

Origin of contorted convergent plate boundaries: insight from the Kazakhstan Orocline in the Central Asian Orogenic Belt

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Curved plate boundaries, which are commonly referred to as oroclines and result from bending of quasi-linear orogenic belts, have fascinated generations of geologists since 1950s. Such structures are widely recognized in the late Paleozoic global orogenic systems (e.g. the Tasmanides of eastern Australia, the Central Asian Orogenic Belt and the European Variscan Belt), and their origin is fundamentally important for understanding the geodynamics of convergent plate boundaries and the mechanisms that drive orogenesis and the assembly of the supercontinent. In this contribution, we focus on the Kazakhstan Orocline in Central Asia with an aim at understanding the geodynamics of oroclinal bending along convergent plate boundaries. This orocline is delineated by U-shaped arc systems that were quasi-linear prior to the Late Devonian as demonstrated by paleomagnetic studies. The development of the Kazakhstan Orocline was previously attributed to bucking of linear orogenic belts in response to the amalgamation of the Siberian and Tarim cratons. However, our work demonstrates that oroclinal bending initiated prior to the collision of the Siberian Craton with the northern limb of the Kazakhstan Orocline in the latest Carboniferous, and major phase of oroclinal bending occurred during subduction in the Late Devonian to Early Carboniferous. Alternatively, we suggest a new subduction-related tectonic model that involves major phase of oroclinal bending ($\sim 120^{\circ}$) driven by along-strike variation in rollback, similarly as the bending of the New Hebrides Arc in Southwest Pacific. A further $\sim 60^{\circ}$ bending may have been triggered by the Late Carboniferous to Permian amalgamation of Siberian, Tarim and Baltic cratons. The new tectonic model builds a link for oroclinal bending with the subduction dynamics, and highlights the role of trench retreat in the formation of oroclines in accretionary orogens.

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