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Investigating the areal variability of infiltration in heterogeneous material : the case of the black marl of south Alps

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Black Marls cover a wide area over the Durance watershed in south east France. Marl erosion results in dams filling all along the Durance River down to the "Etang de Berre" (Mediterranean Coast). In the most sloping parts of the area, black marl is also subject to slope failure and may be involved in the landslide hazard. The work presented here has been carried out in the Draix Experimental Field Network (Draix ERBs) located in the badlands areas of the French Southern Alps (black marls). The Draix ERBs have been created in the early eighties to study erosion and flash flood processes. It has been recently awarded ORE label (Observatory for Environmental Research) from the French Ministry of Research. The present study is part of the ECOUPREF ANR project which aims at investigating the triggering role of preferential flows upon landslide motion. The specific objective of this work is to describe and modelling the areal variability of infiltration processes in heterogeneous marl formations. Investigation of infiltration processes is carried out for weathered and non-weathered marl using 2 experimental hillslopes (site W for weathered and site NW for non-weathered). Both have been instrumented with water content sensors, tensiome-

ters, suction lysimeters, and piezometers. Soil water and groundwater have been sampled monthly since April 2007 for chemical and isotopic analyses. In October 2007, an experiment of simulated rainfall with water enriched in bromide and chloride has been carried out on a 100 m2 plot (site W). Further equipment has been set up including 28 piezometers (from 1 m to 4 m deep), water level sensors and water content sensors. A 680 mm rainfall has been applied during 72 hours. Chloride has been used as tracer over the first 36 h and Bromide over the remaining time. Groundwater has been sampled every 90 minutes in all the piezometers. The initial results from the long term hydrodynamic and isotopic survey shows that different hydrological behaviours may be described according to the soil nature and the observation depth. In both hillslope sites, mixing processes in groundwater resulted in quite constant delta 18O over time, though slightly depleted compared with the mean rainwater content (calculated over the period Feb. 2004-Sept 2007). Marl regolith water in site W showed much depleted, time-varying 18O content. Unlike the isotopic content in groundwater, the difference between soil water and rainwater delta 18O (considering both mean rainwater content and monthly variations) is attributed to the poor water turnover in the soil matrix which means that recharge is mainly due to preferential infiltration. In the site NW, a better drainage of the soil resulted in a quite good fitting between soil water and surface water delta 18O. Contribution of Darcyan infiltration is believed to be greater in site NW than in site W. The first results from the artificial rainfall experiment showed no clear organisation in the hydrodynamic behaviour according to depth or slope. Thus, water level variation proved greater in a 3,40 m depth piezometer than in the neighbouring 1m depth piezometer. Also, electrical conductivity recording showed that different behaviours could be observed: no reaction, usual dilution effect with recovering the pre event conductivity, drop of conductivity without recovering the initial conductivity, late dilution. These first results have been corroborated by lab experiments for quantifying the hydrodynamic features of the weathered marl in different suction conditions. Such long term and short term interdisciplinary investigations of flow processes are expected to provide valuable information for the 2D modelling of infiltration in highly heterogeneous hillslope soils.