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APPLICATION OF QUATERNARY STUDIES FOR THE ASSESSMENT OF ACTIVE AND CAPABLE FAULTS IN THE CENTRAL APENNINES: IMPLICATIONS FOR MICROZONATION AND SEISMOTECTONIC ANALYSES

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ABSTRACT: The study of the Quaternary evolution of defined areas for the recognition and characterization of active and capable faults is essential for an adequate and aware land use planning and management. Here, we present two case studies in the Abruzzi Apennines, one in the Celano area, where focused geological studies allowed us to rule out the presence of an active and capable fault in a site selected for the realization of a primary school, and one in the Bagno area, where an active and capable fault has been first detected and should be included in revised seismic microzonation studies.

KEYWORDS: Quaternary, seismic microzonation, active and capable faults, palaeoseismology, central Apennines

1. INTRODUCTION

The study of the Quaternary geological evolution of tectonically active areas is fundamental to define the recent kinematic history of faults, both for seismotectonic studies and, in urban areas, for planning activities aimed at reducing the risk connected to the fault activity.

The central Apennine is characterized by a number of normal faults active through the Quaternary, which are considered the surface expression of seismogenic sources potentially responsible for M 6.5-7 seismic events. The faults generally bound to the north-east the intermontane basins where cities, villages and urban areas are mostly located. In this work, we present two case studies in the Abruzzi region, one in the Fucino basin and one in the L'Aquila basin, to show the application of Quaternary geological studies to active and capable faulting assessment, and their effectiveness in land use planning and management, in particular in terms of planning actions aimed at reducing the related risks.

The first case study is located in the town of Celano (AQ), along the northern margin of the Fucino basin, where a complex Quaternary normal-fault arrangement is shown by the available literature (e.g. Galadini and Messina, 2004). The 1st level of seismic microzonation studies performed in the area indicates the presence of an active and capable fault and defines a large setback (according to the Linee Guida per la Gestione del Territorio in aree interessate da Faglie Attive e Capaci) which encompasses the area of the "ex Campo Bonaldi", that was formerly selected for the realization of a school. The active and capable faults database ITHACA reports an active and capable fault in the site of the school (Fig. 1), related to the northern portion of the Fucino fault system (Cavinato et al., 2002; Bianchi Fasani et al., 2008).

The second case study is in the area of Bagno (AQ), in the L'Aquila basins. Here, Nocentini et al. (2017) hypothesised the presence of a normal fault in the area, that is not reported in the 1st level seismic microzonation studies performed in the area after the 2009 L'Aquila earthquake.

2. MATERIALS AND METHODS

A multidisciplinary approach is applied to the identification of active and capable faults in the two case studies. In particular, we carried out geological surveys and aerial photo interpretation aimed at defining the Quaternary morpho-stratigraphic setting useful to cast light on the recent fault activity. In both case studies, we performed palaeoseismological investigations to unravel the possible presence of active and capable faults and, if any, to investigate their recent activity. As for the Celano area, we also performed two boreholes with the goal of achieving more robust chrono-stratigraphic data in the site of the school.

3. RESULTS

3.1. Celano

The trench at the "ex Campo Bonaldi" site (Fig. 2) exposed five continental units which were not affected by any fault plane. The absence of dislocation is also confirmed by the horizontal stratigraphic continuity of the sequence cored by the boreholes we made at the extremities of the trench.

The geological field survey of the Quaternary units we made in the area of Celano gave evidence of late Quaternary activity of NW-SE trending faults, comprising the Santa Iona normal fault, which displaced eluvial deposits deriving from deposits of the Second Sedimentary

