Palaeostress review of the Zagros fold-and-thrust belt and tectonic implications

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Introduction

The present-day Zagros fold-and-thrust belt of SW-Iran corresponds to the former Arabian passive continental margin of the southern Neo-Tethyan basin since the Permian–Triassic rifting, undergoing later collisional deformation in mid-late Cenozoic times. Here, an overview of brittle tectonics and palaeostress reconstructions of the Zagros fold-and-thrust belt is presented through the Figs 1–6 (after Navabpour et al., 2007, 2008, 2010, 2011 and the references cited therein).

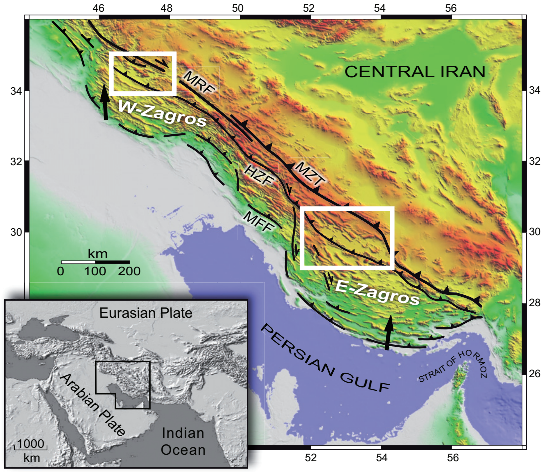
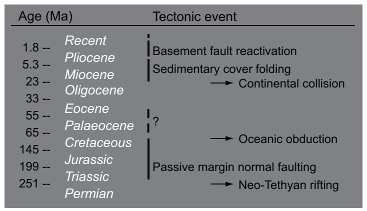


Fig. 1. Index map of the studied areas (white boxes) within the Zagros fold-and-thrust belt. MZT, Main Zagros Thrust; MRF, Main Recent Fault; HZF, High Zagros Fault; MFF, Mountain Front Fault. Large black arrows indicate GPS plate convergence directions in the Iranian reference frame. Inset: location map in the Middle East.

Fig. 2. Main tectonic events of the Zagros fold-and-thrust belt, since the Permian–Triassic rifting and oceanic opening until the mid-late Cenozoic continental collision and shortening.



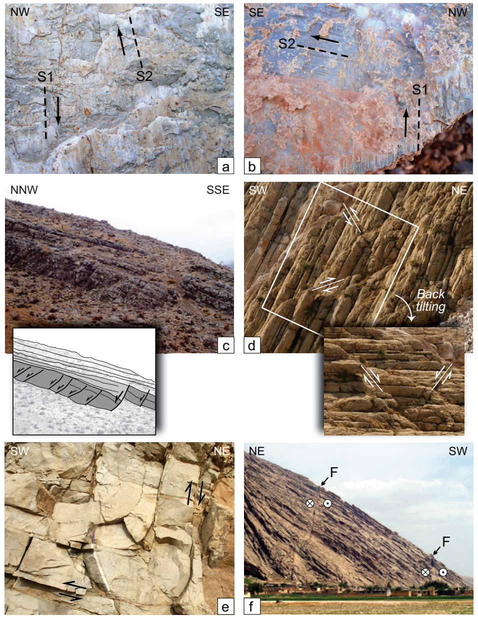


Fig. 3. Typical geometries of brittle structures, indicating relative chronologies. (a) Successive normal and reverse striae on a fault plane (S1 then S2). (b) Successive reverse and right-lateral strike-slip striae on a fault plane (S1 then S2). (c) Sedimentary wedge (light grey in inset) on the hanging wall (dark grey in inset) of a palaeo-submarine normal fault, indicating an approximately N–S extension during Jurassic period. (d) Conjugate reverse faults in the present-day folded strata, interpreted as pre-folding conjugate normal faults by back-tilting the strata to initial horizontal attitude (in inset). (e) Syn-fold bedding-parallel reverse slips. (f) Post-fold vertical right-lateral strike-slip faults (F) cut through earlier folded strata.

