LATE QUATERNARY FAULTING IN THE NE MARGIN OF THE SARNO PLAIN (SOUTHERN APENNINES, ITALY)

E. Valente[1], A. Ascione[1], N. Santangelo[1], A. Santo[2]

[1] Dipartimento di Scienze della Terra, dell'Ambiente e delle Risorse, Università degli Studi di Napoli Federico II, Napoli, Italy
[2] Dipartimento di Ingegneria Civile, Edile e Ambientale, Università degli Studi di Napoli Federico II, Napoli, Italy

Introduction. The Sarno plain is placed along the Tyrrhenian flank of the southern Apennines. The southern Apennines has been affected, since the late Tortonian, by extensional tectonics related to the opening of the Tyrrhenian back-arc basin (Patacca *et al*., 1990). This process caused the formation, since the Lower Pleistocene, of large peri-Tyrrhenian grabens and half-grabens filled up by a several thousands of meter thick sequences of marine and continental deposits interbedded with volcanoclastic units (Santangelo *et al*., 2017). The Sarno plain is located in the southern part of the large Campana plain peri-Tyrrhenian graben, which includes the volcanic districts of the Phlegrean Fields and the Somma-Vesuvius. The latter volcanic edifice bounds the Sarno plain to the N, whereas the carbonate ridges the Sarno Mts. and Lattari Mts. bound the plain towards NE and SE, respectively.

Cinque *et al*. (1987) point to tectonic subsidence of the Sarno plain of about 30 m in the last 130 ka. Holocene fault activity has been proved for both the Sebeto plain (located N of the

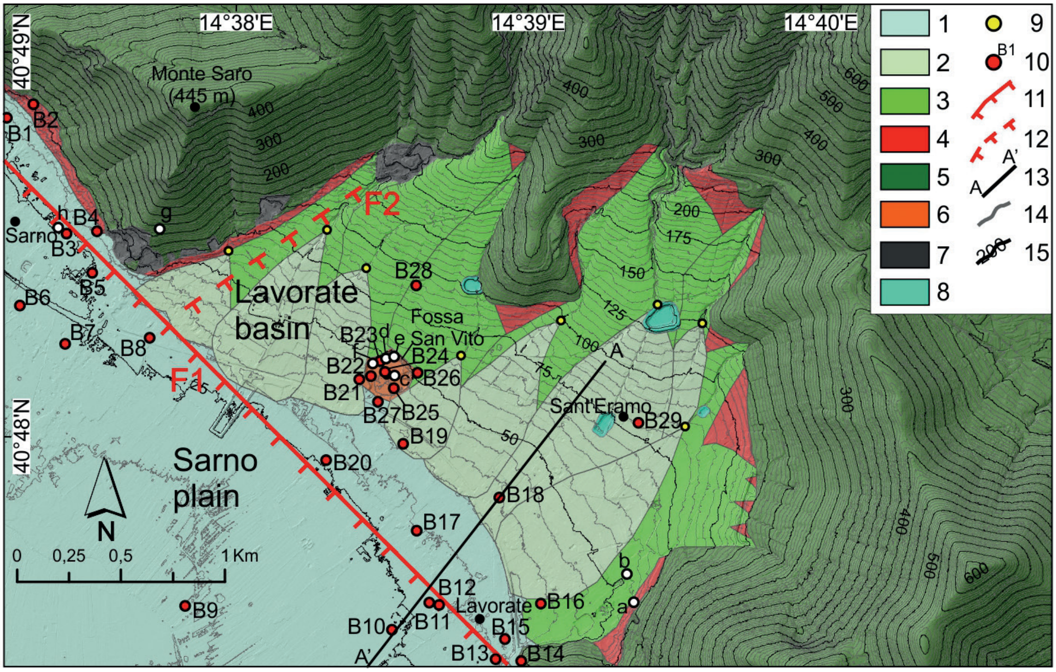

Fig. 1 - Geological map of the study area. 1) Allucial deposits (Holocene); 2) 2nd generation alluvial fan (Upper Pleistocene - Holocene); 3) 1st generation alluvial fan (Middle to Upper Pleistocene); 4) debris slope deposits (Middle to Upper Pleistocene); 5) Carbonate bedrock (Mesozoic); 6) Fossa San Vito sinkhole; 7) quarry; 8) water flow tank; 9) hydrographic apex; 10) borehole; 11) normal fault (certain); 12) normal fault (inferred); 13) trace of geological cross section; 14) 5m contour line; 15) 25 m contour line.

