



RESEARCH ARTICLE

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The Impact of Coastal Road Construction on Kıyıcık Landslide (Artvin, Türkiye) in December 2024

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Abstract

Steep slopes along narrow-high coastlines are highly susceptible to slope hazards due to road construction and quarrying activities. On December 8, 2024, a landslide occurred on the southern slope of the Black Sea Coastal Highway near the Kıyıcık locality in the Arhavi district (Artvin, Türkiye). This landslide resulted in the loss of four lives and led to the temporary closure of the Black Sea Coastal Highway, which is of both national and international importance. This study aims to investigate the role of the Black Sea Coastal Road construction in triggering the Kıyıcık landslide. The research utilizes historical aerial photographs, high-resolution drone imagery obtained after the landslide, a 1:25,000 scale topographic map, and climate records from 1962 to 2022. X-ray diffraction (XRD) analysis was conducted to determine the mineral composition of the landslide mass, and spatial analyses were performed using Remote Sensing and Geographic Information System (GIS) technologies. The weathering effect of marine moisture and wind on the narrow-high coastal slope, and the erosion effect of heavy waves in stormy weather overtopping the road platform and reaching the slope are natural processes. The landslide mass comprises saprolite and lateritic regolith—products of the chemical weathering of mafic volcanic rocks. Road construction and quarrying operations have increased slope steepness, fracture density in the mafic volcanic rocks, and the intensity of chemical weathering processes. A total of 244.4 kg/m² of rainfall and infiltration between November 16 and 29, 2024, caused water accumulation in the loose regolith, increasing the static load and triggering a translational earth landslide. Tension cracks and fissures observed in the area indicate that the landslide remains active, highlighting the need for further risk mitigation measures.

Keywords Narrow-high coast, Coastal Road, Landslide, Artvin (Türkiye)

1 Introduction

At 03:15 AM on the night of December 8, 2024, a significant mass movement occurred on the steep southern slope of the Black Sea Coastal Highway (D010) at the Kıyıcık locality in the Arhavi district (Artvin, Türkiye) (Lat. 41.3376°, Lon. 41.2665°, Elev. 255 m), resulting in multiple fatalities (Fig. 1) (Altunöz and Okur 2024;

Arhavi 2024; Artvin 2024; Görüm et al. 2025). Four individuals lost their lives after being trapped in their vehicles under the displaced landslide material (Altunöz and Okur 2024; Özkaya 2024). The landslide debris, composed of loose saprolite and lateritic regolith formed by weathering, slid down and blocked the Black Sea Coastal Highway—disrupting two-way traffic between Artvin and Trabzon. The D010 highway is vital for national transportation and trade and serves as a strategic international corridor, providing Türkiye with a direct connection to Georgia (Fig. 1).

The 190-km-long Trabzon–Sarp section of the Black Sea Coastal Highway (D010) traverses a predominantly

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