*L. PICCARDI, **L. FERRELI, ****E. TONDI, ***A.M. MICHETTI, **E. VITTORI

PALEOSEISMOLOGY ANALYSIS ALONG THE MATTINATA FAULT, APULIA FORELAND, SOUTHERN ITALY

CONTENTS

ABSTRACT

Paleoseismic analyses have been carried out in a segment of the South Gargano Line (SGL), east-west-trending, right-lateral strike-slip structure, that cuts through the southern side of the Gargano promontory, a carbonate massif belonging to the Adria microplate, the foreland of both the Apenninic and Dinaric mountain chains. The SGL is a seismogenic structure, with an historic earthquake in 1627 in its western segment reaching Imax=X MCS. However, the knowledge on the local seismicity is still limited. Therefore, this study has focused on the eastern fault segment, the Monte Sant'Angelo Fault (MSF), in order to verify the associated seismic potential. Two trench sites were selected at the base of two prominent fault escarpments, where the MSF is characterized by significant vertical components of fault displacement.

The preliminary results allow to document that: i) the recent vertical slip-rate of the MSF exceeds 0.2 to 0.3 mm/yr; ii) the MSF moves with incremental slip episodes with vertical surface offset up to several decimeters; iii) based on the evidence for coseismic surface faulting observed in the trenches and assuming a rupture length in the order of 20+ km, the seismic potential of the MSF segment would be similar to that displayed by the western SGL segment during the 1627 event.

KEY WORDS: Active fault, slip rate, radiocarbon dating

1. INTRODUCTION

The Gargano region (Southern Italy) is of special interest in terms of active tectonics and earthquake hazard characterization for the Italian peninsula and in general for the Adriatic region. This is because it is an area of faulted foreland with important historic earthquakes. The strongest and best documented historical earthquake is the July 30, 1627, event, which hit the western part of the Gargano structure with an epicentral intensity of X MCS (estimated magnitude 6.6 - 6.7, CPTI, 1999). A regional geo-structural analysis and detailed morphostructural studies have allowed to assess the main spatial and dimensional properties of the active faults and characterize their activity in Holocene times, by recording specific indicators relating surface faulting phenomena to the geomorphic signature in the local landscape (PICCARDI, 1998; PICCARDI *et alii*, 1999; PICCARDI, in press).

The Gargano promontory is bordered to the south by an east-west trending active fault system (Fig. 1), the Mattinata fault system (MFS) (FUNICIELLO *et alii*, 1988), a spectacular east-west trending fault, over 60 km long, which is the inland sector of the South Gargano Line (SGL), the most important tectonic structure of the region (BOSELLINI *et alii*, 1993, BORRE *et alii*, 2003, and references therein). According to PICCARDI (1998), the Mattinata fault system is a right-lateral, segmented structure, capable of repeated Holocene surface faulting episodes, and responsible for the most relevant historic seismic events of the area. It includes several right lateral fault segments; some of them are known as: i) the San Marco in Lamis fault, ii) the San Giovanni Rotondo fault, and iii) the Monte Sant'Angelo fault. To the west, the SGL extends as far as the Apennines thrust front (refer to Fig. 1); however, the relations between this structure and the main thrust front are not clear.

In order to extend back in time the available information on earthquake history, several sites were selected for paleoseismological investigations along the eastern segment (MSF), including exploratory trenching and dating of distinctive geologic markers.

2. PALEOSEISMOLOGY ANALYSIS: PRELIMINARY RESULTS

The best known historical seismic events along the Mattinata fault (CPTI, 1999) are that of July 30, 1627 (I=X, Mk=6.7), which affected a large area around San Severo, and that of August 10, 1893 (I=VIII, Mk=5.4), which struck the area around Mattinata (Fig. 2). The first one, which completely destroyed the town of San Severo, is the strongest event historically documented in the Gargano region. The seismogenic structure responsible for this earthquake is, however, still poorly defined. The 1893 earthquake is the strongest historical event reported by the seismic catalogue for the Monte Sant'Angelo area. The source of this earthquake is likely to be the Monte

* CNR-Istituto di Geoscienze e Georisorse, Sezione di Firenze, Firenze, Italy. E-mail: piccardi@geo.unifi.it
** APAT, Agenzia per la Protezione dell'Ambiente e per i Servizi Tecnici, Roma, Italy
*** Dipartimento di Scienze Chimiche, Fisiche e Matematiche, Università dell'Insubria, Como, Italy
**** Dipartimento di Scienze della Terra, Università di Camerino, Camerino, Italy

