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^{40}Ar/^{39}Ar age constraints on the tectonothermal evolution of the Chapedony metamorphic core complex, Central Iran

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The Chapedony metamorphic core complex in Central Iran is characterized by extensional tectonics, in which the Posht-e-Badam metamorphic basement, Cretaceous cover rocks and unmetamorphosed volcanic rocks of an upper plate are tectonically superimposed on high-grade metamorphic rocks of a lower plate along ductile-to-brittle the Neybaz-Chatak detachment fault. U-Pb zircon dating of migmatite and granite of the Chapedony dome revealed the existence of Eocene high-grade metamorphic rocks (Ramezani and Tucker, 2003, Amer. J. Sci., 303, p. 622-665). Here, we report new structural data from the Chapedony metamorphic core complex and new ^{40}Ar/^{39}Ar data on hornblende, muscovite, biotite, and potassium feldspar, which help constrain the kinematic and thermal evolution of this terrain during Tertiary extensional exhumation. The Chapedony metamorphic core complex displays characteristics of both mantled gneiss dome and metamorphic core complex. The dome structure is elongate in NNE-SSW direction and comprises mainly high-grade metamorphic rocks, migmatites, rare paragneisses and abundant orthogneisses, which are cored by a number of Eocene syn- and post-kinematic granite, granodiorite and hornblende-diorite intrusions. Hornblende samples from relatively high structural levels yield discordant age spectra that suggest initial cooling about 46 Ma. When coupled with preliminary thermobarometric calculations, which yield peak $P-T-t$ conditions of ca. 4 kbar and ca. 650–700 °C, the hornblende data suggest that exhumation of the Chapedony may have initiated in Eocene, approximately coincident with the initial phases of unroofing. Thermal history during the final stage of exhumation of the Chapedony is constrained by muscovite, biotite, and potassium feldspar cooling ages of 44–41 Ma

from a range of structural levels. Comparison of hornblende, muscovite, biotite, and potassium feldspar cooling ages with previously published U-Pb zircon ages implies very rapid cooling rates of the entire complex between 46-41 Ma from ca. 700˚C to 200˚C. Such thermal gradients could be readily explained if the Neybaz-Chatak detachment fault dipped $>30˚$. Between hornblende and mica cooling ages suggest that cooling at higher temperatures was the same as lower temperatures. In the final part, this thermal history is used to constrain, tectonic history of the metamorphic core complex.

The Neybaz-Chatak detachment fault shear zone exposes a variety of mylonitic rocks ranging from protomylonitic augen gneiss through mylonitic orthogneiss to ultramylonite and phyllonite, mostly along upper boundary of the shear zone. These fabrics indicate that hydrothermal activity assisted to shearing by lowering of shear resistance and also resulted in variable retrogression and phyllonite formation. Ca. 20 to 100 m wide zones of massive, unfoliated cataclasites and hydrothermal chlorite-breccia with components from both hangingwall and footwall units separate the dome interior from overlying Post-e-Badam unit. Structural data indicate that NE-SW stretching and tectonic unroofing contributed to dome formation. No Eocene ductile metamorphic overprint has been found in the hangingwall unit. $^{40}Ar/^{39}Ar$ white mica of phyllonites from the Chatak-Neybaz shear zone yield ages of ca. 46–41 Ma and are interpreted to date activity along the shear zone.

Locally, nearly unmetamorphic Eocene clastic and and volcanic rocks are exposed directly overlying the, and in tectonic contact with, cataclasites. These are often veined by numerous quartz veins. Further terrestrial basins filled with coarse-grained clastic sediments (Kerman Conglomerate) occur in some distance to the Chatak-Neybaz shear zone. These basins are considered to have formed at north-eastern margin within a halfgraben-type rollover structure due to NE-SW extension. The basin is filled by bad-sorted sandstone and conglomerate with clasts, which are derived from the denudating Posht-e-Badam complex in the hangingwall of exhuming Chapedony dome. We suggest that formation of these basins is a result of extension related to exhumation of the Chapedony metamorphic core complex, and these basins represent, therefore, collapse basins.

The existence of the Eocene Chapedony metamorphic core complex with a migmatite core in its centre reveals the presence of melts and a high geothermal gradient in mid-crustal levels. The data, therefore, show that the Iranian plateau was affected by magmatic underplating and crustal extension during Eocene.