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Surface evidence of active tectonics along the Pergola-Melandro fault: A critical issue for the seismogenic potential of the southern Apennines, Italy

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Abstract

The Pergola-Melandro basin (southern Apennines) is characterized by a below-average release of seismic energy within a wider earthquake-prone region. In fact, it is placed between the maximum intensity areas of two of the most destructive earthquakes reported in the Italian seismic catalogue: the M ≥ 7.0 Agri Valley earthquake in 1857 and the Ms = 6.9 Irpinia earthquake in 1980. In this work, we present geomorphologic analysis, electrical resistivity surveys and field data, including paleoseismologic evidence, that provided the first direct constraints on the presence of a ∼20 km long, seismogenic fault at the western border of the Pergola-Melandro basin. We also obtained geological information on the recent deformation history of the Pergola-Melandro fault that indicates the occurrence of at least four surface faulting earthquakes since Late Pleistocene age. The empirical relationships linking fault length and magnitude would assign to the Pergola-Melandro fault an event of M ≥ 6.5. These new data have important implication on the seismic hazard assessment of this sector of the Apennines, that also includes large cities such as Potenza, about 20 km far from the recognized Pergola-Melandro fault, and highlight the relevance of the geological approach in areas where the seismological records are poor. Finally, we discuss the Pergola-Melandro fault within the regional seismotectonic context. In particular, this fault belongs to the system of normal faults with an apenninic orientation, both NE and SW dipping, accommodating the NE-crustal extension taking place in the area. Nearby faults, similarly oriented but with opposite dip, may coexist whether linked by secondary faults that act as slip transfer structures. This complex system of active faults would be more realistic than a narrow band of faults running along the belt axis with an homogenous geometry, and moreover, it is more consistent with the high extension rate measured by historical earthquakes and geodetic data.

Keywords: Southern Apennines; Seismogenic fault; Surface faulting; Seismic hazard, Italy

1. Introduction

The Lucanian Apennine represents one of the most seismically active portion of the belt being repeatedly hit by large-moderate earthquakes in historical and instrumental time. In order to contribute to the understanding of the

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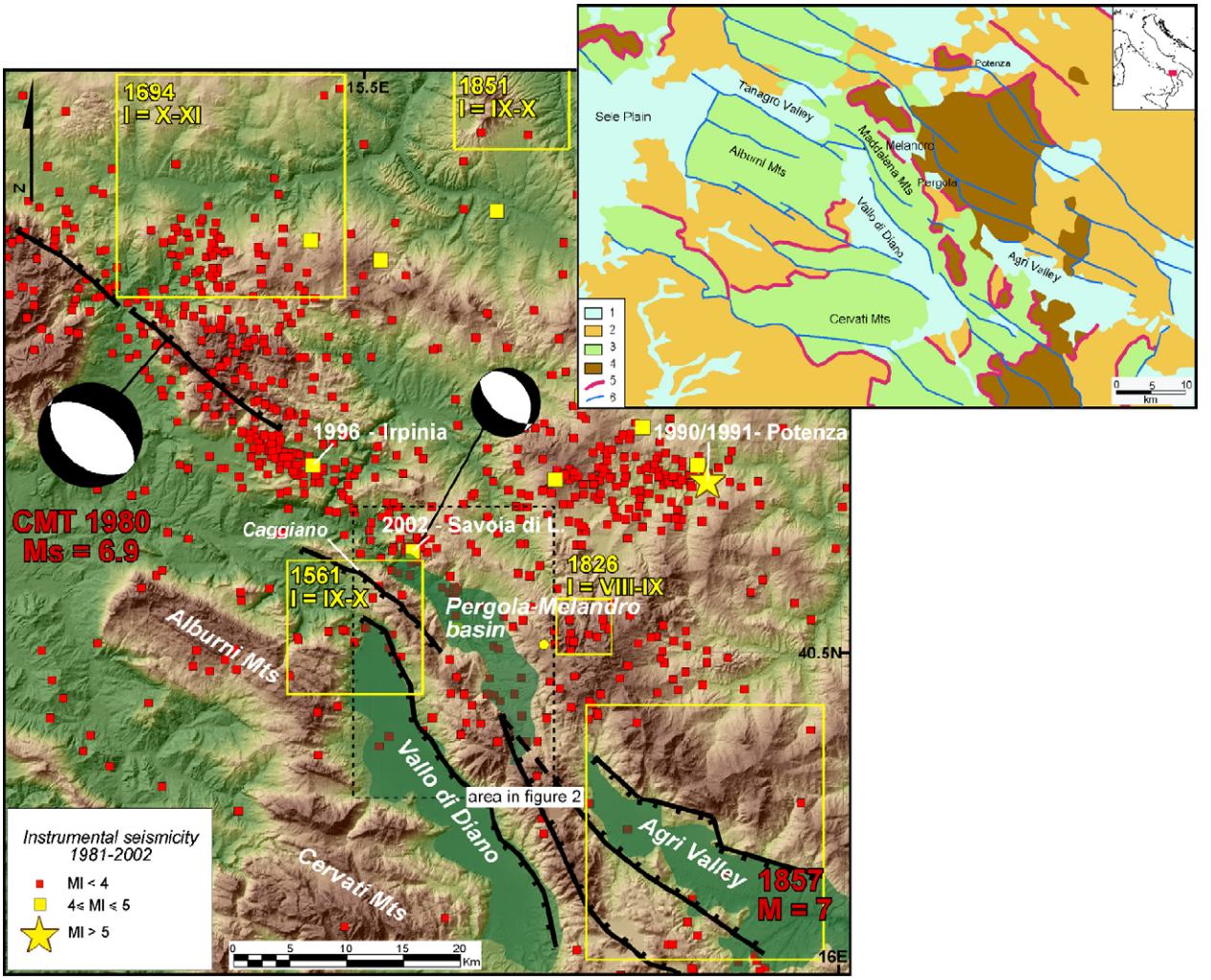

