T33B-4665: 3D Numerical Model of Continental Breakup via Plume Lithosphere Interaction Near Cratonic Blocks: Implications for the Tanzanian Craton

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Although many continental rift basins and their successfully rifted counterparts at passive continental margins are magmatic, some are not. This dichotomy prompted end-member views of the mechanism driving continental rifting, deep-seated and mantle plume-driven for some, owing to shallow lithospheric stretching for others. In that regard, the East African Rift (EAR), the 3000 km-long divergent boundary between the Nubian and Somalian plates, provides a unique setting with the juxtaposition of the eastern, magma-rich, and western, magma-poor, branches on either sides of the 250-km thick Tanzanian craton. Here we implement high-resolution rheologically realistic 3D numerical model of plume-lithosphere interactions in extensional far-field settings to explain this contrasted behaviour in a unified framework starting from simple, symmetrical initial conditions with an isolated mantle plume rising beneath a craton in an east-west tensional far field stress. The upwelling mantle plume is deflected by the cratonic keel and preferentially channelled along one of its sides. This leads to the coeval development of a magma-rich branch above the plume head and a magma-poor one along the opposite side of the craton, the formation of a rotating microplate between the two rift branches, and the feeding of melt to both branches form a single mantle source. The model bears strong similarities with the evolution of the eastern and western branches of the central EAR and the geodetically observed rotation of the Victoria microplate. This result reconciles the passive (plume-activated) versus active (far-field tectonic stresses) rift models as our experiments shows both processes in action and demonstrate the possibility of developing both magmatic and amagmatic rifts in identical geotectonic environments.

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