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THE NEW SEISMOTECTONIC MAP OF THE EMILIA-ROMAGNA REGION AND SURROUNDING AREAS

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Introduction

To have an overview of the active tectonics and seismic hazard, the Emilia-Romagna Region published in 2004 the first edition of the regional seismotectonic map (Boccaletti *et alii*, 2004).
However, since 2004 many seismic events have occurred and new knowledge has been acquired. Seismic networks have been implemented, the Po Plain and the Northern Apennines have been affected by several seismic sequences and new studies have been performed. This allowed us to acquire a considerable amount of new data and to better characterize the tectonic structures.
Therefore, we considered necessary to update the first edition, expanding the study area because some geological processes, although far, may influence the safety of the territory and activities in the region.
To compile a seismotectonic map it is essential to identify and represent the active tectonic structures. According to the purposes of the map, among which is to provide regional-scale data and information to plan more detailed specific studies, we decided to adopt a broad definition of the term “active”. We therefore mapped as “active” those structures that show clear evidence of influence on the evolution of the present morphological landscape or have deformed stratigraphic horizons not older than 450 ky (age of the base unconformity of the Upper Emilia-Romagna Synthem). Structures showing minor or not certain evidence of morphological influence on the evolution of the present landscape or deformation of stratigraphic units not older than 450 ky have been mapped as “potentially active”.