Somma-Vesuvius) and Sarno plain (Irollo *et al.*, 2005). Both plains are bounded by NE-SW trending normal fault systems (Irollo *et al.*, 2005), which have been included in the national database of active and capable faults (www.sgi2.isprambiente.it/ithacaweb/viewer/). Historical seismicity points to the occurrence of few low to moderate magnitude earthquakes since 1000 A.D. The strongest events are the 5th December 1499 earthquake (Mw = 5.56) and the 31st March 1737 earthquake (Mw = 5.10), located NW and N of the Sarno Mts., respectively. The most recent, and strongest, seismic event occurred the 27th April 1930 (Mw = 4.9) about 6 km SE of the Sarno town (Rovida *et al.*, 2016).

We are carrying out a detailed scale geological and geomorphological analysis of the NE border of the Sarno plain aimed at identifying evidence of recent faulting in the study area. Our study is based on analysis of 1:5000 topographic maps (Technical Map of the Campania Region) and high resolution (1X1 m) dtm, on field surveys and collection of subsurface stratigraphical data (drillings and borehole logs, collectively and ranging in depth from 20 to 250 m).

Geological and geomorphological setting. The study area includes the mountain front, mainly NW-SE trending, of the carbonate Sarno Mts. and adjoining sector of the plain, which extends from the town of Sarno, to the NW, to the Lavorate settlement to the SE (Fig. 1). In the area spanning from Sarno to Lavorate, a localized depocenter (hereinafter named Lavorate basin) occurs in a deep indentation of the mountain front (Fig. 1). The Lavorate basin is bounded to the NW by a rectilinear escarpment and is filled by alluvial fan deposits interbedded with tephra layers. Slope breccia and colluvial deposits occur locally at the toe of the carbonate slopes. The alluvial fan system consists of two generation of entrenched fans, with the oldest fans being steeper than the youngest ones. A sinkhole (Fossa San Vito area) affects the alluvial fans (Fig. 1). The alluvial fans pass laterally into the alluvial fill of the Sarno plain, which are composed by alluvial sediments interbedded with volcanic deposits, paleosoils and peat

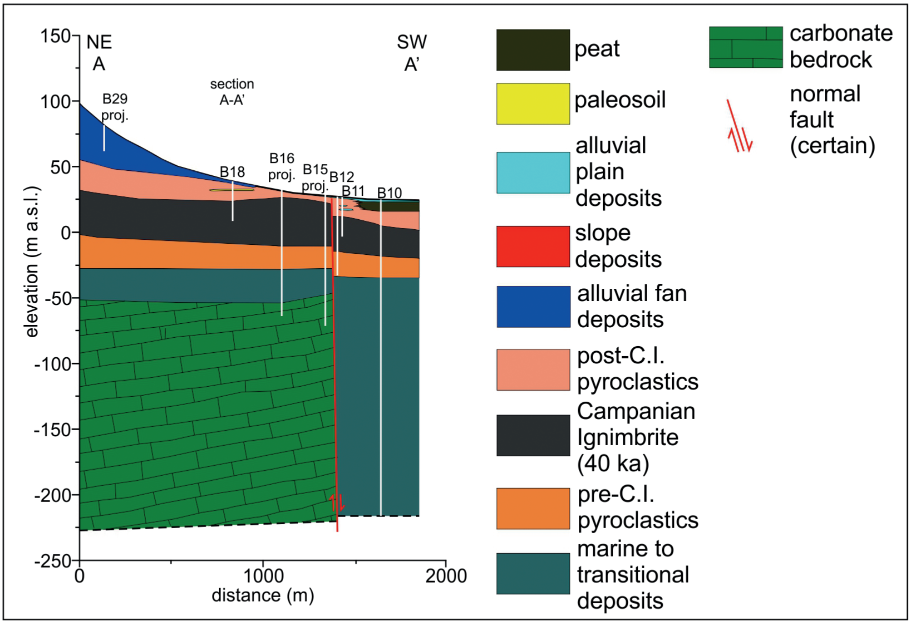

Fig. 2 - Geological cross sections of the study area. Location is reported in Fig. 1.

layers. Towards the SE, the youngest alluvial fans are truncated by ~3 to 5 m high, SW-facing rectilinear scarp.

