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Dynamics and the Wilson Cycle: An EarthScope vision

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Wilson's model has two major components, each with distinctive observables. Initial subduction of ocean lithosphere collides continents across a closing ocean basin, creating a mountain range; rifting then initiates within the collisional orogeny and progresses to create oceanic spreading and creation of a new ocean basin. Subduction eventually initiates near the old, cold, and heavily sedimented continental margin, leading to subduction, and repeating the cycle. This model is largely kinematic in nature, and predictive in application. We re-evaluate the Wilson Cycle in light of process-oriented perspectives afforded by the surface to mantle Earthscope results. Repeating episodes of mountain building by means of continental collisions remains clear, but new observations augment or diverge from Wilson's concepts. A 'new' component stems from observations from both the East and West coasts: translational fault systems played critical roles in continental accretion, collision, and rifting. Earthscope data sets also have enabled imaging of the structure of western U.S. lithosphere with unprecedented detail. From new and existing data sets, we conclude that collision occurs in 'ribbons' in large part linked to the shapes of the landmasses colliding landmasses, and deformation includes a major component of transform tectonics. Post-orogenic gravitational collapse may occur far inboard of the site of collision. A third 'new' feature is that plate coupling with the mantle leads to deformation outside the classic Wilson Cycle. For example, the passive margin of eastern N. America shows tectonic activity, uplift, and magmatism long after the onset of seafloor spreading, demonstrating the dynamic nature of lithosphere-asthenosphere coupling. A 'fourth' observation is that lateral density contrasts and volatile migration during subduction and collision effectively refertilize mantle lithosphere, and pre-condition later tectonic cycles.