Latest Toarcian (c. 175-177 Ma) 40Ar/39Ar mineral ages for amphibolite-facies basement rocks of the Gasht Complex, Alborz Mountains, North Iran: deep crustal response to mid-Jurassic rifting

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Metamorphic rocks in the Alborz Mountains are mainly known from the HP-LT Asalem-Shanderman Complex, the Gasht Complex, Gorgan Schists, and the Fariman Schists near Mashad. Recent argon ages are limited to eclogites and blueschists of the Asalem-Shanderman Complex, where phengites yielded c. 350 Ma step-heating ages that reflect cooling, following peak metamorphism related to subduction of the Palaeotethys Ocean (Rosetti et al. 2016).

The Gasht Complex in the Gasht-Masuleh area comprises metasediments and metabasic rocks metamorphosed at amphibolite-facies peak metamorphic conditions (c. 630°C and 8.6 kbar, Razaghi et al., 2018). The metamorphism is most probably related to the accretion of Cimmerian terranes to the Turan Terrane in the late Triassic following closure of the Palaeotethys Ocean and resulting in the Cimmerian Orogeny.

Micas from metapelites, amphibole from an amphibolite and magmatic white mica from deformed granite from the Gasht Complex yield very similar 40Ar/39Ar step-heating plateau ages between 175.1 ± 0.5 Ma and 177.0 ± 0.4 Ma (2 sigma) that are independent of grain size and nominal closure temperatures. In addition, clearly retrograde white mica replacing andalusite porphyroblasts in a metapelite yielded a similar plateau age of 176.1 ± 0.5 Ma.

In the Gasht-Masuleh area the contact between basement and the cover rocks is largely tectonic due to later faulting, but the Gasht Complex must have formed the depositional basement to the late Triassic-Middle Jurassic Shemshak Group. Sedimentation started in the Carnian above the regionally developed Eo-Cimmerian unconformity in the central and eastern Alborz and continued until the mid-Bajocian.

Notably, within the Shemshak Gp. a distinct, regional scale unconformity developed in the mid-Bajocian (c. 170 Ma) recognized by rapid coarsening in sediment grain size. Only locally, in the eastern Alborz Mountains, it developed as an angular unconformity related to block rotation. This Mid-Cimmerian unconformity formed as a result of tectonic movements causing rapid uplift and erosion.

Our c. 175 – 177 Ma mica and amphibole plateau ages for the Gasht Complex are unlikely to
reflect slow cooling following the (Carboniferous? Late Triassic?) metamorphism, as this would result in increasingly younger ages for amphibole, white mica and biotite. Instead, the indistinguishable ages for peak metamorphic and retrograde minerals must be due to very rapid cooling at the Toarcian-Aalian boundary (c. 174 Ma) that resulted from rapid basement uplift and at the surface caused the mid-Bajocian Mid-Cimmerian unconformity. Thus, the c. 175 – 177 Ma $^{40}$Ar/$^{39}$Ar ages document the thermal response of the basement below the Shemshak Group to a mid-Jurassic extensional tectonic event.

From a regional perspective, the Mid-Cimmerian unconformity may represent the break-up unconformity of back-arc rift basins that formed due to northward Neotethys subduction to the south of the Alborz Mountains (Wilmsen et al. 2009) and/or the onset of sea-floor spreading within the South Caspian Basin to the north (Fürsich et al. 2009).