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Assessment of relative active tectonics, southwest border of the Sierra Nevada (southern Spain)

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Abstract

We present a new method for evaluating relative active tectonics based on geomorphic indices useful in evaluating morphology and topography. Indices used include: stream length-gradient index (SL), drainage basin asymmetry (Af), hypsometric integral (Hi), ratio of valley-floor width to valley height (Vf), index of drainage basin shape (Bs), and index of mountain front sinuosity (Smf). Results from the analysis are accumulated and expressed as an index of relative active tectonics (Iat), which we divide into four classes from relatively low to highest tectonic activity.

The study area along the southwest border of the Sierra Nevada in southern Spain is an ideal location to test the concept of an index to predict relative tectonic activity on a basis of area rather than a single valley or mountain front. The study area has variable rates of active tectonics resulting from the collision of Africa with Europe that has produced linear east–west anticlinal forms, as well as extension with variable vertical rates of normal faulting to about 0.5 m/ky. We test the hypothesis that areas of known, relatively high rates of active tectonics are associated with indicatives values of Iat.

Keywords: Tectonic geomorphology; Geomorphic indices of active tectonics; Sierra Nevada; Betic Cordillera; Southern Spain

1. Introduction

Recent tectonic activity associated with continental uplift is expressed along the SW border of the Sierra Nevada in southern Spain by fault scarps, deeply incised rivers, and Quaternary deposits along mountain fronts and in fault-bounded basins (Sanz de Galdeano et al., 1998). The regional seismic record is characterized by high frequency of relatively small magnitude earthquakes (less than magnitude 4) with infrequent, large, catastrophic earthquakes. The study of active tectonics, and in particular those areas with relatively high activity, in the Holocene and late Pleistocene is important to evaluate the earthquake hazard (Keller and Pinter, 2002). On a regional scale, obtaining rates of active tectonics is difficult or even knowing where to go in a particular region for quantitative studies to obtain rates.

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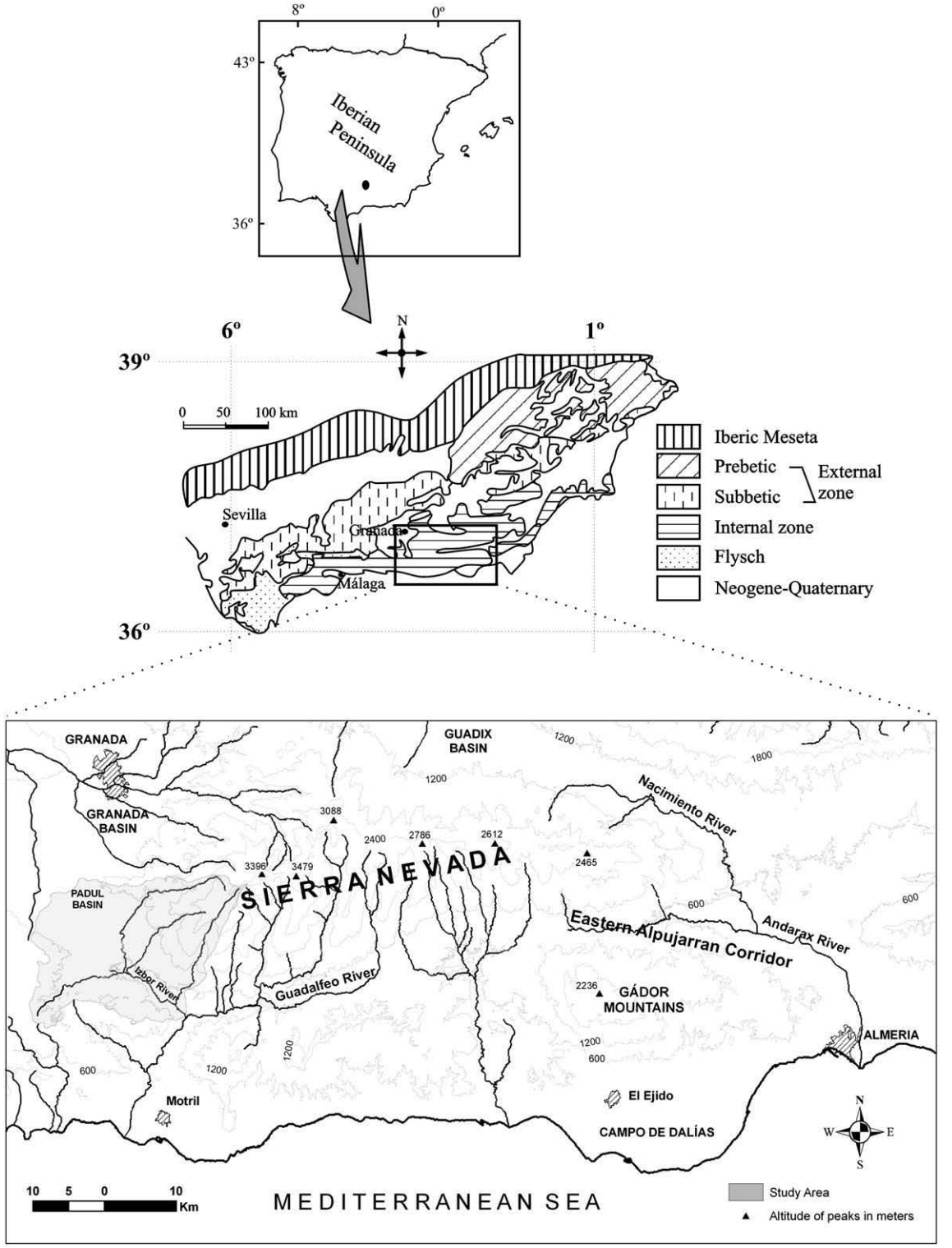

Fig. 1. Geographical and geological setting of the study area.