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Regional and local trends of maximum burial and exhumation timing in the Northern Apennines of Italy: a new updated dataset of low-temperature thermal and thermochronological data integrated with geological constraints

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In order to assemble a regional-scale resource of maximum burial data and exhumation ages for the Northern Apennines of Italy, a dataset of published data regarding apatite (U-Th)/He, apatite fission-track (AFT), zircon (U-Th)/He, zircon fission-track, vitrinite reflectance and clay mineral analyses (Kübler index and illite content in I/S) has been compiled, over an area defined by coordinates 44°57'N 8°48'E to the NW and 44°48'N 11°59'E to the SE. The first aim of this work is to integrate thermal and thermochronological data and to strongly link them to the tectonic and geological evolution of the areas they are related to. All the data have been organized in a single database to unravel new information for better constraining the interpretations of the same data. In some cases it is evident how data interpretations derived from different types of analyses are clearly in contrast among themselves. An example of this situation is the La Spezia structure, a kilometer-scale fold constituted mainly of foredeep sandstones (Macigno fm), which underwent a maximum burial of about 4 km (AFT data attest the presence of both reset and unreset fission-tracks), whereas vitrinite reflectance and clay minerals data indicate maximum burial of about 7.9 and more than 8.8 km respectively (Abbate et al., 1994; Reutter et al., 1980, 1983; Cerrina Feroni et al., 1983); contrasting results which need to be explained.
Thermal and thermochronological data are lacking in some key areas: in particular we focused on the western portion of the Northern Apennines, where a new set of samples for vitrinite reflectance, clay minerals and apatite fission-track analyses has been collected. In order to obtain a full integration of the results derived from the aforementioned methods, samples for each kind of analysis were collected from different tectonic units (Tuscan, Subligurian and Ligurian Units, and Epiligurian Succession) presently lying at different depths and outcropping mainly in tectonic windows.
From a general overview, both thermochronological and thermal data show regional trends, in ages and temperatures, respectively, varying, to a first approximation, from SW to NE and from NW to SE (Thomson et al., 2010; Dellisanti et al., 2010, Corrado et al., 2010): exhumation ages become younger toward NE and SE and temperatures related to maximum burial decrease in the same directions. These general trends are mainly interpreted as related to the progressive migration through time in these directions of the activity of the main thrust nappes forming the Northern Apennines. In contrast to this evolutionary scenario, there are several data (either thermochronological or thermal) that do not fit these general trends, but reflect more local geological features, such as the polyphased exhumation of the Alpi Apuane metamorphic core complex (Fellin et al., 2007). A more complete interpretation of the whole updated dataset will be provided in order to explain these "anomalous" features, when this wouldn't previously have been done; such features need to be (re-)interpreted by integrating thermochronological and thermal data, and constrained by tectonic and stratigraphic information.

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