Remelting the Gondwanan Mantle

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The Marion Rise on the SW Indian ridge is one of the two largest oceanic rises. Sampling shows SWIR crust is generally thin and discontinuous, even over the rise. Thus, in the absence of thickened crust, the Marion Swell at the top of the rise should be supported by previously melted buoyant depleted mantle. Though basalts and peridotites are more refractory up the rise, the degree of melting inferred from peridotite Cr spinel and basalt $Na_{8.0}$ is only moderate. The peridotites, however, have substantially lower bulk alumina than those sampled to the east and west. Thus, the Marion platform mantle source must be garnet-poor and therefor highly buoyant. This requires removal of high silica melts during the earlier melting, causing excess pyroxene depletion, consistent with a hydrous back-arc or arc environment.

Plate reconstructions shows the Marion Swell corresponds to mantle pulled from beneath the Pan-African Orogenic Belt, during breakup of Gondwana, while SWIR mantle to the east and west originated beneath Archean cratonic lithosphere. The Pan-African Orogenic belt is a 650 to 500 Ma ~1000-km wide terrain consisting of accreted micro-continental fragments and juvenile island arcs formed by subduction and basin closure. The major suture zones bounding the belt are strike-slip zones due to southward-directed escape tectonics. These were re-occupied during Gondwana rifting, and now bound the Marion Swell as the Andrew Bain and Gallieni Fracture Zones. Thus, the Marion Rise is likely the product of delamination of old arc-related lithosphere along with the Marion, Crozet, and Reunion Hotspots.