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Multi-stage metamorphism in the South Armenian Block during the Late Jurassic to Early Cretaceous: Tectonics over south-dipping subduction of Northern branch of Neotethys

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ABSTRACT

The geologic evolution of the South Armenian Block (SAB) in the Mesozoic is reconstructed from a structural, metamorphic, and geochronologic study including U–Pb and $^{40}Ar/^{39}Ar$ dating. The South Armenian Block Crystalline Basement (SABCB) outcrops solely in a narrow tectonic window, NW of Yerevan. The study of this zone provides key and unprecedented information concerning closing of the Northern Neotethys oceanic domain north of the Taurides-Anatolides platform from the Middle Jurassic to the Early Cretaceous. The basement comprises of presumed Proterozoic orthogneiss overlain by metamorphosed pelites as well as intrusions of granodiorite and leucogranite during the Late Jurassic and Early Cretaceous. Structural, geochronological and petrological observations show a multiphased evolution of the northern margin of the SAB during the Late Jurassic and Early Cretaceous. A south-dipping subduction under the East Anatolian Platform-South Armenian Block (EAP-SAB) is proposed in order to suit recent findings pertaining emplacement of relatively hot subduction related granodiorite as well as the metamorphic evolution of the crystalline basement in the Lesser Caucasus area. The metamorphism is interpreted as evidencing: (1) M1 Barrovian MP–MT conditions (staurolite–kyanite) at c. 157–160 Ma and intrusion of dioritic magmas at c. 150–156 Ma, (2) near-adiabatic decompression is featured by partial melting and production of leucogranites at c. 153 Ma, followed by M2 HT–LP conditions (andalusite–K-feldspar). A phase of shearing and recrystallization is ascribed to doming at c. 130–150 Ma and cooling at 400 °C by c. 123 Ma (M3). Structural observations show (1) top to the north shearing during M1 and (2) radial extension during M2. The extensional event ends by emplacement of a thick detrital series along radial S, E and W-dipping normal faults. Further, the crystalline basement is unconformably covered by Upper Cretaceous-Paleocene series dated by nannofossils, evolving from Maastrichtian marly sandstones to Paleocene limestones.

1. Introduction

The Crystalline Basement of the South Armenian Block (SAB) (Fig. 1A and B) has a geological history poorly constrained. The SAB was involved in a long and complex tectonic evolution including a presumed Panafrican high-grade metamorphism (Baghdasarian and Ghukasian, 1983; Aghamalyan et al., 2011a,b). However, contrary to other occurrences of Paleozoic sedimentary rocks SE of Yerevan (Sosson et al., 2010), the presumed Paleozoic sediments of the Tsaghkuniats crystalline massif are metamorphosed. Both the metamorphic basement and the cross-cutting intrusions are unconformably covered by Upper Cretaceous deposits (Fig. 2A–C). This observation leads us to question the Precambrian age forwarded for the metamorphism, as well as the tectonic setting and its geodynamic cause. Indeed, several geodynamic processes can explain the metamorphic history of this basement, including (1) a rifting stage leading to Neotethys ocean opening and drifting from Gondwana in the Permian to Early Mesozoic times (Sosson et al., 2010 and references therein), (2) oceanic closure by subduction of Paleotethys from the Early to late Mesozoic and (3) subsequent continental subduction/ocean crust obduction in the middle-Late Cretaceous (Galoyan et al., 2009; Rolland et al., 2009b), followed by (4) continental collision or

