



Tectonic history of the central Sanandaj-Sirjan zone, Iran: Potentially Permian to Mesozoic polymetamorphism and implications for tectonics of the Sanandaj-Sirjan zone

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The determination of metamorphic conditions and of its age is critical to the understanding of the mountain belt formation as metamorphism is an expression of subduction or plate collision. In this study, we report the metamorphic evolution, preliminary Ar-Ar mineral ages and structures from two amphibolite-grade metamorphic units of the Dorud-Azna region in the central part of Sanandaj-Sirjan metamorphic zone and discuss the tectonic implications. The Sanandaj-Sirjan metamorphic zone is nearly parallel to the Main Zagros Reverse Fault and is located above the Neotethyan ophiolitic suture. Structural studies and our previous U-Pb zircon dating work demonstrated that the area comprise three metamorphosed tectonic units, which are from footwall to hangingwall: (1) The Triassic June complex is metamorphosed within greenschist facies conditions, overlain by (2) the amphibolite-grade metamorphic Panafrican Galeh-Doz orthogneiss, which is intruded by some mafic dykes, and (3) the Amphibolite-Metagabbro unit with Carboniferous metagabbro bodies. To the East, the Darijune gabbro intruded within the Permian Kuh-e-June Marble and the mentioned two other metamorphic units.

The granitic Galeh-Doz orthogneiss displays two different P-T conditions. The best average estimates for the magmatic mineral assemblage (plagioclase core + amphibole core + K-feldspar + quartz) range between 675 and 710 °C and 3.7 and 4.2 kbar, whilst the temperature of 530 and 625 °C and pressure of 0.7 to 2.8 kbar is consistent with the first metamorphic mineral assemblage. Ar-Ar amphibole ages from the Galeh-Doz orthogneiss give plateau-like steps between 260 and 270 Ma. We interpret this age as the cooling age after an amphibolite facies-grade metamorphism. An amphibole from relatively well preserved dyke within the Galeh-Doz orthogneiss gives staircase pattern with an age of 261 ± 3 Ma in the first step considered similarly as a metamorphic overprint in metamorphic rocks, whereas plateau-like steps of 316 ± 1 Ma are interpreted as the cooling through appropriate Ar retention temperature (ca. 500 – 550 °C) after crystallization of amphibole in a magma.

Interestingly, the amphibole porphyroclasts in the metagabbro from the Ampholite-Metagabbro unit give temperatures ranging from 540–610 °C and 3.1–5.0 in the core to 650–720 °C 5.9–8.5 kbar in the rim indicating a prograde part of the P-T path. In addition, two lenses of metapelite were investigated: First, a garnet-muscovite-biotite schist gives a P-T estimate of a garnet cores and rims of 640–655 °C at 6.2 to 7 kbar and 660–690 °C at 7.2–8.2 kbar, respectively. Ar-Ar experiments on white mica yield staircase patterns from 36 ± 12 Ma to 170 ± 2 Ma, implying polymetamorphism with a minimum Jurassic cooling through the Ar retention temperature of ca. 425 ± 25 °C and a Cenozoic low-grade metamorphic overprint. Second, a garnet-biotite schist yield lower P-T conditions, which vary from 600 to 620 °C and 5 to 6.5 kbar in garnet cores to 585–600 °C and 4.5–6 kbar for garnet rims. Ar-Ar experiments on white mica yield a staircase pattern from 52 ± 7 Ma to 131 ± 4 Ma. We interpret therefore, amphibolite-grade metamorphism predate 170 Ma and an overprint at around 50–32 Ma during emplacement of the Amphibolite-Metagabbro unit over the June complex and Galeh-Doz orthogneiss. All three units are overprinted by late-stage retrogressive chlorite, which gave temperatures ranging mainly from 240 to 350 °C according to the chlorite-geothermometer of Cathelineau (1988), the talc-bearing greenschists of the June complex bear two groups of temperatures, 225–270 °C and 330–385 °C.

The amphibolite facies grade metamorphism is associated with ductile fabrics including a prominent ca. E-W trending stretching lineation oblique the strike of the Sanandaj-Sirjan zone. This implies pre-Middle Jurassic transpression. In summary, the new data demonstrate pre-Middle Jurassic amphibolite-grade metamorphism in both Galeh-Doz and Amphibolite-Metagabbro units and thick-skinned Paleogene emplacement of these units over the June complex, which resulted in retrogression within greenschist facies conditions. The old age of amphibolite-facies grade metamorphism challenges the common view that it is related to subduction of the Neotethyan Ocean. It rather represents accretion of a basement block to Central Iran.