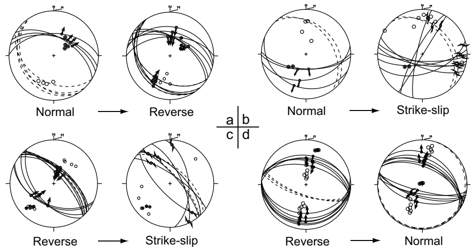


Fig. 4. Stereoplot presentation of fault slip data, indicating kinematic changes. (a) North-dipping normal faults reactivated as reverse faults. (b) South-dipping normal faults reactivated as left-lateral strike-slip faults. (c) Northeast-dipping bedding-parallel reverse slips reactivated as right-lateral strike-slip faults. (d) Back-tilting presentation for the corresponding fault slip data of Fig. 3d. Faults are shown by great circles and slip arrows. Dashed great circles are bedding planes.

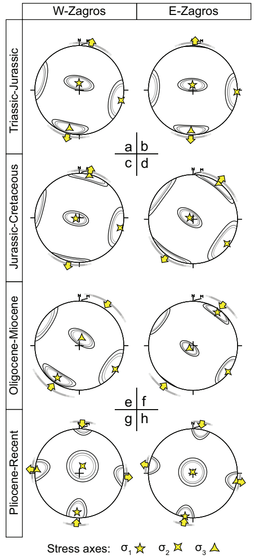


Fig. 5. Stress tensors, calculated based on fault slip data, indicating major changes in stress regimes through time from normal (a, b, c and d) to thrust (e and f) and strike-slip (g and h). In diagrams, the principal stress axes are shown with their 60, 75 and 90% confidence ellipses. Pairs of convergent and divergent arrows show directions of compression and extension, respectively, with azimuthal confidence in grey curves.

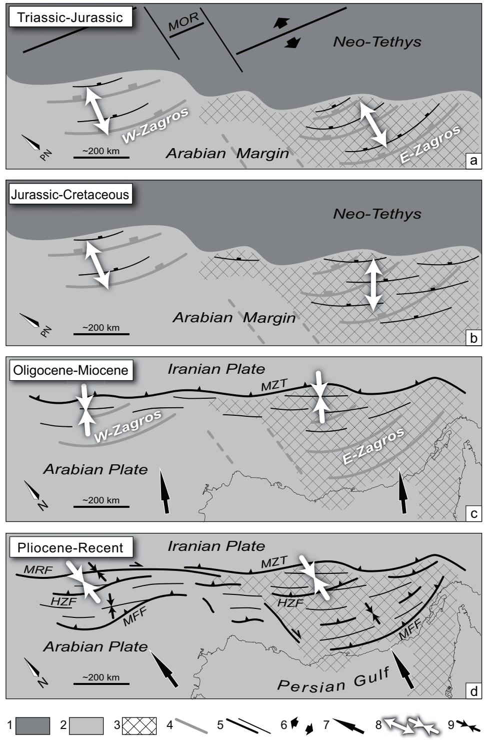


Fig. 6. Schematic presentation of structural evolution of the Zagros fold-and-thrust belt, based on brittle tectonics and palaeostress reconstructions, since the Mesozoic extension (a and b) until the mid-late Cenozoic compression (c and d). 1, oceanic crust; 2,continental crust; 3, thick basal detachment; 4, inherited structure; 5, thick- and thin-skinned structures; 6, inferred plate divergence; 7, plate convergence; 8, directions of extension and compression within the sedimentary cover; 9, direction of seismic compression within the basement. MOR, mid-ocean ridge; PN, palaeo-north. Other abbreviations as in Fig. 1.

Conclusion

Results indicate that after the Permian–Triassic rifting and during the Neo-Tethyan oceanic opening, an extensional tectonic regime affected the sedimentary cover in Triassic–Jurassic times with an approximately N–S trend of σ_3 stress axis oblique to the present-day trend of the mountain belt. Some local changes in the stress field indicate a NE–SW trend of the σ_3 axis during Jurassic–Cretaceous times. The stress state then significantly changed to thrust setting, with a NE–SW trend of σ_1 stress axis, and a compressional tectonic regime prevailed during the continental collision and folding of the sedimentary cover in Oligocene–Miocene times. The compression was followed by a strike-slip stress regime with an approximately N–S trend of the σ_1 axis oblique to the mountain belt during inversion of the inherited extensional basement structures in Pliocene–Recent times. The brittle tectonic reconstructions, therefore, highlighted major changes of stress state in conjunction with transitions between thin- and thick-skinned structures. An oblique divergence is thus suggested for the rifting and oceanic opening, and an increase in plate coupling is evidenced under an oblique covergence after the collision.

References

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