegetation patterns. Surface and subsurface temperatures and incoming radiation were measured to characterize microclimatic conditions. In addition, microscopic, SEM and X-ray diffraction analyses of granite were carried out. These analyses indicate that, under present conditions, mechanical weathering is the main process active in the formation of tafoni, which post-date pits and grooves. In these forms, granular disintegration is mainly induced by chasmoendolithic lichens, salt and thermal stress associated with the dilatation coefficients of different granite-forming minerals. The overall morphology of pits and grooves indicates that they originate from water erosion. In the former, mechanical weathering prevails, caused by epilithic lichens, by freeze–thaw events, and by salt, while only the first two processes are active in the grooves. The intensity of these processes is less effective than in tafoni and on the outer surfaces, suggesting that pits and grooves are inherited features, possibly generated in the same way as landforms occurring on granite in the humid tropics. Copyright © 2005 John Wiley & Sons, Ltd.

KEY WORDS: cold-climate weathering; Tafoni; Antarctica

INTRODUCTION

Rock weathering can be caused by mechanical, chemical and biological processes as well as by their interactions. In Antarctica, as in other cold environments, mechanical weathering processes traditionally have been considered to be dominant (Campbell and Claridge, 1987; Matsuoka, 1995) although some studies have recognized the importance of chemical or biological processes (e.g. Friedman and Weed, 1987; Hall and Otte, 1990; Hall *et al.*, 2002; Etienne, 2002).

Weathering in the Antarctic is still an open question, however, in part because weathering landforms that occur on granitic outcrops are not confined to cryotic environments but are also widespread in the Tropics and mid-latitudes (Lageat *et al.*, 1994; Ollier, 1984).

In relation to mechanical weathering, several authors (e.g., Matsuoka, 1991, 1995, 2001; Hall, 1993; Hall and André, 2001; French and Guglielmin, 1999, 2000a) have debated whether frost action can be important in the arid environment of Antarctica, especially in rocks with very low porosity such as granites (Prick *et al.*, 2003). Other studies have suggested that thermal weathering plays an important role due to thermal shock (e.g., Hall, 1999; Hall and André, 2001) or thermal stress associated with

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