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Broken foreland basins and the influence of flat slab subduction, crustal inheritance, climate, and erosion

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Compartmentalized or broken foreland basins are fundamental components of many convergent margins. Partitioning of collisional and retroarc foreland basins by basement-involved uplift has been linked commonly to flat-slab subduction, with an emerging appreciation for the important influence of: (1) regional and local inheritance of stratigraphic, structural, and crustal rheological heterogeneities; and (2) variations in climate, erosion, and sediment accumulation budgets. Shortening and basement uplift in broken foreland provinces greatly disrupts sediment routing patterns and preconditions vast regions for later phases of intracontinental deformation. Despite the wide range of settings in which broken foreland basins are recognized, there is limited understanding of the processes and controls on the common temporal transition from a single regionally integrated flexural foreland basin to a broken or compartmentalized foreland basin. We explore the stratigraphic, structural, sediment routing, and geodynamic evolution of several broken foreland systems to identify the key elements involved in the development of ancient and modern examples and to better assess the competing influences of flat-slab subduction, crustal inheritance, climate, erosion, and sedimentation. Broken foreland basin systems in ocean-continent convergent systems include the modern Central Andes of South America and the Late Cretaceous-Paleogene Laramide province of North America. In continent-continent collisional systems, broken foreland basins have been reported for both the downgoing and overriding plates (pro- and retro-wedge basins), including the Cenozoic Duero basin associated with the Spanish Pyrenean orogenic system and Mesozoic-Cenozoic basins of the Tibetan plateau within the India-Asia collision zone. A review of proposed broken foreland basins identifies some common stratigraphic and structural elements as well as some potential pitfalls, including the misinterpretation of ancient broken forelands in cases where foreland shortening was insufficient to generate positive topographic features capable of disrupting a contiguous (unbroken) foreland basin.