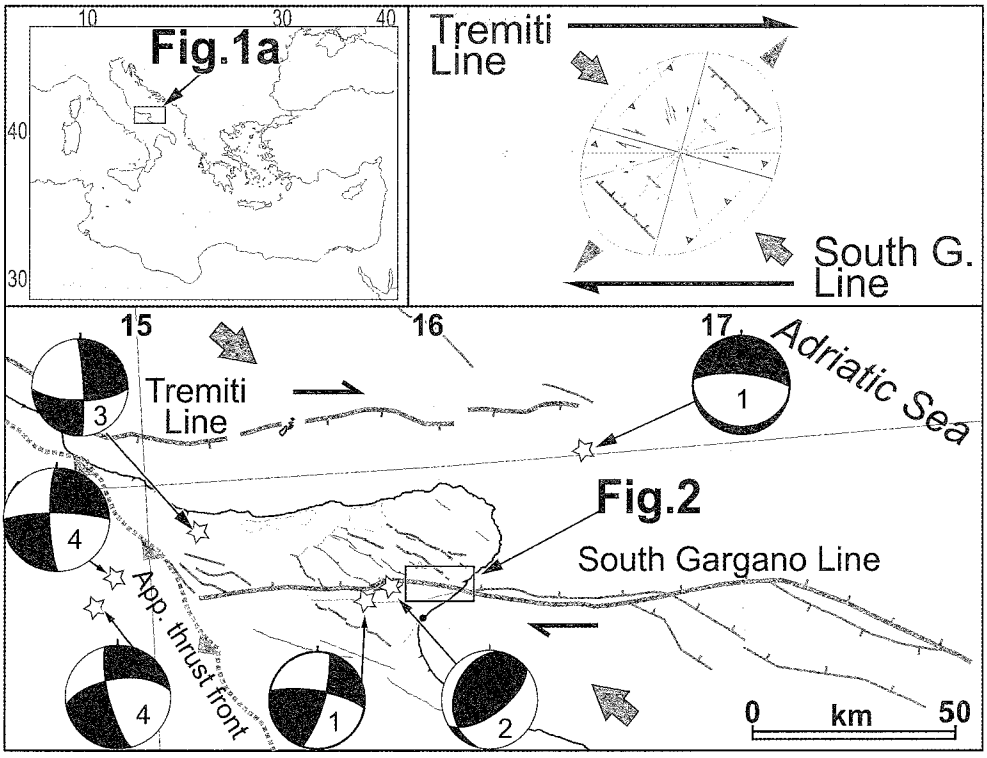

Fig. 1 - a) Structural setting of the Gargano region. b) Seismotectonic map of the Gargano area. Focal mechanisms from: 1) GASPARINI *et alii* (1985); 2) Catalogue of Harvard University Seismology Group (2001); 3) Catalogue of Swiss Seismological Service (2001); 4) INGV.

Sant'Angelo fault (MSF), as coseismic ground breaks were recorded at the eastern inland termination of the fault, at Mattinata, over a length of more than 1 km (BARATTA, 1893). Furthermore, on October 31 and November 1, 2002, two Ml=5.4 and 5.0 earthquakes with epicentres located along the possible western extension of the SGL, struck the Molise area (Fig. 1). These events, characterized by focal mechanism solutions indicating dextral shear along roughly east-west oriented seismogenic faults, may suggest that the whole SGL is to be considered active in response to the current stress field in the area.

A detailed description of the active tectonic evidence is in PICCARDI (in press). In Fig. 3 are illustrated the results of the paleoseismological analysis performed at two trench sites located at the base of the MSF fault scarp (locations in Fig. 2). At the first site, near Mattinata, the up to 5 m deep trench has exposed faulted hangingwall slope deposits, with radiocarbon ages from at least 42,000 yr BP to present. Due to local topography and lithology, the excavation has exposed essentially the hanging-wall deposits, being the footwall behind the fault surface made only of the carbonatic bedrock. This does not allow to estimate any slip rate, but

