**LATE PLEISTOCENE REVERSE SURFACE FAULTING AT THE PECETTO DI VALENZA SITE (AL - NORTHERN ITALY): PRELIMINARY RESULTS**

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**Introduction.** Notwithstanding the considerable investigation and research efforts produced almost 40 years ago for the Italian Nuclear Program, later published in the framework of the “Progetto Finalizzato Geodinamica” (e.g., Carraro, 1976; GSQP, 1976; Enel, 1984, 1985; CNR, 1992; Carraro et al., 1995), the assessment of ground motion and surface faulting hazard in the Monferrato Arc is still poorly constrained. Since the western Po Plain shows subdued historical and instrumental seismicity, it is commonly regarded as a region characterized by a low seismic hazard (http://zonesismiche.mi.ingv.it/), and has been overlooked in the last 30 years from the paleoseismological point of view, while active tectonics studies flourished more to the east, basically due to the available record of strong seismic events during the Middle Ages and later (e.g., Magri and Molin, 1986; Serva, 1990; Benedetti et al., 2000, 2003; Maesano et al., 2001; Burrato et al., 2003; Galadini et al., 2005; Galli, 2005; Livio et al., 2009, 2014). However, several lines of evidence strongly suggest that the seismotectonic potential of the study area is similar to the one known for the central and eastern part of the Po Valley (e.g., Serva, 1990; Michetti et al., 2012; Bonadeo, 2014 and references therein; Turrini et al., 2015).

The recent seismic crisis in Emilia clearly illustrates the need for revised seismic hazard assessment in northern Italy. In this line, the characterization of the maximum earthquake magnitude through paleoseismic analyses might represent a vital tool for mitigating seismic risks, in a region that seems unprepared to cope with the effects of strong earthquakes. In fact, high population density, clustering of industrial facilities, and the great deficit of seismic safety accumulated due to the lack of a proper seismic code (Stucchi et al., 2012), make today the Po Plain one of the regions most exposed to seismic risk of the whole Italian peninsula.

This is particularly true for the Monferrato Arc, which, as noted above, is characterized by quite marginal seismicity according to the Italian Seismic Catalog. In this line, it is very important to remark that recent literature data describe geological features suggesting significant seismic potential in the western Po Plain. New observations, based on recently exposed stratigraphic sections at Cereseto and Ozzano Monferrato (Sassone et al., 2015; Fig. 1b), reveal relevant evidence of Late Quaternary reverse faulting. Moreover, Giraudi (2014, 2015), based on fluvial terrace analyses and the revision of subsurface shallow stratigraphic data, identify previously unmapped Late Quaternary faults in the Vercelli Plain and Casale Monferrato plateau. In the following, we focus on the newly identified Pecetto di Valenza site, where recent paleoseismic surface faulting has been observed for the first time in the study area. We base our interpretations on data coming from an integrated and multidisciplinary analysis, including paleoseismology, pedostratigraphy and geomorphology, as already successfully applied in another case study in the Po Plain area (Livio et al., 2014; Zerboni et al., 2015).

**Geological and geomorphological setting.** The Monferrato Arc is the westernmost of the 3 major salients enclosing the most external structural fronts of the northern Apennines (Fig. 1). The tectonic activity of the Po Plain is closely related to the recent evolution of these structural belts, mainly buried below the Plio-Pleistocene infilling of the basin but emerging or very shallow along the Monferrato Arc (e.g., Mosca, 2006).

Study site (Pecetto di Valenza) is located in the easternmost Monferrato area, in a hilly area bordered by the Po and Tanaro River and encircled by the Valenza and Alessandria fluvial terraces, to the north and to the south of the site respectively. Miocene marls and conglomerates,
unconformably lying upon Eocene marls, are deformed by ca. NW-SE trending thrusts and folds (ENEL - DCO, 1984), as observed in seismic reflection profiles.

