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Spatial distribution of rock fragments in dolines: A case study in a semiarid Mediterranean mountain-range (Sierra de Gádor, SE Spain)

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Abstract

Rock fragments (RFs) at the soil surface have great effects on the intensity of various hydrologic and geomorphic processes. However, little information is available on the spatial distribution of rock fragments (RF) in the dolines, which may be of importance in understanding overland flow and subsequent recharge in limestone karst landscapes. This study analysed spatial variability of RF cover and size in different topographic positions (top, upper, middle and lower position) in three dolines in Sierra de Gádor (Almería province, south-east Spain). The results indicated that cover percentage of small RFs (5–20 mm) increased but large RF cover (250–600 mm and >600 mm) decreased from the upper position to the lower position of the dolines. Small RFs were usually resting on the soil surface while most large RFs tended to be partly embedded in the soil surface. Total RF cover and D_{50} (median diameter) of the surface RFs greater than 5 mm tended to increase with slope gradient.

Keywords: Rock fragments; Doline; Topographic positions; Mediterranean; SE Spain

1. Introduction

Dolines, typical features of limestone terrains, are relatively shallow, bowl-shaped depressions ranging in diameter from a few to more than 1000 m (White, 1988; Ford and Williams, 1989). The formation of dolines mainly results from limestone solution and collapse (Cramer, 1941; Ford and Williams, 1989). In many areas, dolines can act as funnels concentrating near surface waters and forming important point-sources of recharge to limestone aquifers (Gunn, 1983).

For most dolines, soil surfaces are characterized by the presence of rock outcrops and RFs, which are products of geochemical, hydrologic and geomorphic process. Surface RFs, in turn, can affect the intensity of various soil hydrological processes such as surface sealing, infiltration, evaporation, runoff generation, runoff energy dissipation and erosion by water (Abrahams and Parsons, 1994; Brakensiek and Rawls, 1994; Poesen and Lavee, 1994; Poesen et al., 1994; Valentin, 1994; Van Wesemael et al., 1995, 1996). Yair and Lavee (1974) reported that large boulders could increase runoff while small stones decrease it. In fact, RF cover at the soil surface has an ambivalent effect on infiltration rate and on overland flow generation, which depends on various factors such as position, size and cover of RFs as well as structure of the fine earth (Poesen et al., 1990; Poesen and Lavee, 1994). When free on the soil surface, RFs generally prevent the soil from sealing and the infiltration increases, but embedded in the surface, they participate in the

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