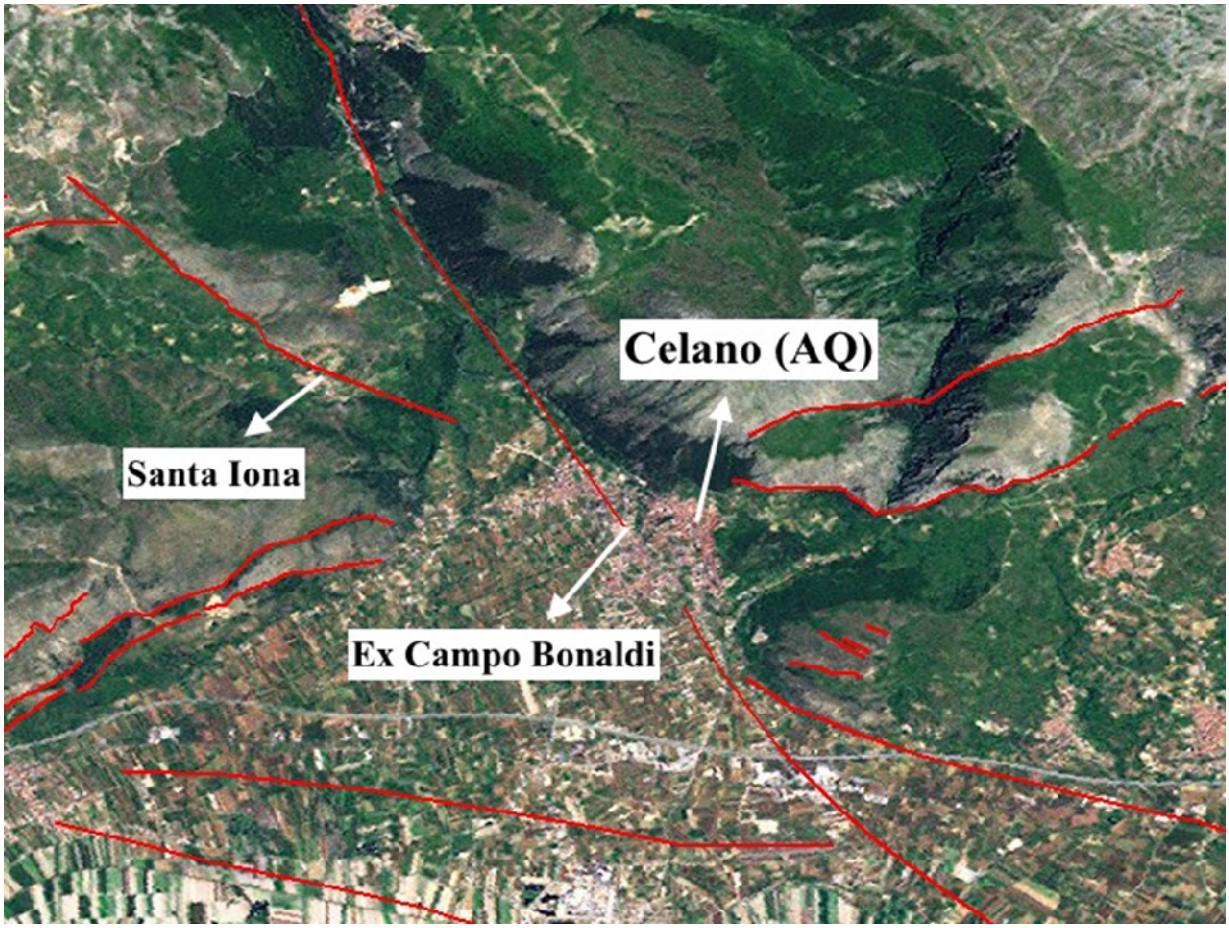

Fig. 1 - Red lines show active and capable faults from database ITHACA in the town of Celano.

Fucino Cycle (Bosi et al, 2003), related to the Early Pleistocene. Differently, N-S trending normal faults that affect the western slope of the Serra di Celano relief are clearly sealed by Early Pleistocene breccias, thus testifying inactivity of these structures in recent times.

3.2. Bagno

The geological-geomorphological survey in the area of Bagno Piccolo revealed the presence of a scarp oriented NW-SE and dipping toward NE. An excavation for a building made along the scarp (Fig. 3A) allowed us to first reveal the presence of a normal shear zone which

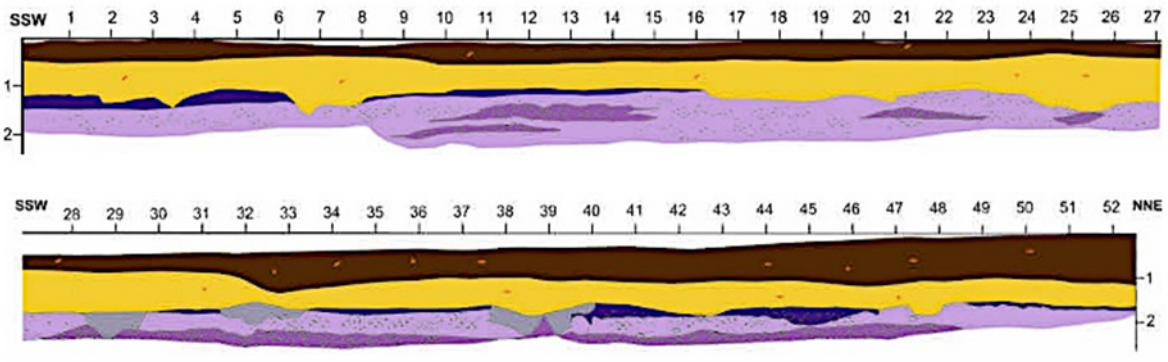

Fig. 2. - Stratigraphy of eastern wall of the palaeosismological trench. Five continental units have been recognized: colluvial deposits (brown and yellow), paleosol (blue) and alluvial deposits (pink and violet).