At the study site, excavation works have exposed a reverse fault zone that displaces the late Miocene marly bedrock (Pecetto Fm.) and the overlying recent colluvial pedogenized deposits. This fact points to a recent landscape evolution of the site partially driven by active contractional tectonics.
**Results.** We made a detailed log of the exposed section (1:10 scale) including pedostratigraphic description of the colluvial units, structural data acquisition, sampling for radiocarbon, OSL dating and for soil thin-section micromorphology, presently still ongoing (Fig. 2).

We defined 5 Log units, including intact and weathered bedrock, a fault breccia and two stacked bodies of colluvial deposits, thickening upslope (Fig. 2), that point to a paleo-valley axis presently infilled by these deposits (Fig. 3).

Preliminary age constraints, coming from AMS dating, indicate two main colluvial phases ascribed at ca. 30 kyr BP and Holocene respectively (Fig. 2). The lowermost samples apparently indicate age reversal, thus pointing to reworking of pre-existing colluvial soils and deposits from the surrounding slopes. Moreover, several soil characteristics (e.g., illuviation, weathering, concretions etc.) indicate a strong and prolonged phase and/or phases of pedogenesis, thus supporting this possibility. This preliminary model needs to be validated by further analyses, including thin section soil micromorphology and comparison with OSL datings.

**Discussion.** The preliminary interpretation of the exposed section indicates the presence of a reverse fault zone, likely associated to Monferrato Arc thrusts system, controlling the morphology of the hills surrounding the exposed section (Fig. 3). Moreover, the data collected so far allow to state that this site show evidence of Late Pleistocene and possibly Holocene reverse surface faulting. This is the first site with documented evidence of coseismic displacement of very recent deposits in the whole Monferrato belt anyway.

The recent geomorphologic evolution of the basin, including an attested event of drainage piracy (Fig. 2), could be partly caused by tectonic-induced surface deformation together with climatically driven regional phases of gully erosion. A detailed pedostratigraphic study together...
with a collection of data over a wider region, could help in disentangle between different scenarios depicting the recent evolution of this sector of the Monferrato area. This site, in fact, has to be interpreted together with other key-sites located along the Monferrato Arc, showing evidence of recent tectonic activity. In particular, these preliminary results are consistent with the activity of the Valenza Deformation Zone a regional transpressional zone supposed to be active at least until the Late Pleistocene (Giraudi, 2015). Moreover, the following geological, geomorphic and geophysical evidence in the Po alluvial valley floor, possibly related to active tectonic shortening, is of particular value for the evaluation of the seismic potential of the area:

- the Trino Isolated Hill, representing the surficial expression of a Quaternary blind thrust (GSQP, 1976; Fig. 1a);
- the Quaternary, major, drainage changes that affected the fluvial network along the buried front of the Monferrato Arc (Forno, 1982; Carraro et al., 1995; Irace et al., 2009; Vezzoli et al., 2010);
- the complex sequence of Mid-Pleistocene to Holocene fluvial units affected by progressive tectonic uplift (Dela Pierre et al., 2003; Festa et al., 2009; Giraudi, 2014, 2015);
- significant ongoing uplift rates based on long-term geodetic survey (e.g., Arca and Beretta, 1985);
- the evidence for Late Pleistocene to Holocene tectonic displacement described by Giraudi (2014, 2015) in the Casale Monferrato (Fig. 1a);
- newly exposed sections showing recent deposits affected by N-verging reverse faults described by Sassone et al. (2015; Fig. 1b) at the Cereseto and Ozzano Monferrato sites.

All these observations are lacking of absolute datings, an epistemic uncertainty that is still strongly limiting a reliable reconstruction of the recent landscape evolution of the area, including its tectonic and paleoseismic imprint. It is therefore reasonable to assume that the study of this
and other sites, including different dating techniques, will therefore provide suitable constraints for the characterization of the style, rates and timing of active tectonics and earthquake faulting in the study area, and of the related seismic hazards.

References


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