Effects of prolonged volcanic activity of the Paraná continental flood basalts on the paleogeography, salt geochemistry and presalt oil resources of the South Atlantic rift

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The recent discovery and intense exploration of giant oil deposits in Early Cretaceous presalt sediments of the South Atlantic rift offshore Brazil (Santos, Campos and Espírito Santo Basins), adjacent to the Paraná Continental Flood Basalt province, has thrown a new light on the complex interaction between continental flood basalts, rift evolution, and rift lake chemistry. Rifting started in the uppermost Jurassic to lowermost Cretaceous with the deposition of fluvial, fresh water lacustrine and then saline lacustrine terrigenous sediments. The continental Paraná flood basalts were dated onshore at 134.6±0.6 Ma (Thiede and Vasconcellos, 2010, *Geology*), possibly related to the Valanginian Weissert Oceanic Anoxic Event. Offshore, basalt volcanism in the rift continued intermittently to 115 Ma, intercalating with presalt sediments. The flood basalts, associated with dikes, sills, and thermal uplift, blocked the entrance of sea water from the south into the southward widening rift. The main source of sediments changed from Proterozoic granites and Paleozoic sandstones to basalts. Farther out into the rift lake, terrigenous sediments gave place to the deposition of thick lacustrine limestones, dolomites, and Mg-silicates from solutions rich in Ca, Mg and silica supplied by the eroding basalts. In latest Aptian time, the entry and repeated desiccation of sea water under an arid climate led to the deposition of stratified salt, several km thick. Ca- and Mg-rich solutions from the eroding basalts, interacting with basin brines, caused the halite to be interlayered with the Ca-Mg chloride tachyhydrite. The subsequent leaching of the carbonates by CO_2 degassing from the basalts was essential to create the high-permeability oil reservoirs sealed by salt.

Mesoarchaean suprasubduction zone ophiolite in the Tartoq Group, SW Greenland

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The Tartoq Group comprises supracrustal rocks of dominantly volcanic origin in several discrete fault-bounded blocks. The main lithological units include: pillow lavas, dykes, gabbros, and serpentinites. Peak metamorphic conditions range from greenschist facies to upper amphibolite and lower granulite facies.

LA-ICP-MS U/Pb zircon age dating of an orthogneiss sheet that was intrusive into the supracrustal rocks yield a minimum age of 2.996 ± 0.006 Ga for the Tartoq Group.

The mafic metavolcanic rocks are dominated by tholeiitic basaltic compositions (MgO = 6-10 wt.% and FeO^T = 12-14 wt.%). They possess negative primitive mantle-normalised Nb-anomalies (Nb_N/La_N = 0.5-0.8). Pillow lavas, dykes and gabbros have similar flat chondrite-normalised REE patterns (La_N/Sm_N = 0.8-1.0), which together with serpentinite cumulate/mantle, indicate that they form a co-magmatic assemblage resembling that of an ophiolitic ocean floor sequence. La, Y, and Nb values are similar to those of modern back-arc basalts and Th/Yb vs. Nb/Yb also indicates a subduction zone component in the source of the volcanic sequence. The serpentinites have SCLM-like PGE patterns.

The structural relations combined with geochemical, and metamorphic data suggest that the Tartoq Group is a slab of Mesoarchaean suprasubduction zone oceanic crust, which after shallow subduction, was emplaced in an exhumation wedge, retrogressed by fluid input, imbricated with marginal orthogneisses, and folded and thrust into several tectonic slices and slabs with the orthogneisses.