GEODYNAMIC EVOLUTION OF CENTRAL IRAN BY PALEOMAGNETIC, STRUCTURAL AND STRATIGRAPHIC DATA

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The individual blocks forming present-day central Iran and neighbouring Afghanistan (northern Iran, Yazd, Tabas, Lut, Helmand; e.g.) are now comprised between the Zagros Neo-Tethyan suture to the south and the Elburz Paleo-tethyan suture to the north. At the end of the Palaeozoic, the Iranian blocks rifted away from the northern margin of Gondwana as consequence of the opening of the Neo-Tethys, and collided with Eurasia during the Late Triassic, giving place to the Eo-Cimmerian orogeny. After this first tectonic event, additional Gondwanan blocks separated by the ongoing opening of Neo-Tethys were progressively accreted south of the active margin, forming the present-day complex structural setting of Iran. Central Iran is characterized by a complex paleogeography and tectonic evolution. Such an example, the Nakhlak area (Yazd block) has a 2500 m thick Lower to Middle Triassic succession that has been interpreted as deposited on the active margin of Central Iran blocks, during the Cimmerian orogeny. In this interpretation the Nakhlak area should have been originally located farther north, in continuity with the Triassic sequences presently outcropping in the Aghdarband region. In this hypothesis, the present-day location of the central Iranian blocks should have been reached by means of a post Triassic 135° counterclockwise rotation. This reconstruction is based on few paleomagnetic data which are presently available at localities of the Yazd, Tabas and Lut blocks of eastern Central Iran which should demonstrate that Central Iran rotated counterclockwise since Triassic. This model is controversial and probably oversimplified.

On the other hand, the complex kinematics of south-eastern Iranian blocks and the role of vertical axis rotations is well evident in the present-day deformation pattern, as described by active faulting and seismicity in eastern Iran. The present-day convergence between Arabia and Eurasia plates indicates that the expected overall deformation is mainly taken by a N-S right-lateral shear between central Iran and Afghanistan. This motion is presently achieved by N-S right-lateral strike-slip faulting, as is seen east and west of the Dasht-e-Lut block. But, further north, N-S right-lateral faulting abruptly changes to a system of E-W left-lateral faults. These latter faults achieve a N-S right-lateral shear by rotating clockwise as they move, like the rungs of a sheared ladder. Such supposed clockwise rotations are opposite to the counterclockwise rotations which have been generally considered for south-eastern iranian blocks on the base of paleomagnetic data. This kinematic model, which is mainly based on seismological and structural observation, seems suggest that most of the paleomagnetic rotations measured in Mesozoic units in Central Iran could have occurred during Neogene and Quaternary times.

In this work we present new Late Ordovician and Triassic paleomagnetic data from Iran and review paleomagnetic data from the literature with the aim to refine the drift history of Iran over the Ordovician-Triassic. Paleomagnetic and structural data from Neogene units will be also presented and discussed in order to define the role of vertical axis rotations in the Neogene to Present tectonic evolution of Central Iran.

We observe a robust congruence of paleomagnetic poles of Iran and West Gondwana during the Late Ordovician-earliest Carboniferous, and clear paleomagnetic
evidence for residence of Iran on subequatorial paleolatitudes during the Late Permian-Induan, noticeably disengaged from the parental Gondwanan margin in the southern hemisphere (Fig. 1). On these two elements, we based the interpretation of pre-Late Permian latitudes from Iran as pertaining to the southern hemisphere and post-Induan latitudes as pertaining to the northern hemisphere. The Iranian block(s) were located close to the Arabian margin of Gondwana in the Late Ordovician-earliest Carboniferous. They drifted off this margin since the Permian, attained subequatorial paleolatitudes at Late Permian-Induan times, and rapidly approached the Eurasian margin by the Olenekian. From then on, the Iranian block(s) maintained Eurasian affinity. The Iranian block(s) covered the entire span of the Paleotethys in ~30-40 Myr at a nominal plate speed of ~7-8 cm/yr. This motion was largely coeval to the transformation of Pangea from an Irvingian B to a Wegenerian A-type configuration.

Fig. 1 - Paleomagnetic-based paleolatitude curve for the Iranian block(s) compared with the paleolatitudes expected at a nominal site located at 33°N, 53°E in central Iran from the West Gondwana and Europe apparent polar wander paths.

Results from Neogene sediments show that two regions of opposite paleomagnetic rotations can be distinguished in Central Iran. It is worth to note that this rotation pattern corresponds with the presence of different strike-slip fault domains which characterize Central Iran, and that has been evidenced by seismic and structural data. In particular the region where CCW rotations have been recognized is characterized by the presence of a N-S right-lateral fault system (i.e. the Nayaband Fault), whereas CW rotations are associated with the ENE-WSW oriented left-lateral strike-slip faults (i.e. the Great Kavir Fault). This pattern of vertical axis rotations and strike-slip faulting suggest that in Central Iran block-rotation has been a major mechanism to accomplish the Arabia-Iran convergence during the Neogene and Quaternary.