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NEOTECTONICS AS A PROCEDURE TO UNCOVER ACTIVE SEISMOGENIC FAULTS: THE PRESENT EFFICACY OF THE ITALIAN APPROACH MATURED IN 1970-1980

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APPENDIX A

We include here some of the historical and recent definitions of "active tectonics", "active fault" and "capable fault". A complete bibliography including the less recent references on this issue can be found in the famous report by Slemmons & McKinney (1977), representing a milestone in the field of study regarding active tectonics.

As for the first decades of the 20th century, an interesting definition was produced by Willis (1923), who considered an active fault as one that is likely to experience future movements. According to this author, faults that have shown evidence of activation in historical times should be considered active, as well as those that exhibit visible surface dislocations indicating recent movements.

In the half of the past century, Louderback (1950; in Slemmons & McKinney, 1977) proposed that active faults are those that are currently experiencing movements or those that activated during recent or historical geological times. These faults are expected to undergo repeated movements in the future.

Schultz & Cleaves (1955; in Slemmons & McKinney, 1977) stated that fractures that have experienced dislocations during historical times should be considered as active faults. They emphasized that if seismological instrumental data indicates that earthquakes originate along a specific fault, that fault should be considered active. Similarly, if accurately positioned geodetic benchmarks, show horizontal or vertical displacements in a particular area, all faults in that area should be considered active.

Bonilla (1967) proposed that an active fault is a fault that experienced movements in the recent past and is expected to undergo movements in the near future. The term "recent past" encompasses the present time and extends back for an unspecified period, in which most geologists include the Holocene. On the other hand, the "near future" refers to a time interval on the order of the lifetime of infrastructures or relevant for long-time development planning.

Wentworth et al. (1969) considered as active those faults which exhibit traces of repeated activity in historic or very recent geologic time. In their geologic work propaedeutic to the estimation of the expected acceleration at a site in the Ventura County, California, the authors mapped and parametrized all faults showing evidence of late Quaternary movement with length sufficient to generate large magnitude earthquakes.

In 1972, Gary and co-authors stated that an active fault is one that exhibits recurrent movements, often indicated by small displacements or seismic activity (Gary et al., 1972; in Slemmons & McKinney, 1977).

A chronological definition is proposed by Grant-Taylor et al. (1974; in Slemmons & McKinney, 1977) who defined an active fault as one that shows evidence of repeated movements over the past 5,000 years. They also acknowledged that it may have activated only once during this period, but it may have undergone multiple episodes of activation over the last 50 kyr. By contrast, a time interval is not quantified by Sherard et al. (1974), who proposed that a fault can be considered active (or possibly active) if it exhibits sufficient evidence of dislocation in the recent geological past so that future surface dislocations within the lifespan of an artificial dam (approximately 100 years) are likely to occur.

The U.S. Bureau of Reclamation, in 1976 (in Slemmons & McKinney, 1977), stated that those faults showing evidence of movement over the past 100 kyr must be considered active.

With reference to the Basin and Range tectonic province of the USA, WSSPC (1997, 2008; see also Machette, 2000) overcome issues due to narrow chronological constraints by defining: *i*) Holocene faults (motion in the last 10 kyr; 11,5 kyr BP cal. age); *ii*) Late Quaternary faults (motion in the last 130 kyr); and *iii*) Quaternary faults (motion in the last 1,8 Myr; or 1,6 Myr in WSSPC, 1997 and Machette, 2000). This choice depended on the fact that the Holocene tectonic characterization in the Basin and Range province is not enough to define fault activity in that domain, affected by recurrence intervals also in the order of tens of thousands of years

As for the capable faults, we find definitions in the regulations for nuclear plants in the USA, where a fault is considered "capable" if it has experienced at least one movement over the last 35 kyr and multiple episodes of activation over the past 500 kyr (US NRC, 2010).

Other chronological constraints in USA may be found in the Alquist-Priolo Fault Zoning Act, a law that restricts building activities near the surface traces of active faults, which deems as capable those faults showing surface ruptures in the last 11 kyr (Bryant & Hart, 2007).

Further definition of capable fault can be derived from more recent nuclear regulations, such as IAEA SSG-9 (U.S. Bureau of Reclamation, 2010), already discussed in the main text of this article.

As far as Italy is concerned, in the ITHACA database ("ITaly HAzards from CApable faults - Catalogo delle faglie capaci in Italia") of the Istituto Superiore per la Protezione e la Ricerca Ambientale (ITHACA Working Group, 2019), following the IAEA general lines, a fault is deemed capable "*when it is considered capable of producing, within a time interval of societal interest, deformation/displacement of the topographic surface and/or in its vicinity*". Moreover, ITHACA considers various factors to assess fault capability, including geological evidence of coseismic surface faulting, geomorphic and/or stratigraphic evidence of surface faulting during the Late Pleistocene-Holocene, specifically after the LGM, as well as just morphological indicators of supposed fault-related slopes that bound Quaternary extensional basins, even without the support of morpho-stratigraphic constraints of actual fault activity.

Galadini et al. (2001) proposed that, considering the Italian tectonic framework, a given fault is active if it exhibits evidence of Late Pleistocene-Holocene activity, after the LGM.

The guidelines for Seismic Microzonation currently in force in Italy (Technical Commission for Seismic Microzonation, 2015) define "surface faulting" as the abrupt (coseismic) vertical and/or horizontal movement of the ground surface along one or more fault planes. According to these guidelines, a fault is defined as active and capable if there is evidence of at least one episode of surface rupture over the past 40 kyr. This time frame has been chosen as it represents the lower limit of the radiocarbon dating method's applicability, which is the most commonly used dating technique in active faulting studies.

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