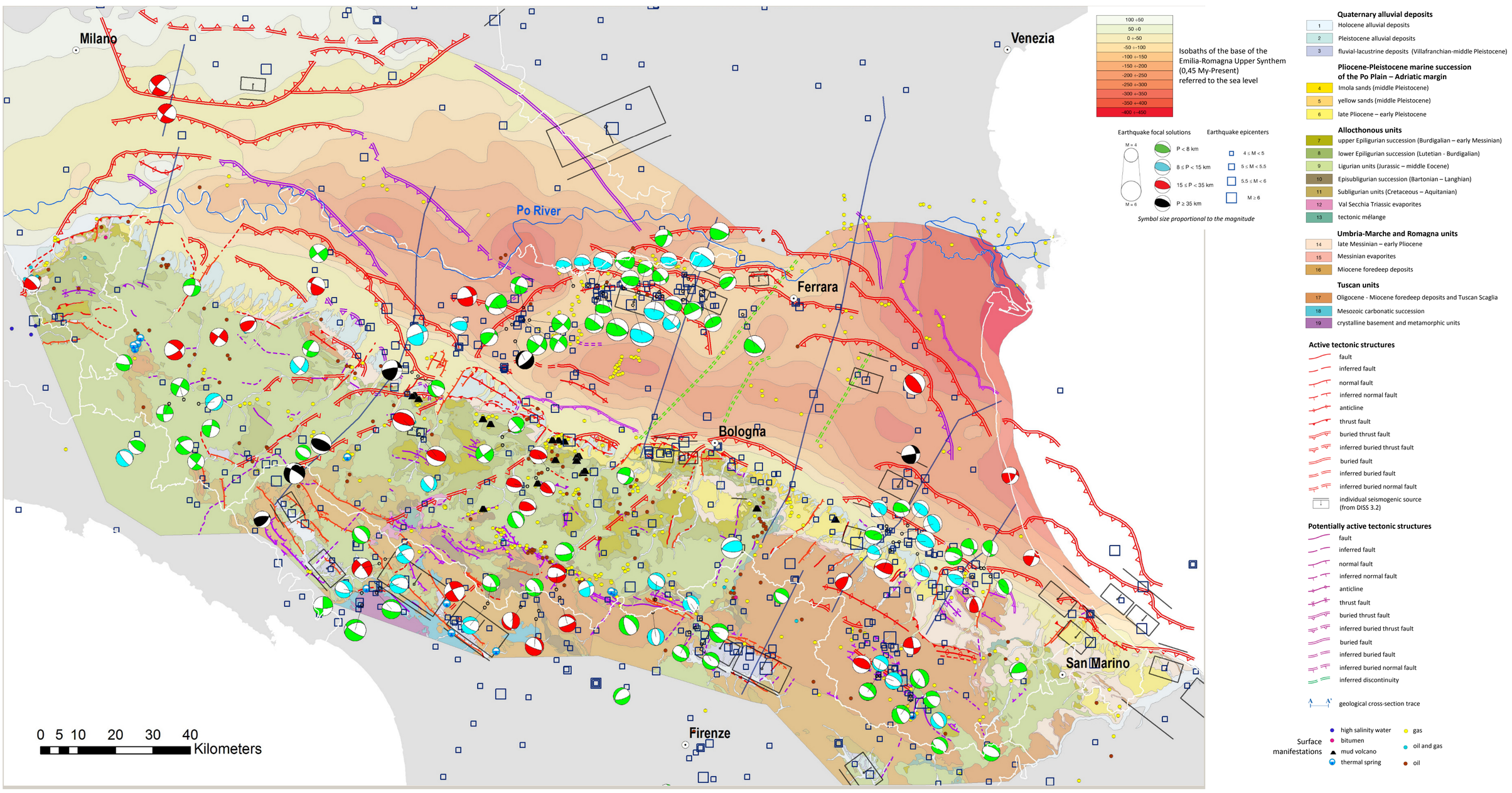
The new map

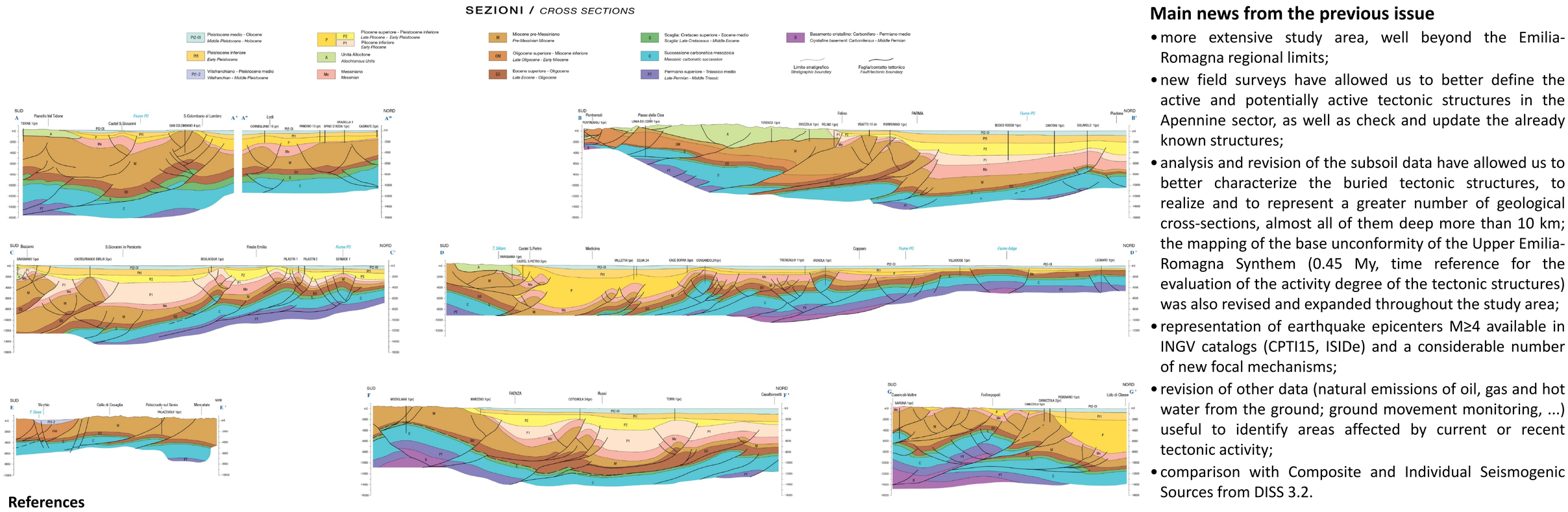
To realize the new map, in addition to the verification of data published in 2004, specific studies and new surveys were carried out. The distinction between active faults, potentially active faults and non-active faults was based on the analysis and comparison of geologic, morphotectonic and seismologic data.

In the map we represent the epicenters of earthquakes with a M≥4 and the available focal mechanisms. Historical data are from CPTI15 (Rovida et al., 2016), instrumental data are from ISIDe (ISIDe Working Group, 2015).
Focal mechanisms of earthquakes with a Mw≥4 are from different catalogues (Pondrelli *et alii*, 2006; Pondrelli *et alii*, 2015; Vannucci and Gasperini, 2004). The focal mechanisms of the events listed in the ISIDe catalogue were located in the map on the basis of coordinates listed in this catalog; the focal mechanisms of events in 1951, near Lodi, were located using the relocation by Caciagli *et alii* (2015).

The different geomorphological environments present in the study area (axial zone of the chain, the Apennine-Po Plain margin, plain and coast) required different criteria of analysis and investigation, resulting in different degrees of knowledge. The recognition of recent and active structures in the axial zone was based on the morphotectonic analysis, dislocation and/or deformation of recent deposits and surfaces and detailed structural analysis.
Finally, we compared the position of the active or potentially active faults with the earthquake epicenters and the available focal mechanisms.
Along the Apennines-Po Plain margin, numerous morphological data indicate recent deformations but sometimes active structures do not outcrop and structural analysis is not possible; so, in this area the comparison between field and subsoil data is crucial.
The tectonic structures of the plain are mostly buried and only in a few cases we were able to observe surface evidence. The absence of surface evidence for many of the recognized structural elements is not directly related to their activity degree, as evidenced by the frequent seismicity. The study of the areas in the plain was therefore based primarily on the analysis and interpretation of subsoil data acquired for oil, gas and water exploration.

We also compared the location of the natural emissions of hydrocarbons, hot springs and mud volcanoes with the active and potentially active tectonic structures. This comparison shows that most of the surface manifestations are located in areas where the subsoil is affected by important tectonic structures, many of which are considered active. This suggests that these structures could provide the pathway through which the fluid rise to the surface.
Finally, we also attempted a comparison between the main active and potentially active structures and the ground movement. Also considering the anthropogenic factors, the comparison showed the minor rates or absence of subsidence are in correspondence of active structures while greater subsidence rates are in areas with high thickness of Quaternary sediments, corresponding to the main synclines.





Main news from the previous issue

- more extensive study area, well beyond the Emilia-Romagna regional limits;
- new field surveys have allowed us to better define the active and potentially active tectonic structures in the Apennine sector, as well as check and update the already known structures;
- analysis and revision of the subsoil data have allowed us to better characterize the buried tectonic structures, to realize and to represent a greater number of geological cross-sections, almost all of them deep more than 10 km; the mapping of the base unconformity of the Upper Emilia-Romagna Synthem (0.45 My, time reference for the evaluation of the activity degree of the tectonic structures) was also revised and expanded throughout the study area;
- representation of earthquake epicenters M≥4 available in INGV catalogs (CPTI15, ISIDe) and a considerable number of new focal mechanisms;
- revision of other data (natural emissions of oil, gas and hot water from the ground; ground movement monitoring, ...) useful to identify areas affected by current or recent tectonic activity;
- comparison with Composite and Individual Seismogenic Sources from DISS 3.2.

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