Geophysical Research Abstracts
Vol. 20, EGU2018-6412, 2018
EGU General Assembly 2018

Geochemical evidences for compartmentalized paleofluid circulation during thrust stacking and late-stage normal slip re-activation in the Gran Sasso Range, Central Apennines, Italy

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In the Italian Apennines seismicity is associated to fluid infiltration, but the origin of these fluids remains debated. We adopted a multidisciplinary structural and geochemical approach comprising standard petrography, cathodoluminescence, carbon and oxygen isotopes, strontium isotopes and noble gases isotopes in order to understand the origin of paleofluids in the outstanding exposures of the Gran Sasso Range carbonate-rock massif. The Gran Sasso Range, in the Italian Central Apennines, developed by multiple stacking events of thrust sheets, which started in Early Pliocene times. The Gran Sasso Range involves the sedimentary successions that were located at the paleogeographic boundary between the Lazio-Abruzzi carbonate platform to the South and the Umbria-Marche pelagic basin to the North. Thrust faults generally strike almost E-W and have a top-to-the-North tectonic transport direction, and are dissected by the Quaternary Campo Imperatore high-angle extensional fault system. The Monte Camicia area, in the eastern side of the Gran Sasso Range, exposes two overlying thrust sheets. The lower thrust zone (Fornaca Thrust) separates the Upper Triassic Bituminous Dolostone Fm. in the hanging wall, from the Lower Jurassic limestones of the Corniola Fm. in the footwall. The overlying thrust zone (Monte Camicia Thrust) juxtaposed younger rocks on older ones, namely the Upper Cretaceous Rudist Limestone in the hanging wall onto the Upper Triassic Bituminous Dolostone in the footwall. The Fornaca Thrust has been interpreted as an in-sequence fault formed in Early Pliocene times, while the interpretation of the Monte Camicia Thrust is still controversial, as either an out-of-sequence thrust or an extensional fault zone formed in Late Pliocene times, or even a folded, pre-orogenic extensional fault zone. Our field data support the out-of-sequence thrust fault kinematics, overprinted by late-stage normal slip re-activation. The Fornaca and Monte Camicia Thrusts have strikingly different structural diagenetic features. Our preliminary results indicate that in the Fornaca Thrust, layer-parallel dolomite breccias in Triassic dolostones and veins in the Corniola limestones formed in closed system conditions during Lower Pliocene shortening, with significant contribution of pressure-solution, particularly in the limestones. On the other hand, the Monte Camicia Thrust accommodated deformation mostly by cataclasis at shallower depth and is widely affected by syn to post-thrusting dissolution, vug enhancement and dedolomitization. In this latter case, geochemical data indicate an open hydraulic system characterized by meteoric and soil-derived fluids circulating along the fault zone. Strontium and noble gases data indicate that fluids involved in thrust-related deformations and in post-thrusting extensional collapse did not interact with basement, mantle or volcanic-derived fluids.