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Petrology, mineral chemistry and Sr–Nd–Pb isotopic compositions of granitoids in the central Menderes metamorphic core complex: Constraints on the evolution of Aegean lithosphere slab

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ABSTRACT

Plutonic associations in the central Menderes metamorphic core complex are suitable rocks in order to understand the magma forming processes in extended terrains. Syn-extensional Salihli and Turgutlu granitoids have granodioritic composition and contain monzonitic and monzodioritic microgranular enclaves. They are transitional metaluminous/peraluminous and high-K calc-alkaline in character and are located on I- and S-type transition. Salihli and Turgutlu granodiorites are geochemically similar to each other while their microgranular enclave chemistry is in contrast with low SiO_2 and high Mg # values. Mineral chemistry data from granodiorites and mafic microgranular enclaves confirm their shallow emplacement at about 7 km. Geochemical modelling suggests that syn-extensional granitoids were derived from the mixing of mantle and lower crustal components, which were finally modified by a significant amount of upper crustal contamination and fractional crystallization processes at shallow crustal levels. Early-Middle Miocene syn-extensional granitoids across the Aegean region form a magmatic belt associated with roll-back of the Aegean lithosphere slab. Roll-back induced magmatism together with ductile deformation in western Turkey ceased after cooling of the Salihli granodiorites at 12.2 Ma. But core-complex related magmatism was continuous in the Cycladic metamorphic core complex during Late Miocene and was followed by an active arc volcanism in the southern Aegean. Such abrupt change from ductile to brittle mode of extension in western Turkey can be explained by opening of a slab window on the Aegean lithosphere slab, which would lead to upwelling of fertile subslab asthenospheric mantle, forming transitional and finally OIB-type basalts.

1. Introduction

Alpine orogenesis resulted in convergence of the African and Eurasian plates, which was characterised by syn- and post-collisional events that led to extensive magmatic activity over the amalgamated tectonic units in the Aegean region (Fig. 1a–b). One of these tectonic units, the Menderes Massif, is now regarded as a typical metamorphic core complex (MCC) that began to have exhumed since Latest Oligocene to Early Miocene in western Turkey and is closely associated with syn-extensional granitoids in the immediate footwall of the extensional detachment faults and steeply dipping shear zones (Hetzel et al., 1995a,b, 1996; Işık et al., 2003; Thomson and Ring, 2006). The Menderes MCC appears to have close temporal and spatial relationships with the Cycladic MCC together with syn-extensional granitoids that developed during Early to Late Miocene in the central Aegean region (Fig. 1b). Although detailed account of structural features and geochronological data from syn-extensional granitoids in the Aegean region has been documented, source characteristics of these granitoids are still subjected to debate. Syn-extensional granitoids in western Turkey are commonly assumed to have been formed by derivation from hybrid magmas that was generated by upwelling of an asthenospheric heat source and subsequent thinning of lithosphere. Origin of the Cycladic syn-extensional granitoids was commonly considered as a result of partial melting of lower crust, forming the source of I- and S-type granitoids (Altherr and Siebel, 2002; Pe-Piper, 2000). However, recent arguments explain their origin by mixing of mafic and felsic melts at variable proportions (e.g. Bolhar et al., 2012). The Menderes and Cycladic granitoids with I-type character also include variable amount of mafic enclaves, but their origin is controversial and explained either by input of a juvenile, mantle-derived mafic magma (Aydoğan et al., 2008; Erkül, 2012; Erkül and Erkül, 2012) or co-magmatic early differentiates of host granite magma (Altherr and Siebel, 2002; Stouraiti et al., 2010). There has been agreement on the heterogeneity of mantle sources forming the

