



DEM-based morphometry of range-front escarpments in Attica, central Greece, and its relation to fault slip rates^{☆,☆☆}

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Abstract

In this paper, we apply current geological knowledge on faulting processes to digital processing of Digital Elevation Models (DEM) in order to pinpoint locations of active faults. The analysis is based on semiautomatic interpretation of 20- and 60-m DEM and their products (slope, shaded relief). In Northern–Eastern Attica, five normal fault segments were recognized on the 20-m DEM. All faults strike WNW–ESE. The faults are from west to east: Thriassion (THFS), Fili (FIFS), Afidnai (AFFS), Avlon (AVFS), and Pendeli (PEFS) and range in length from 10 to 20 km. All of them show geomorphic evidence for recent activity such as prominent range-front escarpments, V-shaped valleys, triangular facets, and tilted footwall areas. However, escarpment morphometry and footwall geometry reveal systematic differences between the “external” segments (PEFS, THFS, and AVFS) and the “internal” segments (AFFS and FIFS), which may be due to mechanical interaction among segments and/or preexisting topography. In addition, transects across all five escarpments show mean scarp slope angles of $22.1^\circ \pm 0.7^\circ$ for both carbonate and metamorphic bedrock. The slope angle equation for the external segments shows asymptotic behaviour with increasing height. We make an empirical suggestion that slope angle is a function of the long-term fault slip rate which ranges between 0.13 and 0.3 mm/yr. The identified faults may rupture up to magnitude 6.4–6.6 earthquakes. The analysis of the 60-m DEM shows a difference in fault patterns between Western and Northern Attica, which is related to crustal rheology variations.

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1. Introduction

Many workers have used Digital Elevation Models (DEM) to observe and map landforms and structural boundaries, and to display and to understand spatial relationships of structures (e.g., Murphy, 1993; Wdowski and Zilberman, 1997; Goldsworthy and

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