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Kinematic and paleostress evolution of NW-SE trending »Dinaric« faults in Slovenia – A case for Neogene orogen-perpendicular extension in the External Dinaries

Lea Lajmiš (1), Jure Žalohar (1), Asta Gregorič (2), and Marko Vrabec (1)

(1) Department of Geology, NTF, University of Ljubljana, Ljubljana, Slovenia (lea.lajmis@geo.ntf.uni-lj.si), (2) Jožef Stefan Institute, Ljubljana, Slovenia

Orogen-parallel NW-SE trending faults with right-lateral offsets are ubiquitous in the Dinaric orogen. These faults consistently cut and displace thrusting-related structures and are therefore commonly interpreted as belonging to the final stage of tectonic evolution of the Dinarides (e.g. PICHA, 2002). In central Slovenia (northwestern External Dinarides), many such map-scale and regional-scale NW-SE trending faults with marked topographic expression are present. We studied mesoscopic structural characteristics and map-scale relationships of the faults, and measured fault-slip data on exposed fault planes. Kinematic and dynamic analysis of fault-slip data was performed with the T-TECTO software package (ŽALOHAR & VRABEC, 2007).

We separated four major Tertiary tectonic phases. The oldest phase is characterized by NE-SW directed compression, which we attribute to ?Paleogene thrusting of the External Dinarides. The second phase is characterized by NE-SW oriented tension in extensional tectonic regime and is of post-Eocene age, constrained by its occurence in Dinaric foreland flysch strata. The existence of this phase is well-supported by fault-slip data and is also evidenced by fault geometry in ouctrop scale and map scale, manifested occasionally by half-graben structures and NW-SE trending conjugate normal fault sets. The third phase is marked by ∼E-W compression with ∼N-S oriented tension in strike-slip stress regime. This phase typically produced oblique-slip reactivation of Phase 2 normal faults, whereas other effects in outcrop- or map-scale structures were not found. We tentatively assume Miocene timing for Phases 2 and 3. The fourth phase shows ∼N-S oriented compression with ∼E-W oriented tension in strike-slip stress regime. This phase produced dextral reactivation of NW-SE trending normal faults, which is clearly visible from relative age relationships of slickensides on fault planes. Map-scale dextral offsets on NW-SE trending faults are also evident. Phase 4 is consistent with modern stress and strain field in the region as indicated by earthquake focal mechanisms and GPS measurments (e.g. WEBER et al., 2010), and we ascribe it to the Pliocene-Quaternary inversional/transpressional phase in the northwestern Dinarides (e.g. VRABEC & FODOR, 2006).

NW-SE trending orogen-parallel »Dinaric« faults clearly have a complex polyphase history. A major implication is that they probably originated as normal faults and were only later reactivated as right-lateral strike-slip faults. Geodynamic processes responsible for NE-SW directed orogen-perpendicular extension, which produced normal faulting, are presently not understood. Earlier intepretations assumed that the tensional episode in the Dinarides reflects Miocene extension in the Pannonian Basin (ILIĆ & NEUBAUER, 2005). However, in our study area the measured direction of tension does not match the generally ∼E-W oriented Miocene tension documented in the adjacent Pannonian domain (e.g. FODOR et al., 1998). We therefore propose a working hypotesis that Dinaric tension is related to late-stage orogenic extensional processes, similar to those documented in many modern and fossil orogens worldwide.