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Topographic controls on soil properties affecting post-fire erosion and sediment redistribution in a mixed forested-agricultural Mediterranean catchment

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Landuse organisation in Mediterranean France tends to follow a typical pattern where large flat coastal areas are densely urbanised and oriented toward summer tourism, inland alluvial plains are dedicated to vineyards for wine making, and hilly areas surrounding inland plains are occupied by forests and isolated housing. This spatial organisation reflects long term patterns of sediment redistribution where upslope geological substrates have provided sediments to downslope geomorphological units such as alluvial plains and colluvial deposits. Forest fires periodically destroy the forest canopy and litter layer and create conditions of aggravated erosion for a few years at a time. Typically, a forested area has probably undergone dozens of cycles of post-fire erosion and regrowth during the past millennia. The objective of this study was to analyse sediment dynamics for a burned forested area and compare these to erosion processes encountered in cultivated soils in the same catchment. The analysis was carried out in three steps. In the first, landuse was mapped using colour airphotos for a 230 km² catchment in the “Massif des Maures” in SE France. For each of the two major landuse classes of interest (forested, vineyard), slope distributions were calculated based on a 25 m DEM. Similarly, channel slopes were calculated for stream sections flowing through the two landuse classes. This initial survey was complemented by two field studies. In the first, zones of river bank erosion and sediment deposition in channels were mapped over a total length of about 40 km. This was carried out to identify critical slope thresholds for major sediment deposition. In the second, a North facing slope was sampled for litter layer depth, surface stone cover, soil depth, and textu-

ral and aggregate stability analyses for burned (August, 2003) and unburned forests and cultivated fields. The grainsize characteristics of slopes were compared to those of sediments trapped in stream channels. Almost three years after a forest fire in the Massif des Maures, the litter layer has only begun to recover and erosion processes are still active even though a substantial underbrush has developed and cork oak crowns have recovered. Runoff during post-fire rainfall events selectively removes the soil fraction finer than about 2 cm, leaving behind a stone lag on the surface. The steep slopes of the forested zone feed runoff directly into ephemeral streams, so there is virtually no deposition within the burned forested area. In addition, steep channel slopes eliminate the possibility of channel storage until the sediments have arrived well into the main river channel downstream. This indicates that delivery ratios are close to 100% for post-fire erosion in the burned Mediterranean catchments of SE France. The surface of the unburned forest is protected by a dense mat of litter, and the cultivated soils show some selective erosion depending on cultivation method. A comparison of erosion factors for forested and agricultural areas indicates that although both areas are sensitive to slope inclination, soil erodibility in the forested zone is dominated by the litter layer in the unburned forest, surface stone cover in the burned forest, and a combination of stone cover and aggregate stability in the agricultural soils.