Journal of Structural Geology 82 (2016) 16–36

Contents lists available at ScienceDirect

Journal of Structural Geology

journal homepage: www.elsevier.com/locate/jsg

Normal faulting along the western side of the Matese Mountains: Implications for active tectonics in the Central Apennines (Italy)

Paolo Boncio [a, *], Anna Maria Dichiarante [b], Eugenio Auciello [a], Michele Saroli [c], Francesco Stoppa [a]

[a] Dipartimento DISPUTer, Università "G. D'Annunzio" di Chieti – Pescara, Via dei Vestini 30, 66100 Chieti, Italy
[b] Department of Earth Sciences, Durham University, Science Labs, Durham DH1 3LE, United Kingdom
[c] Dipartimento Di Ingegneria Civile e Meccanica, Università degli Studi di Cassino e del Lazio Meridionale, Via G. Di Biasio 43, 03043, Cassino, Italy

ARTICLE INFO

Article history:
Received 3 September 2014
Received in revised form
12 October 2015
Accepted 21 October 2015
Available online 7 November 2015

Keywords:
Active normal fault
Apennines
Earthquake
Matese

ABSTRACT

We provide new field data from geologic mapping and bedrock structural geology along the western side of the Matese Mts in central Italy, a region of high seismicity, strain rates among the highest of the entire Apennines (4–5 mm/yr GPS-determined extension), and poorly constrained active faults. The existing knowledge on the Aquae Iuliae normal fault (AIF) was implemented with geometric and kinematic data that better constrain its total length (16.5 km), the minimum long-term throw rate (0.3–0.4 mm/yr, post-late glacial maximum, LGM), and the segmentation. For the first time, we provide evidence of post-350 ka and possibly late Quaternary activity of the Ailano – Piedimonte Matese normal fault (APMF). The APMF is 18 km long. It is composed of a main 11 km-long segment striking NW–SE and progressively bending to the E–W in its southern part, and a 7 km-long segment striking E–W to ENE-WSW with very poor evidence of recent activity. The available data suggest a possible post-LGM throw rate of the main segment of $\gtrsim$0.15 mm/yr. There is no evidence of active linkage in the step-over zone between the AIF and APMF (Prata Sannita step-over).

An original tectonic model is proposed by comparing structural and geodetic data. The AIF and APMF belong to two major, nearly parallel fault systems. One system runs at the core of the Matese Mts and is formed by the AIF and the faults of the Gallo-Letino-Matese Lake system. The other system runs along the western side of the Matese Mts and is formed by the APMF, linked to the SE with the Piedimonte Matese – Gioia Sannitica fault. The finite extension of the APMF might be transferred to the NW towards the San Pietro Infine fault. The nearly 2–3 mm/yr GPS-determined extension rate is probably partitioned between the two systems, with a ratio that is difficult to establish due to poor GPS coverage. The proposed model, though incomplete (several faults/transfer zones need further investigations), aids in the seismotectonic interpretation of poorly-known earthquakes (e.g., 346/355 AD earthquake on the Ailano – Piedimonte Matese – Gioia Sannitica fault system), and stimulates and further orients seismotectonic investigations aimed at constraining the segmentation pattern and seismogenic potential of the area.

1. Introduction

The Matese region of central Italy was struck by several strong earthquakes (346 AD, 847 AD, 1293 M5.8, 1349 M6.6, 1456 M7.2, 1688 M7.0, 1805 M6.6; Rovida et al., 2011; Guidoboni et al., 2007). Despite this high seismicity, only two faults in northern Matese were recognized to be responsible for strong historical earthquakes: the Isernia-Bojano-Guardiaregia normal fault system and the Pozzilli – Capriati al Volturno (Aquae Iuliae) normal fault (Fig. 1). The NE dipping Isernia-Bojano-Guardiaregia normal fault system is considered the seismogenic source of the 1805 earthquake, and possibly one shock of the 1456 earthquake sequence (e.g., Di Bucci et al., 2005 and references therein; Galli and Galadini, 2003). The Aquae Iuliae fault is a SW dipping normal fault considered responsible for the first shock of the September 1349 earthquake sequence (Galli and Naso, 2009).

In central and southern Matese, the active faults are not constrained, and the seismogenic sources of the 346 AD and 1688

* Corresponding author.
E-mail address: pboncio@unich.it (P. Boncio).