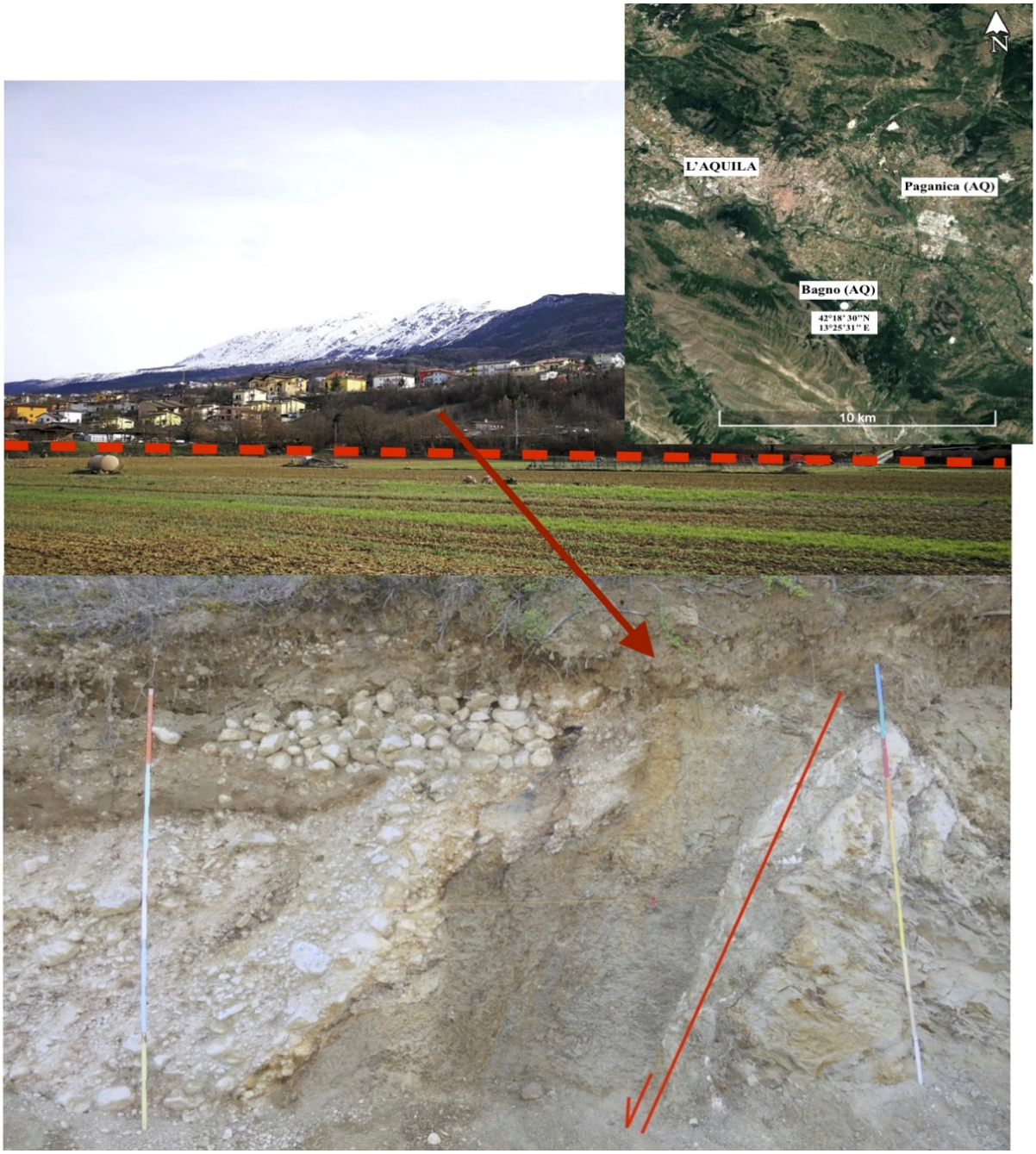

Fig. 3 - A) Bagno Piccolo locality crossed by a scarp, marked by the red dashed line. B) Normal fault zone (red line) that placed into contact Miocene Flysch with continental deposits.

brought into contact Miocene Flysch and Quaternary deposits (alluvial fan and colluvial sediments) (Fig. 3B). Following Nocentini et al. (2017), the alluvial fan deposits can be related to the "Sintema di Campo di Pile", dated to the Late Pleistocene. This indicates a late Quaternary activity of the fault. Further analyses are still ongoing to better characterise the recent movements of this fault zone.

4. DISCUSSION AND CONCLUSIONS

The field geological survey and the analysis of trenches allowed to verify or exclude the presence of faults in the investigated sites and to achieve a better definition of the Quaternary activity of the identified faults. In the case of Celano, we didn't find any evidence of active faulting in the area of the "ex Campo Bonaldi", where the ITHACA database suggests the presence of

an active and capable fault. We found evidence of late Quaternary activity in the area of Celano along NW-SE trending faults (especially along the Santa Iona fault), which confirms the probable structural linkage between the “Strada Statale Marsicana” segment of the active Fucino fault and the Monti della Magnola segment (Galadini et al, 1998; Galli et al, 2012). Moreover, the absence of late Quaternary activity along the N-S trending normal faults located along the western slope of the Serra di Celano relief highlights the probable lack of structural linkage between the Fucino and Ovindoli-Pezza fault systems.

Regarding the Bagno Piccolo case study, the first identification of a probable active and capable normal fault provides new important information on active faults affecting the L’Aquila area and new detailed data for the seismic microzonation in the area struck by the 2009 earthquake.

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