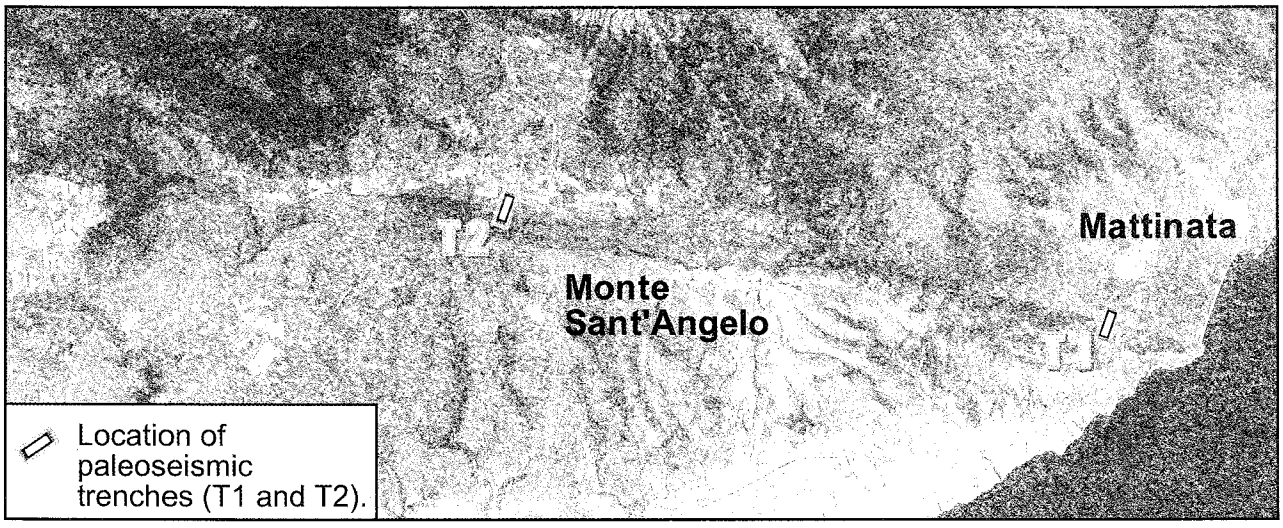

Fig. 2 - (a) SPOT Image of the Monte Sant'Angelo Fault, with location of trenches.