http://dx.doi.org/10.1016/j.jsg.2015.10.005
0191-8141/

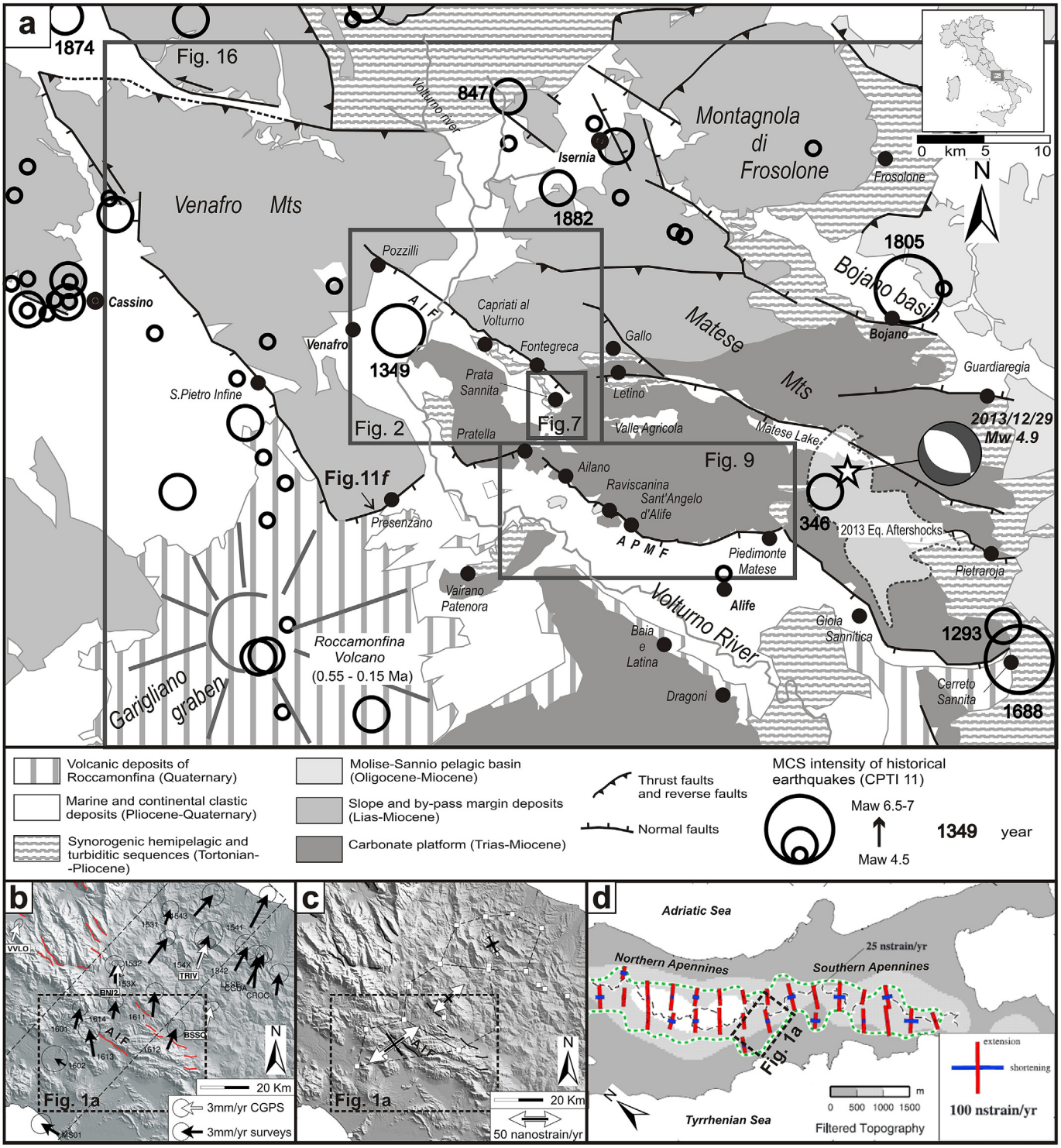

Fig. 1. a) Simplified tectonic map of the Matese area in central Italy with epicentres of damaging historical earthquakes (CPTI11 Catalogue, Rovida et al., 2011; epicentres of 346 and 847 earthquakes are from the CFTI4Med catalogue, Guidoboni et al., 2007), focal mechanism and aftershocks area of the December 29th, 2013 Mw 4.9 earthquake (D'Amico et al., 2014; Ferranti et al., 2015), and location of the areas studied in detail (Aquae Iuliae fault, AIF; Ailano – Piedimonte Matese fault, APMF; and Prata Sannita step-over zone); b, c) GPS-determined 1994–2007 velocity vectors (b) and strain rates (c) from Giuliani et al. (2009); d) principal axes of the strain rate field from GPS data showing the continuous, smoothly varying extension rate (red bars) along the Apennines (from D'Agostino, 2014). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

earthquakes are unknown. Moreover, GPS velocity vectors show high extensional deformation across the Matese, with a total NE-directed extension rate of 4–5 mm/yr across the Aquae Iuliae and Isernia-Bojano normal faults in northern Matese (Fig. 1b, c; Giuliani et al., 2009). An average extensional strain rate of 64 nanostrain/yr, corresponding to a ~2 mm/yr extension rate averaged over a 28 km-wide polygon (Fig. 1c), was calculated across the Aquae Iuliae fault. The GPS data, together with the poor geologic knowledge of the