



Beachrock formation on the coast of Gökçeada Island and its relation to the active tectonics of the region, northern Aegean Sea, Turkey



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ABSTRACT

There are beachrock formations in 5 different sections of the south coast of Gökçeada, Turkey's largest Aegean island. These beachrocks form two different groups in terms of layering characteristics, $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ stable isotope compositions, consecutive cementation structures, and ¹⁴C dating. The West Group beachrocks, to the west, were dated to 4010–5830 BP, while the East Group beachrocks were dated to 620–2390 BP. The beachrock formations in both groups are separated by the NE–SW-trending Uğurlu Fault. The Uğurlu Fault is a right lateral, strike slip with reverse component oblique fault, and is an active fault within the North Anatolian Fault Zone. In the period between the formation of the two beachrock groups (2390–4010 BP), an earthquake was responsible for the destruction of Gökçeada Yenibademi mound and the development of two generations of beachrock.

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1. Introduction

Beachrocks are sedimentary structures forming as a result of cementation by calcium carbonate of coastal sediments in the tidal zone. Generally they are observed where there is warm sea water in tropical and subtropical regions (Russel and McIntire, 1965; Scoffin and Stoddart, 1987; Pirazzoli, 2007; McLean, 2011). While the first studies of beachrocks determined the formation environments in tropical and subtropical belts (Ginsburg, 1953; Russell, 1959; Russel and McIntire, 1965), later studies recognized the presence of beachrocks in temperate (Zenkovitch, 1967; Rey et al., 2004) and cold regions (Binkley et al., 1980; Kneale and Viles, 2000).

Attempts have been made to explain the cementation of beach sediments forming beachrock by very different processes such as evaporation, mixing of water masses with different characteristics and microbiological activity (Ginsburg, 1953; Stoddart and Cann, 1965a,b; Taylor and Illing, 1969; Schmalz, 1971; Thorstenson et al., 1972; Hanor, 1978; Krumbein, 1979; Strasser et al., 1989; Molenaar and Venmans, 1993; Bernier et al., 1997; Turner, 2005; Vousdoukas et al., 2007). On coasts with micro tidal conditions (between 0 and 2 m), cemented beachrocks have been shown as

criteria to determine past sea level (Thomas, 2009) and due to these characteristics they have been widely used for sea level changes (Hopley, 1986; Kelletat, 2006; Pirazzoli, 2007; Vousdoukas et al., 2007). In the Mediterranean, which has micro tidal amplitudes, beachrocks have a widespread distribution and in this area beachrocks have been obtained for use as an indicator to determine sea level changes (see Ginsburg, 1953; Boekschoten, 1962; Goudie, 1969; Friedman and Gavish, 1971; Alexandersson, 1972a,b; Beier, 1985; Holail and Rashed, 1992; Bernier and Dalongeville, 1996; El-Sayed, 1988; Avşarcan, 1997; Yalıtırak et al., 2002; Fouache et al., 2005; Morhange et al., 2006; George et al., 2006; Vousdoukas et al., 2007; Sanlaville et al., 1997; Ertek et al., 2008; Çiner et al., 2009; Öztürk, 2013; Öztürk et al., 2013, 2015). On the coasts of the Aegean, which links the Mediterranean to the Black Sea, intense beachrock formation has been observed (Bernier and Dalongeville, 1998; Plomaritis, 1999; Ertek and Erginal, 2003; Makrykosta et al., 2006; Vousdoukas and Velegrakis, 2006; Erginal et al., 2008, 2010; Erginal, 2012; Erginal and Öztürk, 2012).

This study investigated beachrocks developed on the south coast of Gökçeada (north Aegean Sea) (Fig. 1). The presence of beachrock formations on Gökçeada were first reported by Erginal and Ertek (2009) on the southwest of the island near Kapıkaya (Fig. 1c; L5 locality). The researchers examined samples obtained from this location using SEM-EDX and thin section analyses to reveal the micromorphology of the cement in the beachrocks. Accordingly, the cementation characteristics and cement

