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Stratigraphic and structural evolution of the Tablate area (Granada Basin, Spain): inferences on the possible seismic activity of the Padul Fault

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Numerous works have reported in the past the presence of a possible seismogenic fault (the Padul Fault) potentially able to trigger strong earthquakes in the Tablate area, in between the western periclinal termination of the Sierra Nevada (Betic Codillera) and the southern termination of the Granada intramontane Basin (Spain). This seismogenic structure is an extensional fault NW-SE trending and SW dipping, about 15 km-long and with up to 800 m of throw, bounding a Mio-Plio-Quaternary intramontane basin (the Lecrin Basin), filled by predominantly continental clastic deposits overlaying a Paleozoic-Triassic metamorphic basement involved in the Upper Cretaceous to Neogene Alpine orogenesis making up the Betic Cordillera.
Several geomorphologic evidences (i.e. well-preserved fault scarps in bedrock, offset of paleosoils and/or recent alluvial fans) indicate the recent activity of the Padul Fault. However, stratigraphic and structural studies necessary to define the evolutionary history of the Lecrin Basin, and consequently the role played by this tectonic structure in the basin evolution, are missing in literature. For this reason, we present the results of a field-based work aimed to an exhaustive characterization of the stratigraphy and depositional environments of the Mio-Plio-Quaternary deposits outcropping in the Tablate area, as well as of the tectonic structures crosscutting these deposits. By integrating the results obtained by geological mapping, stratigraphic-structural analyses and optical microscopy, we fill this knowledge gap by assessing the temporal and spatial evolution of the fault sets present in the basinal deposits.
Serravallian to Messinian, E-W and N-S trending normal fault scarps represent the ancient tectonic structures of the area. These fault scarps were onlapped by the continental deposits filling the Lecrin Basin, which recorded the stratigraphic differences between high and low structural areas. Both E-W and N-S trending faults formed from the Messinian to the early Pliocene as conjugate sets as a consequence of the deformation that surrounded the western periclinalic termination of the Sierra Nevada, which started in the Upper Tortonian. Afterwards, NW-SE trending normal faults localized at the northeastern quadrant of the Lecrin Basin. These faults rarely affect the Plio-Quaternary deposits, resulting more developed within the Miocene deposits underneath. The NW-SE faults are comprised of en-echelon geometries and, overall, are characterized by lengths greater than 2.5 km and throws up to about 100 m. The NW-SE faults represent the surface expression of the southern termination of the Padul Fault and, therefore, the information gathered along these faults are key to better constrain the time evolution of the presumed seismogenic structure.
In conclusion, the activity of the Padul Fault during the Serravallian-Messinian time is suggested by the depositional architecture of the coeval clastic deposits related to sin-sedimentary extensional tectonics, which mainly localized along the northeastern quadrant of the Lecrin Basin. A more recent activity of this fault is suggested by geomorphologic evidences (i.e. well-preserved fault scarps in bedrock, offset of paleosoils and/or recent alluvial fans). A slip rate of 0.03 mm/y is inferred for the southern termination of the Padul Fault during the Serravallian to Messinian time, whereas a minimum slip rate of 0.02 mm/y characterized this fault from the Pliocene to current time. Taking into account the overall length of the Padul fault, a Mw= 6 maximum magnitude earthquake can be calculated.