

**Key Points:**

- The migration of drainage divides on horsts is shaped by the competition between gradient in uplift and erosional contrast
- Discrepancies between χ and Gilbert metrics highlight the need for comprehensive assessments with erosion rates, to interpret main drainage divide migration
- Findings provide empirical support for modeling studies of drainage divide migration driven by asymmetric uplift in a natural setting

Supporting Information:

Supporting Information may be found in the online version of this article.

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Drainage Divide Migration on Asymmetrically Uplifted Horsts, Western Türkiye

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Abstract The migration of a main drainage divide is pivotal in landscape evolution, providing key insights into how tectonic and erosional processes shape landscapes. However, the dynamics of divide migration in response to asymmetric uplift and erosion are not well constrained in natural settings compared to modeling studies. This study examines drainage divide migration in response to gradient in uplift and erosional contrast in the horst systems of the western Anatolia Extensional Province, Türkiye. Using 11 new cosmogenic ¹⁰Be-derived erosion rates and topographic metrics, we demonstrate that differing positions of main drainage divides result from variations in uplift gradient and erosional contrast, despite the simultaneous exhumation of horsts under the same extensional regime. The findings show that Madran Horst's main drainage divide is closer to its more uplifted eastern flank and is controlled by a higher uplift gradient between the flanks. The higher erosion rates in the eastern flanks suggest a quasi-steady-state equilibrium in which the high erosional contrast between the flanks and the gradient in uplift is already balancing each other as supported by Gilbert metrics in contrast to χ . In contrast, the Karıncalıdağ Horst's main drainage divide is approaching its geometric center supported by closer values in χ anomalies, stability in Gilbert metrics, and a decreasing gradient in uplift between flanks. Although the main drainage divide is close to the geometric center, higher erosion rates in the eastern flank suggest ongoing erosion-driven migration. This study provides empirical evidence for drainage divide migration driven by asymmetric uplift and erosional contrast.

Plain Language Summary Drainage divides, which separate different drainage basins, are crucial for understanding how landscapes evolve. While modeling studies have highlighted how uplift and erosion drive divide movement, natural examples supported by geochronological evidence remain scarce. This study examines how gradients in uplift and erosion influence drainage divides in the horst systems of western Türkiye. Using erosion rates derived from cosmogenic ¹⁰Be and topographic metrics, we demonstrate that divide locations are determined by the competition between uplift gradients and erosional contrasts. On the Madran Horst, the divide is positioned closer to the more uplifted eastern flank. In contrast, on the Karıncalıdağ Horst, a balance between erosion and gradient in uplift places the divide nearer to the center.

1. Introduction

A drainage divide is a boundary that separates different drainage basins and directs the flow of surface water. Drainage divides are not static but are highly mobile, with a horizontal migration rate typically less than 1 mm a⁻¹ (He et al., 2024). The migration of a main drainage divide significantly influences landscape evolution (Cowie et al., 2006; Forte & Whipple, 2018; Goren et al., 2014; He et al., 2021; Stark, 2010; Willett et al., 2014). Drainage divide migration also alters drainage area, sediment flux, and stream power, thereby impacting erosion processes during drainage evolution, which has become a significant research focus in recent years (He et al., 2024; Hoskins et al., 2024; Scherler & Schwanghart, 2020; Stokes, Larsen, et al., 2023; Whipple et al., 2017). The movement of a drainage divide indicates differences in cross-divide erosion rate or uplift rate (Whipple et al., 2017). Erosion rates across the divide, are largely governed by factors such as uplift (Forte et al., 2015; Goren et al., 2014; Shi et al., 2021; Sinclair et al., 2017; Whipple et al., 2017), precipitation (Bonnet, 2009; Cooper & Beck, 2009; Willett, 1999), lithology (Buscher et al., 2017; Zondervan et al., 2020), and the occurrence of landslides (Dahlquist et al., 2018; Wang et al., 2020). Among these, the uplift stands out as a pivotal force influencing the migration of the main drainage divide and its associated cross-divide erosion rates in mountainous landscapes (He et al., 2019). Therefore, studying main drainage divide migration is crucial, as it not only enhances the extraction of tectonic information from the topography but also lays the foundation for studying the interaction between