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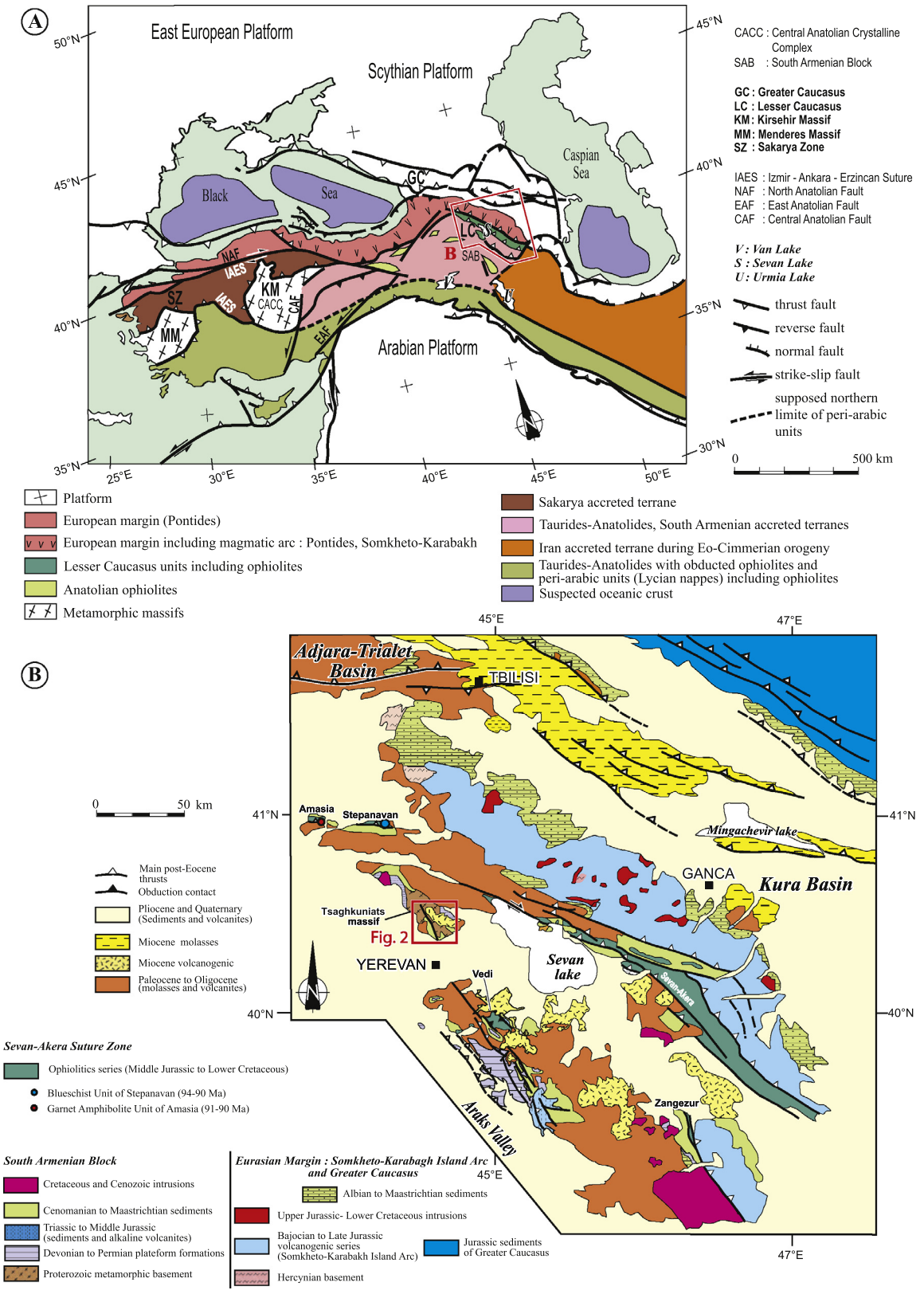

Fig. 1. (A) Tectonic map of the Middle East–Caucasus area, with main blocks and suture zones, after Avagyan et al. (2005), modified. Location of Fig. 1B is indicated. (B) Structural map of the Lesser Caucasus, modified from Sosson et al. (2010). Location of Fig. 2A is indicated.

accretion to the Eurasian margin in Late Mesozoic/Early Cenozoic times (Sosson et al., 2010) and depending on authors the Arabia-Eurasia collision from middle to late Eocene up to Oligocene ((Hempton, 1985; Robertson et al., 2012; Rolland et al., 2009a, 2012; Yılmaz, 1993). Moreover, the influence of the Cimmerian orogeny, known more eastward in Iran, is also a possible cause of this metamorphism (Philippot et al., 2001; Kazmin, 2006; Saintot et al., 2006; Zanchi et al., 2009). Consequently, the SAB Crystalline