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Review Article

A review of tectonics and sedimentation in a forearc setting: Hellenic Thrace Basin, North Aegean Sea and Northern Greece

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ABSTRACT

Exposure of the forearc region of the North Aegean Sea, Greece, offers insight into evolving convergent margins. The sedimentary fill of the Thrace Basin during the Late Eocene to Oligocene time provides a record of subduction-driven processes, such as growth of magmatic arcs and construction of accretionary complexes. This large sediment repository received sediment from two sources. The southern (outboard) basin margin reflects the active influence of the exhumed accretionary prism (e.g. Pindic Cordillera or Biga peninsula), while the northern (inboard) margin records the effect of the magmatic arc in the Rhodope region. The forearc basin sedimentary fills shoal upward into shallow-marine strata but are dominated mainly by deep-marine facies. The depositional trend and stacking pattern are dominated by progradational patterns. This trend, which is observed in both basin margins, is related to tectonic deformation rather than sea-level fluctuations. Additional evidence for this tectonic uplift comes from the backstripping analysis. The accretionary complex provided material into the forearc basin. This material was transported northeast and formed a sand-rich turbidity system that evolved upslope into shallow-marine deposits. Stratigraphic data indicate that this turbidity system exhibits a successive landward (inboard) migration of the depocenter. Provenance data utilizing sandstone petrography, conglomerate clast composition, and bulk-rock geochemistry suggest that this system reflects an increased influx of mafic material into the basin. Volcanic arc-derived material was transported south and east and accumulated in deep-marine settings. Both stratigraphic and provenance data indicate a seaward (outboard) migration of the basin depocenter and a significant increase in felsic detritus into the forearc.

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1. Introduction

Recognition of the relationship between subducting slabs and the development of sedimentary basins in the upper plate of convergent margins was a fundamental breakthrough in understanding the geodynamics of plate boundaries (Dickinson, 1995; Busby et al., 1998; Trop and Ridgway, 2007; Ridgway et al., 2012). Previous studies have documented the existence of a trinity consisting of a magmatic arc, forearc basin and accretionary complex, which develops as a first-order response to subduction along convergent margins (Dickinson and Seely, 1979; Ingersoll, 1983; Unruh et al., 2007; Trop, 2008). The stratigraphic evolution in the forearc basins provides an excellent record of subduction-driven processes, such as flat-slab subduction of spreading ridges and thick oceanic crust (Ridgway et al., 2012), construction of accretionary prisms, and growth of magmatic arcs (Mitchell et al., 2010; Ridgway et al., 2012; Maravelis and Zelilidis, 2013). Several recent studies have focused on the interplay between arc magmatism, accretionary prism exhumation, and sediment deposition in forearc basins (DeGraaff-Surpless et al., 2002; Clift et al., 2005; Fildani et al., 2008; Maravelis and Zelilidis, 2010a; Williams and Graham, 2013).

The Hellenic subduction zone in the Aegean is one of the best examples worldwide of a retreating plate-boundary zone (e.g. Royden, 1993; Ring and Layer, 2003). Some generalized features of retreating subduction zones are well-expressed extensional faults forming intra-arc and back-arc basins (e.g. Ring et al., 2010). Therefore, it is assumed that the exhumation of high-pressure metamorphic rocks in the Aegean, was chiefly accomplished by normal faulting in an intra-/back-arc

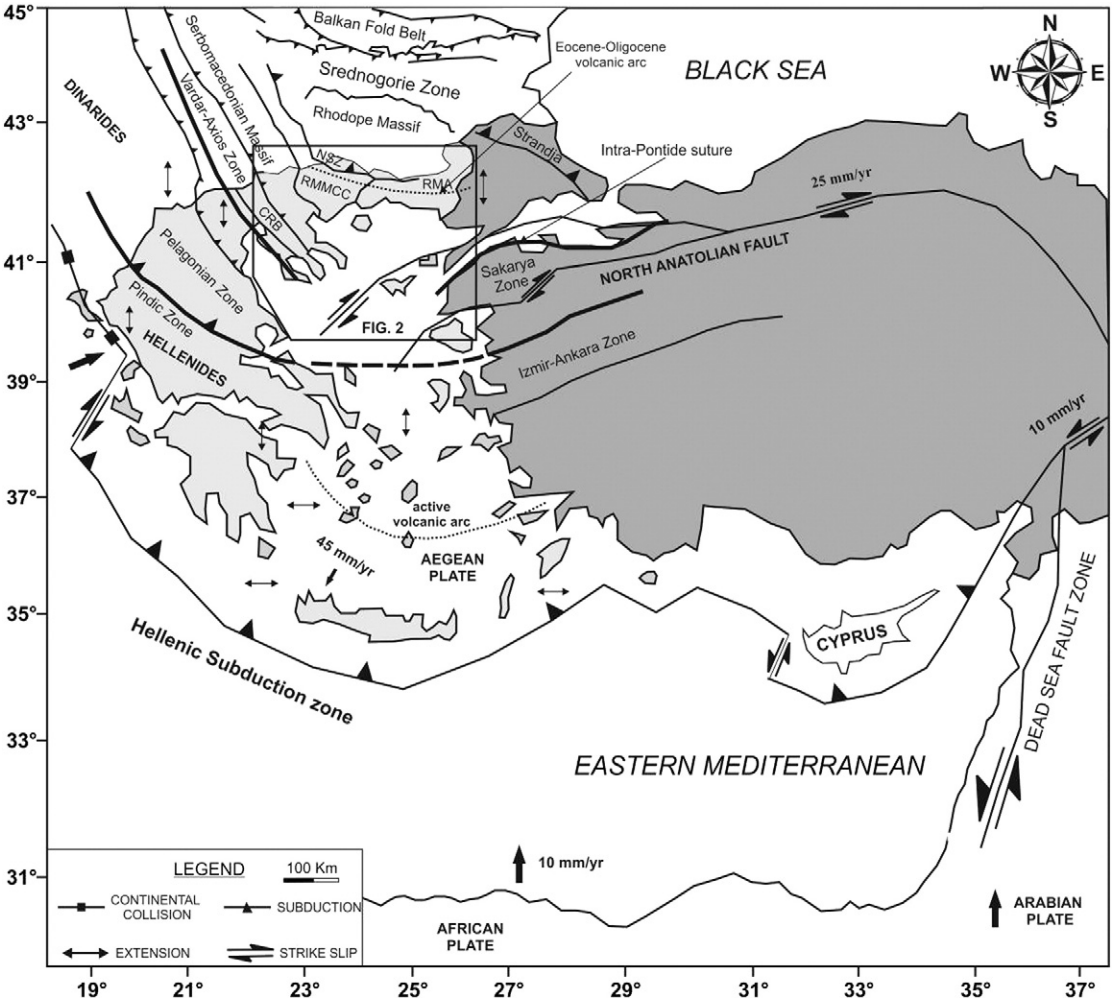

Fig. 1. Map depicting the plate tectonic configuration of the eastern Balkan Peninsula and the position of the study area in relation to the main Alpine orogenic elements of the region (from Dimitriadis et al., 1998; Maravelis and Zelilidis, 2013; Tranos and Lacombe, 2014). CRB: Circum–Rhodope belt, RMA: Rhodopian magmatic arc, RMMCC: Rhodope massif metamorphic core complex, NSZ: Nestos shear zone.

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