The Palaeotethys Suture Zone in NE Iran: New Constraints on the Evolution of the Eo-Cimmerian Belt (Darius Programme)*

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Abstract

North Iran is a key-area for the Cimmerian orogeny, which is related to the Late Triassic collision of Iran with Eurasia and to the closure of the Palaeotethys. Recent analyses of the Cimmerian evolution have been performed on the Alborz, whereas studies in NE Iran are rare. Due to the importance of this region for the reconstruction of the Cimmerian event, a research project sponsored by the Darius Programme has been focused on the area east of Mashad (Fariman). Here, the occurrence of a thick succession of Permian andesitic to basaltic submarine lava flows interfingering with shallow-water limestones and silicilastics raise several questions on the geodynamic significance of this peculiar rock association, previously interpreted as a Palaeotethys-related accretionary wedge. Problematic are also the Permian “ophiolites” of Darreh Anjir, which do not seem to represent typical oceanic crust remnants.

Detailed studies of this succession allowed us to substantially modify previous interpretations. The Permian units were deposited in a marine basin close to a volcanic area, where a large volume of lava flows was emplaced in submarine conditions. Deformational features are not typical of an accretionary wedge as neither disruption of the stratigraphy nor penetrative shear zones and HP metamorphism have been found. Geochemical data suggest an arc-related setting developed on a continental crust. We thus interpret these units as remnants of a supra-subduction arc-related complex, grown during the Permian along the active Eurasian margin above a north-dipping subduction zone, where the Palaeotethys ocean was consumed.

North of this area, the intra-arc basin of Aghdarband records the Triassic history of the collision zone. The Triassic successions show a north-verging Cimmerian imbricate thrust fan developed in a retro-wedge position with respect to the main north-dipping collision zone located south of Mashad. The thrust fan interacts with a major ESE-WSW left-lateral fault zone, accommodating an important component of oblique convergence. All these structures are sealed by the Bajocian Kashaf Rud Formation, indicating that the main deformation, affecting also Upper Triassic units, can be related to the Cimmerian events.
These new data add important information on the evolution of the pre Middle Jurassic history of the basement of the hydrocarbon-rich Kopeh Dagh Mesozoic and Tertiary successions which are exposed in NE Iran and Turkmenistan.

References


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Aim of the presentation:

• Analysis of the collision zone of NE-Iran

• Define the stratigraphic, structural and petrological features of the “Palaeotethys remnants”

• Reconstruct the Permo-Triassic evolution of the area
S-Asia Devonian-Carboniferous basement

Granite cobble in Kara Gheitan:

313.7 Ma U/Pb

(University of Beijing, SROS Laboratory Milano-Bicocca)
Fariman Complex

- Basalt, trachy-andesite, limestone, siliciclastic turbidite, quartzarenite

Darreh Anjir Complex

- Layered gabbros, plagiogranite dikes, basaltic dikes
- LG metabasalt, trachyte, marble, metachert

- LG metabasalt, marble, serpentine
THE DARREH ANJIR COMPLEX

- Layered gabbro
- Plagiogranite dyke
- Lava flows
- Marble
- Lava flows
- Radiolarite
Schematic geological map of the Fariman Complex
Permian limestone

Lava flows (basalts) with calcareous olistoliths

Turbiditic succession

UPPER UNIT

Permian limestone

north

Basalt

South

LOWER UNIT

Greenschist, phyllite, with serpentine

Pillow lava basalt
THE FARIMAN COMPLEX

Sweetognathus guizhouensis

Pseudohindeodus cf. nassichuki

By A. Nicora

Kungurian (Early Permian)

Sweetognathus guizhouensis

Pseudohindeodus cf. nassichuki

By A. Nicora
GEOCHEMISTRY OF THE FARIMAN AND DARREH ANJIR “OPHIOLITES”

No MORB affinity: no ophiolites s.s.

Darreh Anjir gabbros: subduction-related magmatism (low Ti, Nb, Zr)

Darreh Anjir and Fariman basalts: metasomatised mantle source tapped in a back-arc or intra-arc basins

(Pearce et al., 2008)
Reconstruction of the SE Eurasian margin during the Middle Permian
Upper Permian clastics

Polymict conglomerate and sandstone

Non-conformity?

Darreh Anjir Complex
• Tectonic contact between the gabboric complex and the basalts-cherts-marble unit

• Basalts are possibly unrelated to the underlying gabbros

• No Penrose-type ophiolites, no layer-cake structure

• Age constraints: U-Pb on zircons (plagiogranite, radiolarian from cherts (under study)
Mashad intrusives: **215-217 Ma** (Karimporur et al., 2010)

Pre-early Norian deformation of the Fariman Complex

Torbat Jam granite: **218-221 Ma** (own data)
The Aghdarband erosional window

Mid-Cimmerian unconformity
- Miankuh Formation (? Norian)

Eo-Cimmerian unconformity

Aghdarband Basin (Lower-Middle Triassic)
- Sina Formation (Ladinian)
- Sefid Kuh, Nazarkardeh Fm. (Lower Triassic - Anisian)
- Lava flows (? L. Permian-?E. Triassic)
- Qara Gheitan Fm. (? L. Permian-?E. Triassic)

Upper Permian molasse
- Slate and sandstone with conglomerate
- Coarse grained polygenic conglomerates

Palaeotethys remnants (s.l.)
- Andesite, basalt and limestone (Permian)
- Gabbro
- Ultrabasics (piroxenite)

Upper Paleozoic basement (Turan Plate)
- White Marble (Lower Carboniferous)
- Volcaniclastics, limestone, slate (Upper Devonian)
Stratigraphy of the Triassic Aghdarband Basin

• Different successions in each thrust sheet
• Important unconformities suggesting fault activity
• Eo-Cimmerian unconformity recorded by the Miankuhi Fm.
• Miankuhi Fm. intruded by Torbat Jam Granite (218-221 Ma)
VIEW TO THE SE OF THE NORTHERN FAULT ZONE

- Kashaf Rud Fm.
- Upper Devonian metasediments Sina Fm.
- Post-Cimmerian succession of Kopeh Dagh
- Carboniferous lms.
- SK Unit 1
- SK Unit 2
- Sefid Kuh Lms.
- Sina Fm.
- Kara Gheitan
E-PLUNGING FOLD NORTH OF AGHDARBAND