Geophysical Research Abstracts
Vol. 17, EGU2015-505, 2015
EGU General Assembly 2015

Fault and fluid interaction in the Bradano Trough, southern Italy

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We report the preliminary results of a multidisciplinary study directed toward a better understanding of the fault and fluid interaction in the Bradano Trough, the foredeep basin of the southern Apennines fold-and-thrust belt, Italy. The work focuses on fresh tuff deposits located along high-angle faults, which crosscut the foredeep basin infill and the Middle Pleistocene Vulture pyroclastic rocks. Two sites have been studied in detail by mean of integrated field and laboratory analyses. The field survey aimed at deciphering both fault architecture (nature, distribution, and relative timing of formation of the various structural elements) and stratigraphy of the fresh tuff deposits. Laboratory investigation of representative samples of both fresh tuff deposits and mineralized fault-related structural elements (e.g, veins and fluid pipe conduits) targeted their textural, mineralogical and stable isotope compositions.

The fresh tuff deposits consist of a few m-thick, either well-layered or massive, carbonates that include fossils and syn-depositional calcite veins. These deposits grew primarily by lateral progradation. Optical microscopy analysis is consistent with seven main fresh tuff lithofacies, which all show the following similarities: (i) cement-supported textures; (ii) presence of peloids, phyto- and bio-clasts, imprints of gastropods, bivalves, and plants; (iii) occurrence of shrinkage pores, micropores, and fenestrae that are either partially or totally filled by secondary calcite. XRPD analysis of representative powders showed that calcite is the sole mineral phase except for quartz and feldspar, which are detected in trace in a few samples. Similarly, the mineralogical composition of the fault-related structural elements also shows minor amounts of quartz. Both nature and origin of the quartz mineral will be investigated in a future work.

^{13}C and ^{18}O signatures of representative fresh tuff powders are consistent with a pronounced different isotope composition between the study deposits. Deposits present along NW-SE directed normal faults that crosscut both foredeep infill and the underlying Apulian carbonates are characterized by δ^{13}C (PDB) values comprised between +2.3‰ and +5.7‰ and δ^{18}O (SMOW) values between +21.6‰ and +23.7‰Ḋifferently, the fresh tuff deposit located on top of a NE-SW strike-slip fault, which is envisioned as a lateral ramp of a shallow thrust fault departing from a decollement located within the foredeep infill, is characterized by δ^{13}C (PDB) values between -2.7‰ and +1.5‰ and δ^{18}O (SMOW) values from +23.8‰ to +25.3‰Ȧt all locations, a lack of relationships between isotopic composition and fresh tuff texture features were documented. Based on the equation proposed by Panichi and Tongiorgi (1976), the original δ^{13}C values of CO_2 were calculated. Results of such a work show a dissimilar origin of CO_2 present in the fresh tuff deposits. In fact, those located along the NW-SE normal faults shows a mantle-derived CO_2, which was likely channeled in the fault zones through the 6 km-thick Apulian carbonates and the overlying foredeep basin infill. Differently, the fresh tuff topping the NE-SW strike-slip fault shows a mixed CO_2 source, which includes both mantle and organic components, and therefore suggest the entrapment of shallow, intra-basinal, organic-rich fluids within the latter strike-slip fault.