

Do continental lithospheric discontinuities control tectonic plate motion directions?

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Abstract

Plate-tectonic reconstructions use Euler poles about which plates rotate in small circle patterns. These small circle patterns are outlined by oceanic transform faults and contiguous fracture zones. Because oceanic lithosphere older than ~200 Ma is preferentially destroyed by subduction, pre-Mesozoic plate-tectonic reconstructions lack such constraints from oceanic fracture zones. Based on high-resolution bathymetry, geological and geophysical data, some fracture zones are shown to be contiguous with pre-existing discontinuities in adjacent continents. Combined with results from published analog and numerical models, continental rift zones and oceanic spreading ridges that are initially oblique to these discontinuities are demonstrated to evolve into orientations perpendicular to them, while fracture zones and transform faults develop parallel to them. Consequently, oceanic spreading directions, or plate movement directions, are controlled by pre-existing continental lithospheric discontinuities. This hypothesis constitutes a paradigm shift, from the widespread belief that transform fault and fracture zone orientations are controlled by plate motions, to one where they are inherited from pre-existing continental discontinuities, and control plate movement directions. If so, identifying such discontinuities in ancient continental lithosphere may constrain plate motions in deep geologic time.