Geophysical Research Abstracts
Vol. 12, EGU2010-1380, 2010
EGU General Assembly 2010

A detrital thermochronological study on the late Messinian to Piacenzian sedimentary succession of the Valdesa basin, Northen Apennines, Italy: detecting tectonic and climatic signals

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The aim of the study is to detect and discriminate signals of tectonic activity and climate forcing in an intermontane basin of the northern Appennines, through a detrital thermocronological study of the basin sedimentary succession coupled with a detailed reconstruction of the paleogeography. Eighteen samples were collected from the sandy and pebbly fluvial to shallow marine successions of the Valdelsa Basin, a NW-SE trending depression bounded to the SW by the Mid Tuscan Ridge and to the NE and SE by the ridge M. Albano- Monti del Chianti. Four samples come from the bedrock of the Macigno Formation, a late Oligocene – early Miocene foredeep deposits. The apatite fission-track (AFT) ages for the bedrock vary between 7.8±1.2 and 10.8±2.0 Ma and for the sediments from 5.5±2.8 to 16.6±2.4 Ma. The AFT grain-age distributions of the sediment samples are generally characterized by two components, one younger peak (P1) varying between 3.8±1.7 and 9.5±1.0 Ma and one older peak (P2) varying from 11.1±2.2 to 41.2±10 Ma. In orogenic setting, closure of low-temperature chronometers is commonly associated with exhumation-related cooling caused by erosion or tectonic unloading. The lag-time defined as the difference between the time of closure of a chronological system in the source region and the time of the deposition in the basin can provides a measure of the rate of exhumation. The average lag-time of the P1 component of the Valdelsa Basin samples is ca. 4 Ma and a mean exhumation rate of 1.1-0.9 mm/yr can be estimated. The curves, representing the variation of the lag time, for the two components, show a general trend characterized by decreasing lag-time going upwards in sedimentary succession. This implies increasing cooling rates in the source region over time. Single variations of the lag-time curve correlate with recognised tectonic pulses of the basin NE shoulder and in some cases with global sea-level changes related to intense climatic fluctuation. In particular, four events, mainly controlled by glacio-eustatic cycles, are recognized as being recorded in the lag-time variation curve of component P1: (1) a significant transgression at Miocene – Pliocene boundary, related to the re-establishing of the connection between Atlantic Ocean and Mediterranean Sea after the Messinian salinity crisis; (2) in upper Zanclean (?)-Piacenzian an eustatic level fall is caused by an important continental glaciation in Northern Hemisphere at 3.5 Ma; (3) in the Piacenzian, an important rising in the sea-level, associated with warm and possibly humid climate, overwhelm the tectonic signal; (4) in upper Piacenzian – Gelasian a replacement, in the whole Valdelsa Basin, of a fluvio-deltaic and marine-coastal environment with an alluvial environment is probably caused by the rising of the north-eastern ridge of the basin and by a significant drop in sea-level caused by an important cold period occurring around 2.6 Ma (now the base of Quaternary). In this case the tectonic and climatic signal coupled.