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Paleothermal and thermochronological constraints to the kinematic evolution of an extensional system driven by a low-angle normal fault: the case history of the Altotiberina fault (Northern Apennines, Italy)

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In the Northern Apennines of Italy several paleothermal and low-T thermocronological studies have been performed in the last 20 years to investigate mainly the Tertiary burial and exhumation paths at shallow crustal levels of the main tectonic units that compose the fold-and-thrust belt. Nevertheless few of these studies address the topic of quantifying and dating local exhumation due to still active extensional faulting.
In this contribution we reconstruct the Neogene-Quaternary burial-exhumation history of a regional East-dipping low angle extensional fault system (the Altotiberina fault system, ATF) in the Northern Apennines where extension is still active at rates of about 3 mm/yr. The new dataset is composed of: i) low-T thermochonological data, e.g. U-Th/He and apatite fission tracks, and ii) indicators of thermal exposure such as vitrinite reflectance and illite content in mixed layers illite-smectite.
About 60 samples were collected from the Umbria-Marche-Romagna succession from upper Triassic to Middle Miocene lithostratigraphic units along regional sections across the ATF system. The samples are located in different structural domains: some come from the area near S. Donato 1 well, at the ATF foot-wall, some come from outcrops at the ATF hanging-wall to the East of the Tiber Valley, other ones come from outcrops at the ATF hanging-wall and at the footwall of its main antithetic fault (the SW-dipping Gubbio fault). Data of maximum burial/temperature indicate that the Miocene siliciclastic and hemipelagic deposits at the top of the succession are generally in the immature stage of hydrocarbon generation and in the early and late diagenetic zone of clay mineral thermal zonation; the pelagic Lower Cretaceous deposits are in the mid-mature stage of hydrocarbon generation; the Upper Triassic deposits are in the late mature stage of hydrocarbon generation and in the late diagenetic zone.
Low-T thermochronology indicates no reset of apatite fission tracks to the East of the Gubbio fault and a rather complex pattern of age and temperature distribution close to Monte Tezio-Monte Acuto ridge (West of the Tiber valley). U-Th/ He dating indicates that data are generally reset with younger ages to the West of the study area (ranging from 3.8 to 2.4 My) and older ages to the East of Gubbio (ranging from 4.18 to 4.6 My), apart from the most downthrown block of the extensional system comprised between the ATF and the Gubbio fault, where data are no reset or only partially reset, in general with the youngest exhumation occurring in more internal sectors of the fold-and- thrust belt.
Calculation on exhumation rates indicate higher values (up to about 1 mm/y) at the footwall of the E-dipping low angle regional fault, to the West; intermediate values (up to 0.6 mm/y) at the footwall of the Gubbio fault, to the East, and lower values in the downthrown block between the two.