Uniformitarianism and the Laramide Orogeny of the Wyoming Craton: The Present is the Key to the Past, and the Past…

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ABSTRACT

Seismic studies (COCORP, Deep Probe, and EarthScope BASE) have provided a better understanding of Laramide tectonism at deeper crustal levels. However, deformational mechanisms in the upper crust related to Laramide orogenisis remain unclear. Internal controls of Laramide tectonism in the upper crust have been proposed to be related to basement anisotropies, which may be linked to evolution of foreland arches at deeper crustal levels and structures seen at the surface. This study presents a structural and tectonic analysis of Precambrian anisotropies of the Wyoming craton and provides a hypothesis on the potential role of these features in Laramide orogenisis. Anisotropies are generally oriented in three directions: north-northwest, west-northwest, and northeast. They have a complex and long history of deformation since the Precambrian, most recently, during the Laramide. This work provides evidence for development of long-lived Neoarchean zones of convergence dominantly directed from the southwest towards the craton forming north-northwest weakness zones, as shown from modern analogs. In addition, northeast-southwest-directed pure-shear compressional forces from convergence are postulated to have formed west-northwest- and northeast-trending anisotropies in the form of conjugate shears, again supported by modern convergence zone deformations. It is proposed that these structures were reactivated throughout Laramide contraction, forming discrete zones of transpression that were displaced along a southwest- to northeast-directed Laramide deformational front. In the Wyoming transpressive zone, west-northwest structures were displaced as reverse/left-lateral oblique-slip faults and, where connected, acted as lateral ramps facilitating major arch development along the north- northwest-trending structures. In the Montana transpressive zone, where north-northwest basement anisotropies are not present, reverse-sinistral slip occurred along west- northwest basement-seated faults without the associated vertical slip seen in Wyoming. Basement-seated faults are expressed at the surface as oblique, left-slip reverse faults (west-northwest deformational zones in Wyoming/Montana), high-angle right-slip faults (northeast deformational zones in Wyoming/Montana), and low-angle reverse faults/thrust faults (north-northwest arches generally only in Wyoming) that are interconnected in a convergent deformation system that likely includes the Black Hills. This deformation system is postulated to be a fundamental tectonic feature controlling formation of Laramide arches/uplifts of the Wyoming craton.