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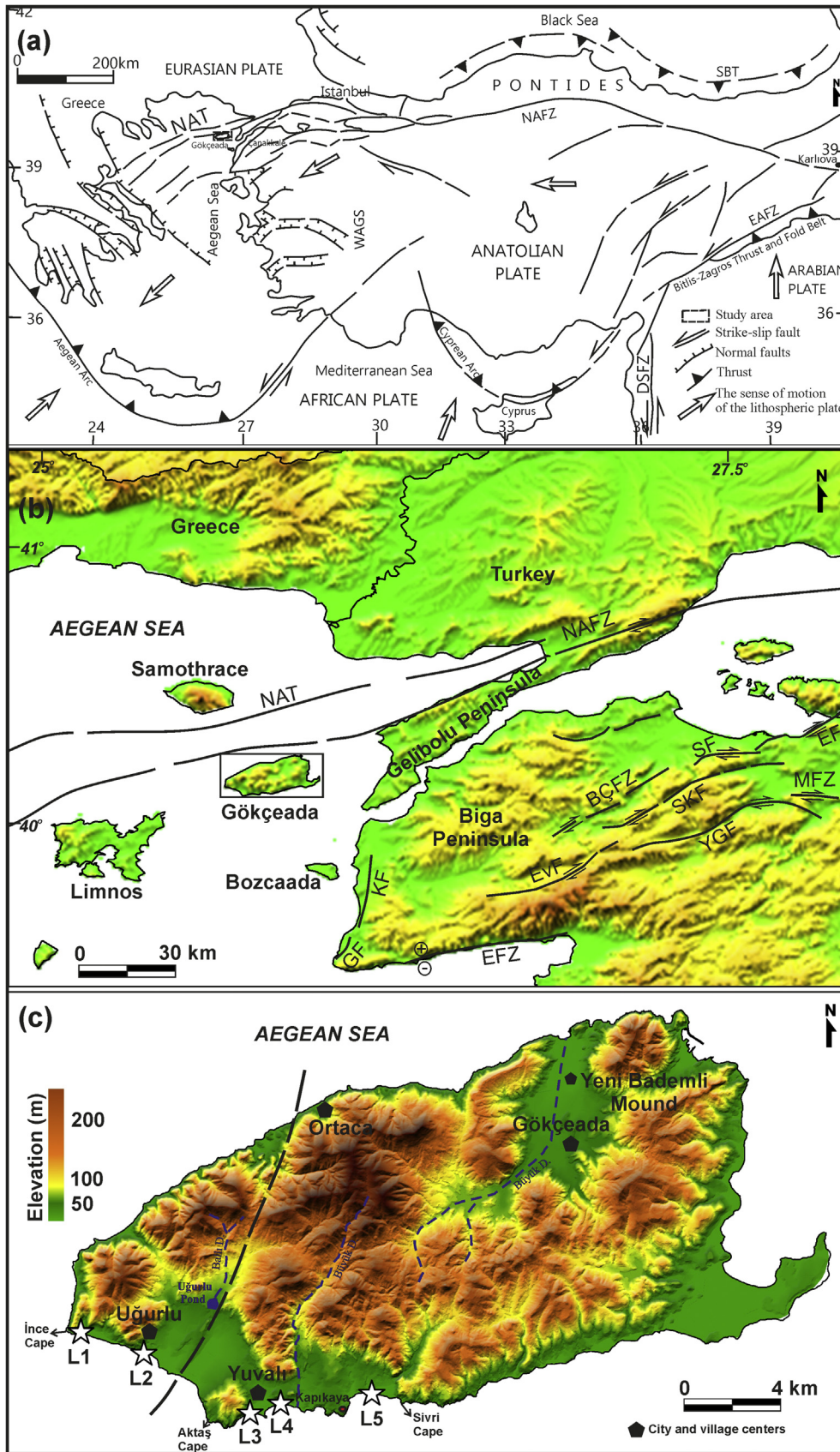


Fig. 1. Geologic-morphologic characteristics of study area and surroundings; **a)** map showing main neotectonic elements found within the study area (from Yigitbaş et al., 2004); **b)** Digital Elevation Model (DEM) showing morphology and active faults in the North Aegean region; and **c)** DEM image showing locations of beachrock identified on Gökçeada and the Uğurlu Fault. Abbreviations and explanations; BCFZ: Biga-Çan Fault Zone, DSFZ: Dead Sea Fault Zone, EAFZ: East Anatolian Fault Zone, EF: Edincik Fault, EFZ: Edremit Fault Zone, EvF: Evciler Fault, GF: Gülpınar Fault, KF: Kestaneli Fault, MFZ: Manyas Fault Zone, NAFZ: North Anatolian Fault Zone, NAT: North Aegean Trough, SBT: Southern Black Sea Thrust, SF: Sinekçi Fault, SKF: Sarıköy Fault, WAGS: West Anatolian Graben System, YGF: Yenice-Gönen Fault.

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