Fig. 1. Historical (yellow square) and instrumental seismicity of the Pergola-Melandro basin and neighbourhood. The 1980 earthquake focal solution, the trace of the seismogenic faults (black lines) in the area and the focal solution of Savoia di Lucania seismic sequence are also shown. At the upper right of the figure is a schematic geological and structural setting of the Lucanian Apennine. Legend: 1- Plio-Quaternary deposits; 2- accrectionary wedge terrains; 3- Meso-Cenozoic neritic carbonates of the Campania-Lucania platform; 4- Lagonegro units; 5- main thrusts; 6- main faults.

seismogenic potential within the Lucanian Apennine (Fig. 1), we focused our study in the Pergola-Melandro basin, a poorly-known area from an active tectonics point of view. In fact, the Pergola-Melandro (hereinafter referred to as PM) basin is located in between the epicentral zones of two large seismic events: the 1980 Irpinia earthquake to the north and the 1857 Agri Valley seismic event to the south (Fig. 1 and Table 1). The Irpinia fault, responsible for the 1980 seismic event, has been widely studied (i.e. Pantosti et al., 1993) and identified as a NW-SE trending normal fault, NE-dipping; the 1857 mainly normal fault has been located by most of the authors within the Agri Valley although the geometry (dipping, strike and location) of the main fault is still strongly debated (Benedetti et al., 1998; Cello et al., 2003; Maschio et al., 2005; Barchi et al., 2006). Within the PM basin, the literature does not report any clear and detailed mapping of a surface seismogenic fault trace nor the historical events of the area (1561 and 1826 seismic events) are definitively attributed to local faults (Fig. 1). The 1561 is the largest earthquake (Ma = 6.4) occurring just west of the PM basin; at present the responsible fault is hypothetically attributed to the NW-SE Caggiano fault (Fig. 1; Galli et al., 2006).

After a brief description of the geological and seismotectonic setting of the area, we present new surface and shallow subsurface data (stratigraphic, geomorphological and geophysical) that allowed us to identify a seismogenic fault, bounding the western edge of the basin. The recent activity of the fault is also constrained by new radiocarbon