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Mechanisms for Ancestral Rocky Mt. Intraplate Deformation – Preliminary Evaluation of Coupled Convergent/ Divergent Margin Processes and End Loading

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The intraplate Ancestral Rocky Mountains of western North America stretch >6,000 km from British Columbia, Canada to Chihuahua, Mexico and formed as a result of continent-continent collision of Laurentia with the conjoined African and South American plates during Early Carboniferous through Early Permian time. Yucatán and Florida were elements of the encroaching Gondwanan mass. Basement shear zones that formed during Mesoproterozoic rifting of Laurentia were reactivated and exerted significant control on the locations, orientations, and modes of displacement on late Paleozoic faults. The structural style was characterized by rapid uplift and formation of flanking basins; normal, high-angle reverse, and strike-slip faults bound the principal structural elements. Uplifts are interpreted to have been 3 to 4 km high, and preserved thicknesses of basin fill range from 2,300 to 6,000 m. At the same time that Gondwana was colliding with the southern and eastern margin of Laurentia, extension was occurring along the western margin, and Late Paleozoic extension-related mafic lava flows have been mapped in the Toiyabe Range of central Nevada (Smith and Miller, 1990). Counterpart marginal (Atlas, Mauritanides) and intraplate (Reguibat and Gargaf uplifts, Ougarta Adrar basin) structures developed in northwestern Africa during that episode.

The Tien Shan chain (central Asia) began forming within the Eurasian plate in late Miocene time, in response to the ongoing collision of India with Eurasia; the complex lies 1,000- 2,000 km inboard from the Indian-Eurasian collisional boundary. Approximately 40 percent of the shortening that has occurred between the two continental masses during the past 11 Ma can be accounted for in the Tien Shan (Bullen et al., 2001). Ranges and intermontane basins of the Tien Shan span ~2,350 km with an average breadth of ~350 km; ranges attain elevations on the order of 4 km. Basin-bounding faults dip ~45° to 50° and extend to mid-crustal levels (~18 km); hanging-wall transport is greatest along block margins farthest from the continental collisional front; seismicity is high. Thick synorogenic strata (~6,000 m) have accumulated in flanking basins. Far inboard from the collisional front, E-trending Mesoproterozoic-Cambrian extensional structures are undergoing reverse and strike-slip reactivation during Tien Shan deformation. While India continues to collide with Eurasia and the Tien Shan evolve, extension/transtension is occurring north of the Tien Shan in the Baykal and Hövsgöl rifts and in Shansi graben.

These data from the Tien Shan and Ancestral Rockies permit consideration of an eastern driving force for at least some mid-Cambrian Pampean tectonism in western Gondwana. The ~450-km-wide Pampean orogenic belt of penetrative folding, met- to peraluminous granite plutonism, and low- to high-grade metamorphism extends ~800 km from northern Chile to central Argentina.

Collision of Africa with SE Brazil, the Rio Doce orogeny (Campos Neto and Figueiredo, 1995) was coeval with Pampean tectonism and may have driven deformation ~1,500 km inboard from the eastern collisional margin. A passive margin prevailed on the west, and collision of Laurentian fragments (Cuyania, Chilenia) did not occur until Late Ordovician time or later (Pankhurst and Rapela, 1998).

Investigations of intraplate deformational mechanisms are now focussed on the dynamic interaction of synchronous convergent- and divergent-margin processes (England and Houseman, 1988; Smith and Miller, 1990). Aeromagnetic data from Kazakhstan and western North America are being examined, particularly in light of the late Paleozoic mafic lava flows reported from the Toiyabe Range. Potential fields data also provide insight into basement-rooted structures and their reactivation.

Regarding far-field stress propagation, a modification of an end-loading model proposed by Maxson and Tikoff (1996) is being evaluated, in which a converging continent takes the place of a terrane end load. As continental collision progresses a thickened litho-spheric root might develop (>50 km in the Himalayas); driven by the encroaching continent, the root could function as a bulldozer that deforms the lithospheric mantle and the overlying crust by long-wave-length buckling (Tikoff and Maxson, 2001).

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