Geophysical Research Abstracts
Vol. 15, EGU2013-13878, 2013
EGU General Assembly 2013

Late Miocene extensional tectonics in the evolution of the eastern Betics and Neogene-Quaternary basins, an example from the Sorbas basin (SE Spain).

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Neogene to Quaternary basins in the eastern Betics occur in synclines among near E/W-elongated antiformal ridges where the metamorphic basement crops out. These antiforms are related to or cut by large-scale strike-slip faults, both developed in response of the NW-SE Africa-Iberia convergence. Most literature associated the origin and evolution of the Neogene-Quaternary eastern Betics basins with this transpressional strike-slip regime. However, recent work showed the great importance of extensional tectonics in the development and evolution of these basins during the middle to late Miocene.
In order to define the role of Miocene extensional tectonics in the origin and evolution of Neogene – Quaternary basins, we have carefully mapped a key area in the southeastern Betics, the western termination of Sierra Cabrera. We analyzed the age and linking relationships between brittle fault segments, and finally we constructed a balanced cross section. We identified a NW-SE listric normal fault system that was active during the Tortonian producing southwestward hanging-wall displacement. These normal faults show hard linkage relationships with E-W to N70E vertical strike-slip and oblique-slip extensional transfer faults that show both dextral and sinistral kinematics.
The balanced cross section shows that listric faults probably join together into a basal detachment (about 1 km depth) inside the metamorphic basement (Nevado-Filabride complex). The fault system influenced the Tortonian sedimentary evolution of the Sorbas Basin controlling the sediments thickness. The early Tortonian sedimentary unit is missed in the hangingwall of the fault system, meanwhile the thickness of late Tortonian sediments deposited between 11 and 8 Ma change across the main faults from approximately 200 m thick in the footwall of the system to up to 800 m in the main depocentre. Furthermore, the fault system controlled the Tortonian sedimentary facies shifting from continental and deltaic conglomerates in the footwall to silts and basin marls in the main depocentre. Finally, in the Tortonian sediments two main angular unconformities were recognized probably associated with two extensional pulses in the wider context of the late Miocene extension that affected most of the western Mediterranean region. The first unconformity occurred at approx. 10 Ma between early Tortonian continental conglomerates and the Tortonian marine Chozas formation, meanwhile the second one between the Chozas and Turre formations at approx. 8 Ma. These extensional pulses are supported by fission-track and U-He data available in the area that indicate ages approx. 12 Ma for zircon and 7-9 Ma for apatite grains and U-He corresponding with two exhumation events.
Extensional tectonics represented the main control process in the origin and evolution of Neogene-Quaternary basins of the eastern Betics that were later inverted by the current NW-SE convergence between Africa and Europe. Many strike-slip faults interpreted as transcurrent in origin in the eastern Betics represent extensional transfer faults or folded extensional detachments produced during the middle to late Miocene extensional regime.