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Deep structure of the Zagros Mountains and the Iranian plateau: results from petrological and geophysical modelling

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The Zagros range is the result of the collision between the Arabian and Eurasian plates during the Cenozoic. Although it is a collisional belt, it presents some anomalous characteristics including: low velocity anomaly in the mantle and low Pn velocities in Central Iran, in contrast to the Caspian Block and the Arabian plate, (<8.1 km/s). Lithospheric profiles combining geopotential, lithostatic, and thermal analyses suggest a prominent lithospheric thinning below the orogen.
In this work we investigate the mantle structure down to 400 km depth along two profiles crossing the Zagros Mountains from SW to NE. The aim is to identify the geometry of the lithosphere-asthenosphere boundary and to reach a better knowledge of the composition of the lithospheric mantle in a collisional environment.
We use a method which combines gravity, geoid, elevation, thermal, seismic and petrological data. The first profile is located in the westernmost part of the Zagros Mountains, from the Arabian plate to the Caspian Sea, and crosses the Mesopotamian foreland basin, the Lurestan arc, the Zagros and the Alborz Mountains. The second profile is located in the central part of the suture zone from the Arabian plate to Central Iran, crossing the Persian Gulf and the Zagros Mountains.
The results show an important thickness variation of the lithosphere beneath the Zagros range. At crustal level, we found a thickening below the Zagros and the Alborz ranges (up to $\sim$60 km and up to $\sim$55 km, respectively), more significant in the southern profile. At deeper levels, a lithospheric mantle thinning affects the whole area beneath the Zagros extending to the north through the zone below the Alborz and the central plateau. The lithosphere-asthenosphere boundary, which is $\sim$230 km deep below the Foreland Basin and the Zagros Folded Belt, rises up to 120 km below the Sinandaj Sirjan Zone and the Urumieh Dokhtar Magmatic Arc. The mantle thinning is less extended in the westernmost sector of the range than in its central area.
Three different mantle compositions were used to obtain the best fit of the data: (1) a Proterozoic for the mantle below the foreland; (2) a Phanerozoic for the mantle below the orogen; (3) a different composition for the mantle below the Arabian plate.