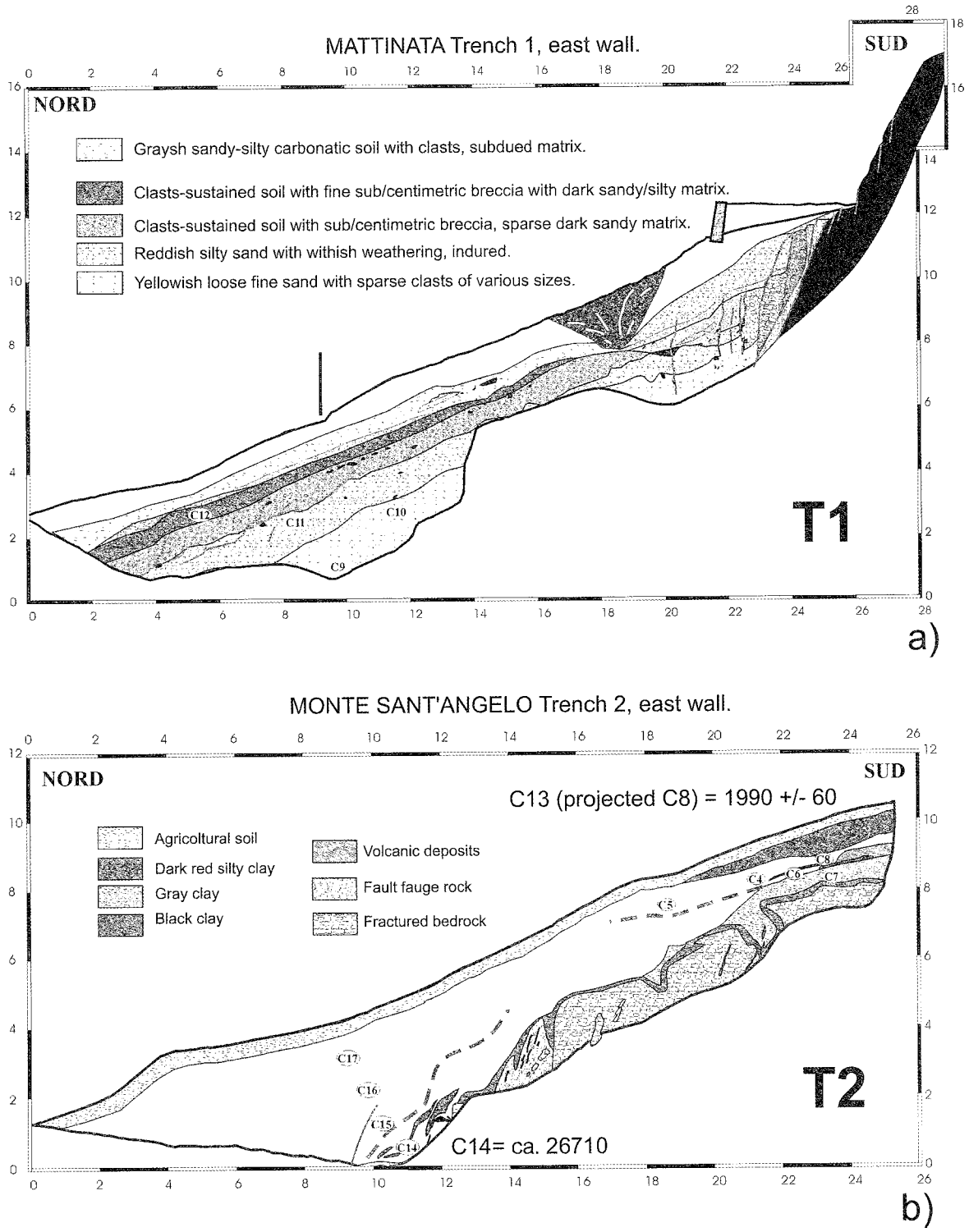

Fig. 3 - a) Paleoseismological log of the east wall of trench 1, at Mattinata; b) Paleoseismological log of the east wall of trench 2, at Monte Sant'Angelo.

the stratigraphic setting and the presence of faulted colluvial wedges reveal the episodic nature of faulting (seismogenic) in very recent times.

The second trench, up to 4 m deep, has exposed colluvial and volcanoclastic deposits, with radiocarbon ages from 27000 yr BP to present. Here it was possible to excavate across both the hanging-wall and foot-wall units, and the obtained slip-rate exceeds 0.2 - 0.3 mm/yr.

In conclusion, this study has enabled to assess that the MSF fault moves with incremental slip episodes characterized by vertical offsets of up to several decimeters. Based on these data, as well as on the evidence of coseismic surface faulting, and assuming that the total length of the MSF fault is about 20 km, it may be inferred that the maximum magnitude that should be expected in this area must be comparable to that released during the 1627 event.

ACKNOWLEDGEMENTS:

The work has been partially supported by funding from the Italian MIUR Cofin 2002 (Resp. G. Cello, prot. 2002043912_001).

REFERENCES

BORRE K., CACON S., CELLO G., KONTNY B., KOSTAK B., LYKKE-ANDERSEN H., MORATTI G., PICCARDI L., STEMBERK J., TONDI E., VILIMEK V. (2003) - *The COST project in Italy: analysis and monitoring of seismogenic faults in the Gargano and Norcia areas (central-southern Apennines, Italy)*. Journal of Geodynamics, **36**, 3-18.

BARATTA M. (1893) - *Intorno ai fenomeni sismici avvenuti nella penisola Garganica durante il 1893*. Annali dell'Ufficio Centrale di Meteorologia, **XV/I**, 297-315.

BOSELLINI A., NERI C., LUCIANI V. (1993) - *Guida ai carbonati Cretaceo-Eocenici di scarpata e bacino del Gargano (Italia meridionale)*. Annali dell'Università di Ferrara (nuova serie), Sez. Scienze della Terra, suppl. to vol. 4, Bologna, 77 pp.

C.P.T.I. GRUPPO DI LAVORO (1999) - *Catalogo Parametrico dei Terremoti Italiani*. ING, GNDT, SGA, SSN, Bologna, 92 pp.

FUNICIELLO R., MONTONE P., SALVINI F., TOZZI M. (1988). *Caratteri strutturali del Promontorio del Gargano*. Mem. Soc. Geol. It., **41**, 1235-1243.

GASPARINI C., IANNACCONE G., SCARPA R. (1985) - *Fault plane solutions and seismicity of the Italian Peninsula*. Tectonophysics, **117**, 59-78.

HARVARD UNIVERSITY SEISMOLOGY GROUP (2001) - *Catalogue of CMT solutions of large events (M>5.0) of the period 1977-1996*. http://www.seismology.harvard.edu/data.

PICCARDI L. (1998) - *Cinematica attuale, comportamento sismico e sismologia storica della faglia attiva di Monte Sant'Angelo (Gargano): la possibile rottura superficiale del 'leggendario' terremoto del 493 d.C.* Geografia Fisica e Dinamica Quaternaria, **21**, 155-166.

PICCARDI L., GAUDEMER Y., TAPPONNIER P., BOCCALETTI M. (1999) - *Active oblique extension in the central Apennines (Italy): evidence from the Fucino basin*. Geophisical Journal International, **139**, 2, 499-530.

PICCARDI L. (in press) - *Paleoseismic evidence of legendary earthquakes: the apparition of Archangel Michael at Monte Sant'Angelo (Gargano, Italy)*. Tectonophysics