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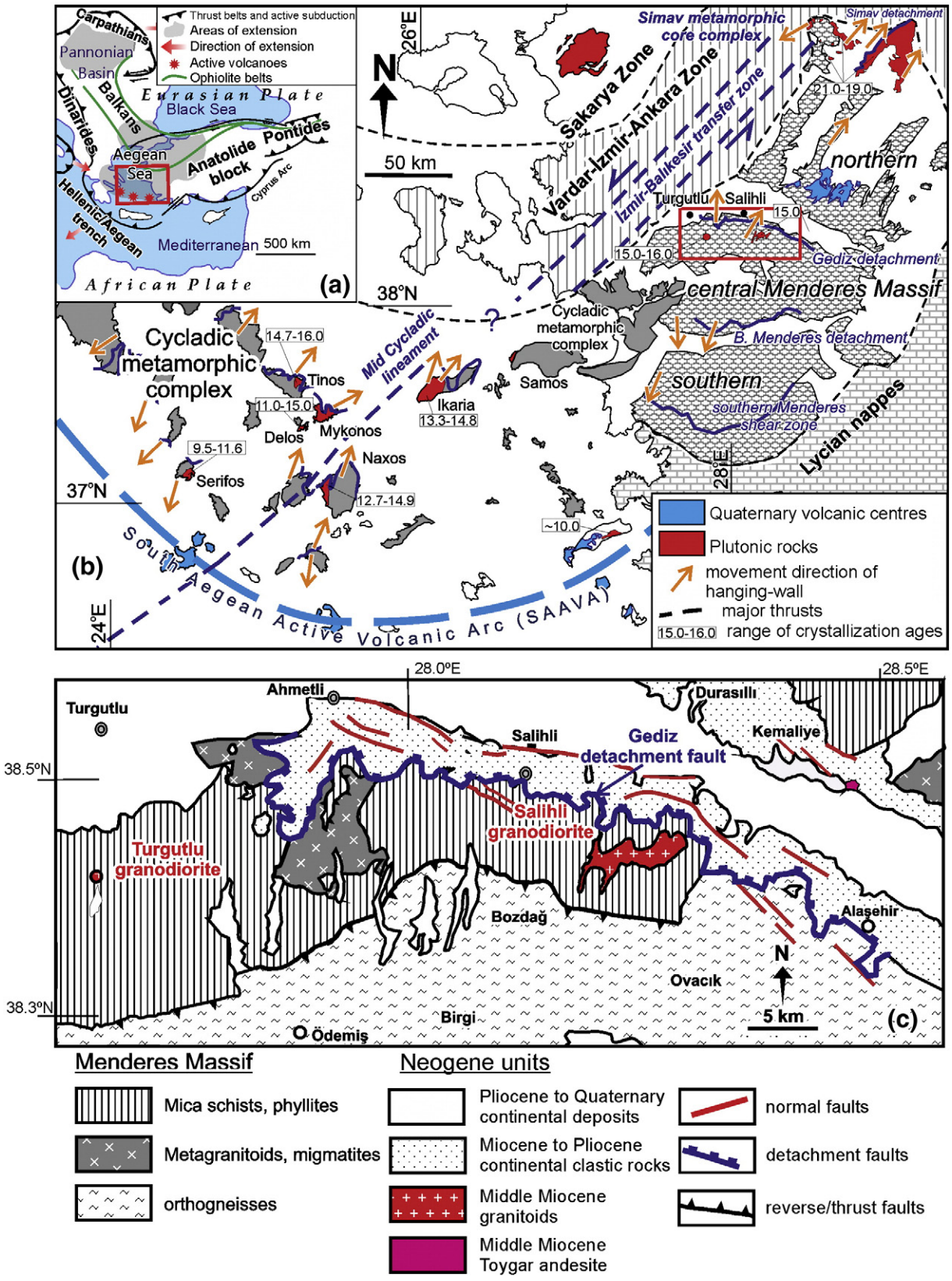

Fig. 1. a–c. Simplified geological map of the Aegean region. Formation age data sources: Bolhar et al. (2010), Catlos et al. (2010), Glodny and Hetzel (2007), Henjes-Kunst et al. (1988) and Iglseder et al. (2009). Lineaments and detachments are from Walcott and White (1998) and Iglseder et al. (2009).

post-collisional magmatic associations in the Menderes and Cycladic MMCs. Heterogenous mantle source below the continental crust of western Turkey was commonly attributed to a metasomatised lithospheric mantle that was influenced by subduction components (Ersoy et al., 2010, 2011, 2012; Güleç, 1991; Innocenti et al., 2005; Prelević et al., 2010, 2012). However, it is not clear whether subduction components