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A mechanical model for complex fault patterns induced by fluid overpressures due to dehydration reaction within evaporitic rocks

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Complex fault patterns, i.e. faults which exhibit a diverse range of strikes, may develop under a weak/absent regional tectonic field (e.g. polygonal faults). We studied a complex synsedimentary fault pattern, geometrically similar to polygonal fault systems, developed during an early Jurassic extensional episode and exposed in the Umbria-Marche Apennines (Italy). Along the passive margin of the African plate, these faults disrupt the Early Jurassic platform overlying the Triassic Evaporites, and bound the subsiding basins where a pelagic succession was successively deposited. We digitised the fault pattern at the regional scale on the grounds of the available geological maps, characterising each fault in terms of attitude, length and throw (i.e. vertical displacement). Fault statistical analysis shows a largely scattered orientation, a high grade of fragmentation, an average length of about 10 km and a constant length/displacement ratio. The analysed fault pattern differs from extensional fault systems for the lack of bimodal conjugate "andersonian" geometry and for the estimated very low long term slip-rates. We propose a conceptual and mechanical model to explain the development and evolution of the complex fault pattern as induced by Triassic Evaporites instability due to dehydration processes (anhydritization) during burial. The lithological architecture of the Triassic Evaporites, made of i nterbedded gypsum layers and dolostones, had a fundamental role in controlling the deformation processes. Cyclic fluid overpressure build-up and release, coexistence of brittle and brittle-ductile (ductile flowage) processes, caused isotropic and not-plane strain fields within the dehydrating rock mass which favoured the development of complex deformation patterns. The mechanical model presented shows that the studied complex fault pattern developed under a stress field consistent with an almost isotropic stress distribution within the

horizontal plane. The data presented show that local, heterogeneous strain fields in both time and space have been dominant over far-field, oriented regional extensional tectonics.