PETROLOGICAL, STRUCTURAL AND GEODYNAMIC CONSTRAINTS FOR THE ZAGROS OROGENY AND REGIONAL-SCALE IMPLICATIONS

AGARD P. 1, OMRANI J. 2, JOLIVET L. 1, WHITECHURCH H. 3, MONIÉ P. 4, VRIELYNCK B. 1

1Laboratoire de Tectonique, UMR 7072, Université P.M. Curie - Paris 6, France. Author: philippeagard@gmail.com 2Geological Survey of Iran, Tehran, Iran. 3EOST, Strasbourg, France. 4Laboratoire Dynamique de la Lithosphère, UMR 5573, Université Montpellier 2, France

The Zagros orogen provides a unique record of the long-standing convergence history between Arabia and Eurasia and allows to evaluate the interplay between a young Tertiary collision and earlier subduction/obduction processes.

We herein present a synthesis of the results obtained on the following geodynamic issues:
(1) the location of the oceanic suture zone, the age of oceanic closure in the Zagros and chronological constraints for the Arabia-Eurasia convergence history,
(2) the syn-subduction tectonometamorphic evolution and the magmatic and geochemical evolution of the upper plate during convergence (the internal Sanandaj-Sirjan and Urumieh-Dokhtar magmatic arcs; SSMA, UDMA, hereafter),
(3) the P-T equilibrium conditions and age constraints of the restricted SE Zagros blueschists (BS), their relationship to those from nearby Makran and Oman, and why they are so few and restricted in space,
(4) the convergence characteristics across the Neotethys during the Upper Cretaceous (kinematic velocities, subduction zones, obduction mechanisms, thermomechanical modeling of the whole transect)... a time window during which, at around 95-85 Ma, transient processes typified by obduction and blueschist exhumation occur at the scale of the whole region, across thousands of kilometres.

A geotectonic scenario for the Zagros convergence, from the time of obduction to recent, is proposed. Some of the salient results are briefly listed below:
− The Main Zagros Thrust (MZT) is deeply rooted, possibly to Moho depths, and the suture zone effectively runs along the MZT. Several major tectonic events take place in the Crush zone (in Lorestan) at the end of the Cretaceous, of the Eocene and from the Mio-Pliocene onwards (ca. < 20-15 Ma). The final resorption of the oceanic domain took place slightly after 35 Ma and collision must have started before ca. 25-23 Ma in northern Zagros. The shortening rate across the Crush zone since the Mid-Miocene (20-15 Ma) is estimated at a minimum 3-4 mm/yr.
− Trace and rare-earth element (REE) systematics on the SSMA and UDMA magmatic belts show that, despite a marked shift from the SSMA to the UDMA at the end of the Tertiary, they originated from similar, subduction-related mantle sources from the Mesozoic to the Eocene. In contrast, syn-collision Upper Miocene to Plio-Quaternary magmatic products show a distinctive adakitic trend, whose distribution supports slab-breakoff at depth along part of the Zagros.
− Geochemical data on the Kermanshah ophiolite, earlier thought to represent a remnant of the Peri-Arabic obduction, have revealed the existence of an intra-oceanic, yet proximal calc-alkaline Eocene arc docked onto Arabia during collision, much after the major regional-scale obduction.
− BS exhumation (c. 100-85 Ma) coincided with obduction processes in the region and followed a sharp rise of convergence velocities across the Neotethys (from 2-3 to 6 cm/yr). Most Zagros BS equilibrated at around 11 kbars and 520-530°C along a warm, 15°C/km gradient, yet one melange unit characterized by exotic blocks in matrix serpentinite reached 17-18 kbars at c. 500°C.
− This BS exhumation was a short-lived process with respect to the long-lived subduction beneath Iran (approx. 150-35 Ma), lasting no longer than 15 My. Our compilation of ages reported for the BS along the Tethyan suture reveals that such a short-lived exhumation is of
regional extent and comparable in size to that of obduction (Figure 1). Such a large-scale exhumation event had not been reported so far on Earth and testifies to the existence of a major, regional-scale modification of the plate-slab coupling in the Neotethyan subduction zone during this period (Figure 2), along thousands of km.