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Superimposed positive and negative inversion of the syn-rift fault network preserved in the Montagna dei Fiori Anticline, Central Apennines, Italy

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Syn-rift tectono-sedimentary inheritance is common in thrust-related anticlines exposed in most foreland thrust-fold belts worldwide. Inherited extensional faults provide mechanical weakness zones that typically undergo positive inversion during contraction. This unavoidably has an impact on the evolution of contractional folds. Moreover, duplexing and imbrication of thrust sheets typically produce gravitational instability of inherited fault patterns and negative inversion can be triggered in the late stages of fault-fold interaction. Such polyphase evolutionary histories can deeply influence deformation and fluid flow patterns in fault-related folds and therefore can strongly influence the distribution of structurally controlled processes such as dolomitization. In this contribution we present the results obtained from a multidisciplinary study of the tectono-sedimentary pattern and paleofluid history in carbonates exposed in the Montagna dei Fiori Anticline, at the mountain front of the Central Apennines (central Italy), where the occurrence of both syn-rift fault zones and related sediments has been previously described. Detailed mapping of the central part of the anticline, bed-perpendicular logging of syn-rift and post-rift strata, structural, petrographical, geochemical, microthermometrical, and petrophysical analyses were used to reconstruct the evolution of this anticline, starting from the pre-orogenic architecture up to its subsequent orogenic reworking. These data reveal: (1) the pre-orogenic tectono-sedimentary architecture of a folded Jurassic fault network; (2) multiple superimposition of extensional and contractional episodes of deformation on the same fault zones; (3) the presence of at least one main dolomitization episode, the timing of which is still being deciphered; (4) demonstrate the causal link between faulting and dolomitization, which favoured formation of dolostones along fault zones, particularly in the intersection/abutting areas between E-W, N-S, and NW-SE fault trends. These new data allow us to definitively discard the hypothesis that lower Jurassic platform carbonates in the Apennines formed due to gravity-driven olistoliths, as recently proposed. In contrast, our results provide robust support to model that these platform carbonates formed as syn-rift extensional fault-bounded blocks, as proposed by most of the previous workers in the area. Since the stratigraphic units and deformation histories at Montagna dei Fiori exist in folds elsewhere in the Central Apennines, these findings impact the regional interpretation of controls on the formation of dolostone geobodies. Ultimately, our work reconfirms the fundamental role of structural inheritance on younger structural patterns and the importance of that inheritance to drive fluid flow and associated diagenetic alteration.