Geophysical Research Abstracts
Vol. 12, EGU2010-10807, 2010
EGU General Assembly 2010

Deformation patterns and landscape evolution across scales: the (south-) central Alborz mountains, Iran

Angela Landgraf (1), Paolo Ballato (1), Manfred R. Strecker (1), Anke M. Friedrich (2), Olaf Zielke (3), J. Ramon Arrowsmith (3), Saeid H. Tabatabaei (4), and Majid Shahpasandzadeh (5)

(1) Universität Potsdam, Inst. für Geowissenschaften, Golm, Germany (landgraf@rz.uni-potsdam.de, +49 331 977 5700), (2) Department für Geo- und Umweltwissenschaften, Universität München, Germany, (3) ASU, School of Earth and Space Exploration, Tempe, AZ 85287, USA, (4) Building and Housing Research Center, Tehran, Iran, (5) Kerman Graduate University of Technology, Kerman, Iran

The highly disparate and diachronous character of tectonic deformation, sparse seismicity, and lack of empirical data pose a major challenge for a correct evaluation and the understanding of tectonic activity in the interior of continents. To overcome this dilemma, instrumental and historic records need to be integrated with millennial and long-term geological time scales. In addition, these environments require a joint evaluation of local studies and orogen-scale processes in order to compare and understand tectonic processes on different length and time scales.

Located in the realm of the Eurasia-Arabia collision zone, the Alborz mountains of northern Iran are a zone of ongoing, yet spatially very disparate tectonic activity. Deformation in the orogen and adjacent regions is partitioned into left-lateral strike-slip faulting and thrusting. Earthquakes are randomly distributed in time and space and have moderate to high magnitudes. However, teleseismically recorded events show a higher record in the northern sector of the orogen. In agreement with this pattern, geomorphic proxies suggest higher rock-uplift rates, thus more pronounced tectonic activity in the north. Normalized channel steepness of major streams draining the Alborz mountains, is higher on north- than on south-draining channels. In contrast, total fault offsets are higher in the internal and southern sectors, and apatite fission-track thermochronology (Rezaeian, 2008), as well as the lithologic record of exhumation clearly reveal limited total exhumation in the northern sector. This suggests that the observed gradient in present-day rock-uplift rates is a relatively young tectonic signal and might reflect changes in orogenic boundary conditions.

These observations may be reconciled by our structural and geomorphic studies in the south-central Alborz mountains, which reveal a complex tectonic history, involving changes in the regional shortening directions that may be related to changes in the tectonic stress regime. Fault kinematic analysis of major and minor faults in this area reveals early NW-oriented shortening associated with dextrally oblique thrusting, superseded by NE-oriented shortening, similar to the present-day. During this neotectonic regime, the reactivation of previously generated faults has resulted in a nascent transpressional duplex adjacent to the city of Tehran. In addition, the variable fault motions through time have left important, long-lasting imprints in the landscape, with inherited, tectonically overprinted and newly generated topographic features. Numerical fault-slip modelling using changing directions of largest horizontal stress (SHmax) shows that some faults are favorably oriented to accommodate the entire range of NW- to NE oriented directions of SHmax. The spatial coincidence of such faults with deeply exhumed areas indicates that fault-reactivation and subsequent interaction is a major cause of the observed deformation pattern in the south-central Alborz mountains. If, however, the change in the direction of SHmax temporally coincides with the shift in the focus of deformation towards northern sectors, cannot be resolved yet. Despite higher rock-uplift rates in the northern Alborz mountains, deformation is still ongoing in the southern range, attested by shortened Quaternary deposits and the historical record of destructive earthquakes on faults at the southern flank.