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THE ROLE OF VOLCANIC AND ANTHROPOGENIC ACTIVITIES IN CONTROLLING THE EROSION PROCESSES AT VULCANO ISLAND (ITALY)

ABSTRACT: DI TRAPANI F.P., DI MAGGIO C. & MADONIA P., *The role of volcanic and anthropogenic activities in controlling the erosion processes at Vulcano Island (Italy)*. (IT ISSN 0391-9838, 2011).

The paper describes the erosion processes acting at La Fossa cone (Vulcano Island, Italy). La Fossa cone is a stratovolcano made up of pyroclastic deposits and lavas covered by tuffs from the last eruption, dated 1888-90. Its flanks are affected by intense water erosion phenomena leading to the formation of denudation surfaces due to sheet erosion, rills, gullies and small canyons. As a consequence of very intense rainfalls, episodic debris flows occur along main gullies and canyons. Fumarolic activity plays an important role in the control of erosion processes, being both an obstacle for the growth of vegetation and a weathering factor. The GIS analysis and comparison of geo-referenced maps and aerial photos highlighted the influence of man-made structures on erosion processes, with particular reference to deep modifications in the natural stream network induced by buildings and roads. The combined effects of volcanic and anthropogenic activities, together with the additional role played by the strong inter-annual variability of rainfall amounts and intensities, give rise to significant changes in water erosion rates. A total volume of 5,700 m³ of volcanic products eroded between the years 1980 and 2008 from the upper portion of La Fossa cone has been estimated by GIS analysis.

KEY WORDS: Anthropogenic activity, Erosion processes, GIS, Volcanic activity, Vulcano Island.

INTRODUCTION

Volcanoes result from endogenous processes that directly create and destroy primary landforms (e.g. Thouret, 1999; Hampton & Cole, 2009). Unlike ordinary mountains, volcanoes are constructed rapidly and usually have a

short-term existence; as a consequence of their rapid construction, many volcanoes are affected by intense erosion.

Water erosion is an important process in volcanic environments as it acts as a detaching and transporting agent. Detachment of soil is produced by raindrop impact and drag force of running water. Eroded particles are transported by overland (sheet or interrill erosion; sheet flood) and concentrated (rill erosion) flows (Lal, 2001); gullies can develop by sub-surface flows and sidewall processes (Bocco, 1991). Generally, water erosion is controlled by a number of factors such as weathering, climate, structure (tectonics and lithology), topography and anthropogenic activity. Particularly, human modification of the relief commonly produces accelerated erosion and concomitant environmental degradation.

The structural instability of the volcanic edifices also favours slope failures. These processes may produce collapses and landslides such as extremely mobile debris or mud flows that can travel at high velocities and for long distances beyond the flanks of volcanoes (Ferrucci & alii, 2005 and references therein). Debris flows are usually triggered by heavy and/or prolonged rainfalls and can start as landslides on hillslopes (e.g. Iverson & alii, 1997; Wic-zorek & alii, 2000) or from bed erosion in steep channels (e.g. Tognacca & alii, 2000).

Tests and evaluation of erosion models are carried out through modern technology that provides efficient tools such as remote sensing and satellite imaging, GPS, GIS and expert systems (e.g. Ciccacci & alii, 1981; Sidorchuk & alii, 2003; Vrieling, 2006; Conoscenti & alii, 2008; Nigel & Rughooputh, 2010, and references therein).

The study presented herein constitutes an example where more tools, such as field survey, remote sensing and GIS, are integrated to determine the sensitivity of a volcanic area (La Fossa cone, Vulcano Island, Southern Italy) to denudation processes and its controlling factors, with particular reference to the relationships between volcanic and anthropogenic activities.

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