Ediacaran to Toarcian evolution of the Gasht Metamorphic Complex, Alborz Mountains, N Iran

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The Alborz Mountains in N Iran underwent several tectono-metamorphic events that reflect the opening and closure of the Paleo- and Neotethys Oceans. Metamorphic rocks that recorded these are rare and discontinuously exposed. They range from the HP-LT Asalem-Shanderman Complex in the west, to the Gasht Metamorphic Complex (GMC, this study), to the Gorgan Schists, and Fariman Schists near Mashhad in the east. They are considered to have formed during the closure of the Paleotethys Ocean. The GMC comprises poorly exposed metasediments and amphibolite metamorphosed under greenschist- to amphibolite-facies conditions. In addition, smaller volumes of granite occur. As the evolution of the basement rocks of the Alborz Mountains is still poorly known and their radiometric ages are very limited, we applied different dating methods to selected samples of the GMC basement to better understand the geological evolution of this part of the Alborz Mountains.

The granite yielded an Ediacaran 551 ± 2.5 Ma LA-ICP-MS U-Pb pooled zircon age. Monazites in two amphibolite-facies metapelites (Bt-Ms-St ± And schists) yielded Triassic 226 ± 24 and 229 ± 25 Ma CHIME U-Pb ages. Foliation-defining biotite and retrograde white mica replacing andalusite porphyroblasts in metapelites and peak-metamorphic amphibole from an amphibolite yielded much younger 175.1 ± 0.5 Ma to 177.0 ± 0.4 Ma ⁴⁰Ar/³⁹Ar plateau ages.

The Ediacaran crystallization age of the granite agrees with the late Neoproterozoic to Cambrian zircon age of the Lahijan granite in the eastern GMC reported by Guest et al. (2006) and indicates that the Alborz basement was a part of the northern margin of Gondwana at that time. It rifted and drifted away from Gondwana due to the opening of the Neotethys, probably in the Permian, along with other Iranian blocks (the so-called Cimmerian terranes). The mid to late Triassic monazite ages date the Barrovian peak metamorphism of the GMC and mark collision and accretion of a Cimmerian terrane following closure of the Paleotethys. The monazite ages overlap with the early Late Triassic age of deposition of the lowest parts of the unconformably overlying Shemshak Group in the central and eastern Alborz Mountains (ca. 213 Ma, Horton et al. 2008). Younger and very similar Toarcian ⁴⁰Ar/³⁹Ar ages for both pro- and retrograde minerals with
different nominal closure temperatures, reflect very rapid cooling of GMC basement below the Shemshak Group due to extension-triggered uplift. This late Toarcian to Aalenian extension event can be correlated with the regional Mid-Cimmerian unconformity of mid-Bajocian age (c. 170 Ma) that resulted from the tectonic movements causing rapid uplift and erosion (Fürsich et al. 2009). Extension probably started in the western Alborz Mountains in the Toarcian and culminated in the Aalenian in the eastern Alborz with the formation of a deep-marine basin and was triggered by the onset of the subduction of Neotethys oceanic crust beneath the Central Iranian Microcontinent (Wilmsen et al. 2009).