Borehole data indicate that the alluvial fan deposits are at least 50 m thick. They pass, at depth, to a ~100 m thick sequence of volcanic and marine to transitional environment deposits. Marine to transitional environment deposits, which are ~30 m thick, lay on top of carbonate rocks and are covered by a ~70 m thick succession of volcanic deposits. The latter include the Campana Ignimbrite (hereinafter C.I.) regional stratigraphic marker, aged 39 ka (De Vivo *et al*., 2001). The C.I. layer, which is 30 m to 40 m thick, separates "pre-C.I." volcanic deposits (~20 m thick) from "post-C.I." volcanic deposits (~10-20 m thick).

The combination of field and borehole data allowed us to construct geological cross-sections representative of the geological setting of the Lavorate basin and adjoining Sarno plain. Figure 2 shows one of the cross sections (Section A-A').

Discussion and conclusion. The geomorphological analysis of the northeastern margin of the Sarno plain, and detailed borehole log data from the Lavorate basin provide new information on the recent, Late Quaternary, evolution of southern part of the Campania plain graben.

Subsurface stratigraphy data allow identifying a ~10-20 m thick "pre-C.I." volcanoclastic unit. Pyroclastic deposits underlying the C.I. have been correlated by Aprile and Toccaceli (2002) with the Taurano Ignimbrite, aged 157.4 ±1 ka (De Vivo *et al*., 2001). Based on such a correlation, a late Middle Pleistocene age is inferred for the marine to transitional environment deposits underlying the pre-C.I. volcanics. In contrast, Cinque *et al*. (1987) correlated the marine to transitional environment deposits underlying the pre-C.I. volcanics to the Euthyrrenian (125 ka). In this second hypothesis, an Upper Pleistocene age is inferred for the pre-C.I., which could be correlated with the Durazzano Ignimbrite, aged 116 ka (Rolandi *et al*., 2003) and found, in several sites along the NE border of the Campana plain, below the C.I. deposits, with a paleosoil separating the two volcanic deposits (Bellucci *et al*., 2003).

The nature of the pre-C.I. pyroclastic unit is not constrained by our data and, consequently, the age model for this unit and the top part of the underlying marine to transitional environment unit (both of which being not older than the late part of the Middle Pleistocene) remains undefined. However, new information on both the structural setting of the investigated area and chronology of fault activity may be inferred from the cross sections that we have constructed. In particular, the sharp deepening of the carbonate bedrock towards the SW constrains location of one of the faults (fault F1) that bound the Sarno plain graben towards the NE, while the increase of thickness of marine to transitional environment sediments underlying the pre-C.I. pyroclastics points to vertical offset along Fault F1 coeval to deposition of this unit (Fig. 2). More recent activations of fault F1 both in the time span framed between deposition of the pre-C.I. volcanics and the C.I. deposition, and after the C.I. deposition (post-39 ka) are identified by the differential vertical displacement of the bottom of the pre-C.I. in relation to the base of the C.I. deposits (Fig. 2). Very recent activity of fault F1 is inferred from the occurrence of a ~ 8 m thick peat layer, possibly Holocene in age, recovered a few meters below the alluvial plain topographic surface, which suggests subsidence-related ponding in the hanging wall block of fault F1.

Integration of surface (geomorphological) and subsurface (stratigraphical) data indicates that the NW-SE trending, SW-facing rectilinear scarp, which truncates the youngest alluvial fans of the Lavorate basin, may be considered as the surface expression of fault F1 activity, thus pointing to fault F1 as an active and capable fault.

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