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Translation and rotation of crustal blocks in the southernmost Atlantic region prior to seafloor spreading: in search of a mechanism.

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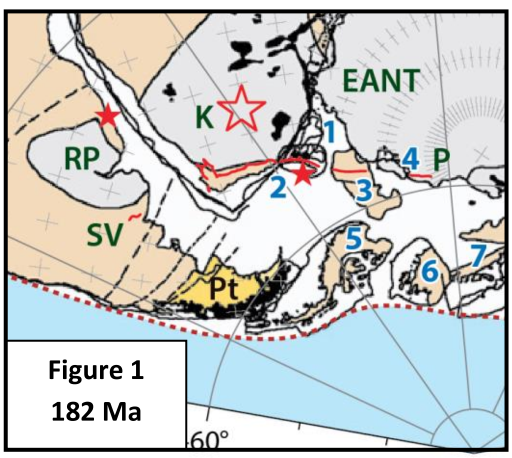
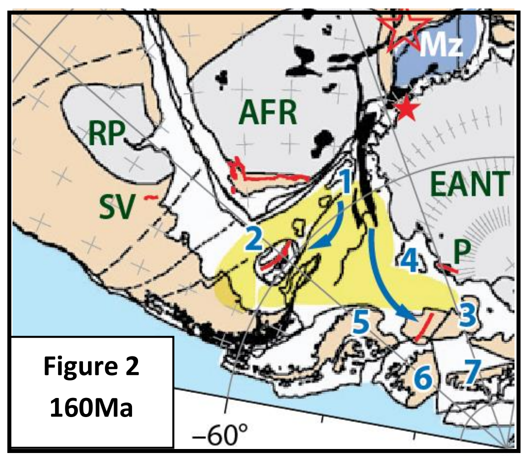
Geological and paleomagnetic data accumulated over many decades strongly indicate that initial fragmentation of the Gondwanaland supercontinent in the southernmost Atlantic-Weddell Sea region involved translation and rotation of two small crustal blocks. It is now well established that the Falkland/Malvinas block on the South American plate (F/M) and the Ellsworth-Whitmore mountains block in West Antarctica (EWM) both contain segments of the earliest Mesozoic Gondwana fold belt. As originally proposed by Adie [1] and Schopf [2] the blocks were both derived from the Natal embayment between the Cape Mountains of southernmost Africa and the Pensacola Mountains of the East Antarctic craton margin (Figure 1). Shortly after the emplacement of the Karoo-Ferrar large igneous province (LIP) at ca. 182Ma, the F/M block was rotated clockwise ~150 ° and the EWM block counterclockwise ~90°, while both were translated at least several hundred kilometers towards the Panthalassic/Pacific Ocean (Figure 2). As indicated by the absence of any shortening in the sedimentary basins of the F/M Plateau and Weddell embayment, the motions of the crustal blocks relative to the major continents seem to have taken place during a phase of extreme extension accompanied by widespread silicic magmatism that preceded seafloor spreading.





Reconstructions [3]. Cratons–gray (RP–Rio de la Plata; K–Kalahari; EANT–East Antarctic. Gondwana fold belt–red line (SV–Sierra de la Ventana; P–Pensacola Mts. Karoo-Ferrar LIP–black. Red stars–hot spots [see 3 for explanation]. 1. Maurice Ewing Bank; 2. F/M block; 3. EWM block; 4. Berkner Is.; 5. Antarctic Peninsula; 6. Thurston Is. block; 7. Marie Byrd Land block. PT-Patagonia. Dashed line is Panthallasic /Pacific margin subduction zone. Yellow in Fig. 2–approximate extent of Late Jurassic siliceous volcanics. Blue arrows in Fig. 2 show movement of F/M and EWM blocks. Darker blue in Fig. 2 is oceanic lithosphere of Mozambique basin (Mz).

The outstanding question remains: what geodynamic processes were involved in the significant translation and rotation of the F/M and EWM blocks prior to the onset of seafloor spreading in the region? There is an unresolved structural problem with these motions, as both blocks move towards other continental fragments. For instance, the F/M block moved significantly closer to the South American continent without any sign of shortening in the intervening Austral basin. We will explore several explanations such as low-angle detachments, oroclinal bending and mantle flow on the basis of geologic and geophysical data and geodynamic modeling.

References:
[1]Adie R (1952) Geol Mag 89: 401-410
[2] Schopf J (1969) Science 164: 63-66
[3] Dalziel I et al. (2013) Annual Rev Earth Planet Sci 41:767-793