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**Palaeontology, Pangaea and Plate Tectonics – Data before Models**

**Paleontología, Pangaea y Placas Tectónicas – Datos antes de Modelos**

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**Abstract.** Abundant samples of ancient/continental rocks and magnetic data suggest widespread presence of continent below the oceans. Pangaea was at least 50% larger than presently seen. Shallow water/terrestrial rocks show that some of this subsided in the Eocene or even as late as 5 Ma ago, thus resolving biodispersal problems raised by current plate tectonic reconstructions. Palaeontologists should prioritize their data over the latter.

Key words: continent, ocean, biodispersal

Palabras claves: continente, oceano, biodispersal

The early part of the 20<sup>th</sup> century credited palaeontological data as important evidence of former continuity of continents (Pangaea) prior to dispersal via continental drift. The latter met opposition until Plate Tectonic theory and continent dispersal driven by ocean ridge spreading became established around 1965. Since then, models of Pangaeian reconstruction, breakup and dispersal have become dogmatic. They fail to accommodate some animal and plant distributions and provoke complex explanations of biodispersal.

Some of the problems (more details in Hallam, 1967; Wegener, 1924):

- Catfish (freshwater) first appeared in the late Cretaceous (Campanian) and are present all over the world.
- Cichlids (freshwater) are present in S. America, Africa, Madagascar and India. The cichlids first appeared in the Eocene.
- *Heterotis niloticus* (freshwater) occurs in Africa, the Czech Republic, Finland, Poland, Denmark, Germany, UK, USA, S. America, China, Phillipines, Indonesia, India, Australia. \_First appeared in the Palaeocene – Eocene.
- The manatee (freshwater and shallow, warm seas) occurs in W. Africa, Florida, the Caribbean and Amazonia. Appeared in the Early Eocene.
- Early Eocene – Late Oligocene terrestrial mammals are “African” (Madagascar is supposed to have separated from Africa 70 m.y. earlier). The explanation is that they swam or floated across the 450 km wide Mozambique Channel (Rabinowitz & Woods, 2006).
- Cuban Eocene and Oligocene faunas are Old World.

The above are not consistent with plate tectonic models that show continents rifting and separating as long ago as the Jurassic - early Cretaceous (Wegener, 1924, concluded that components of Pangaea remained connected until the Late Mesozoic or later).

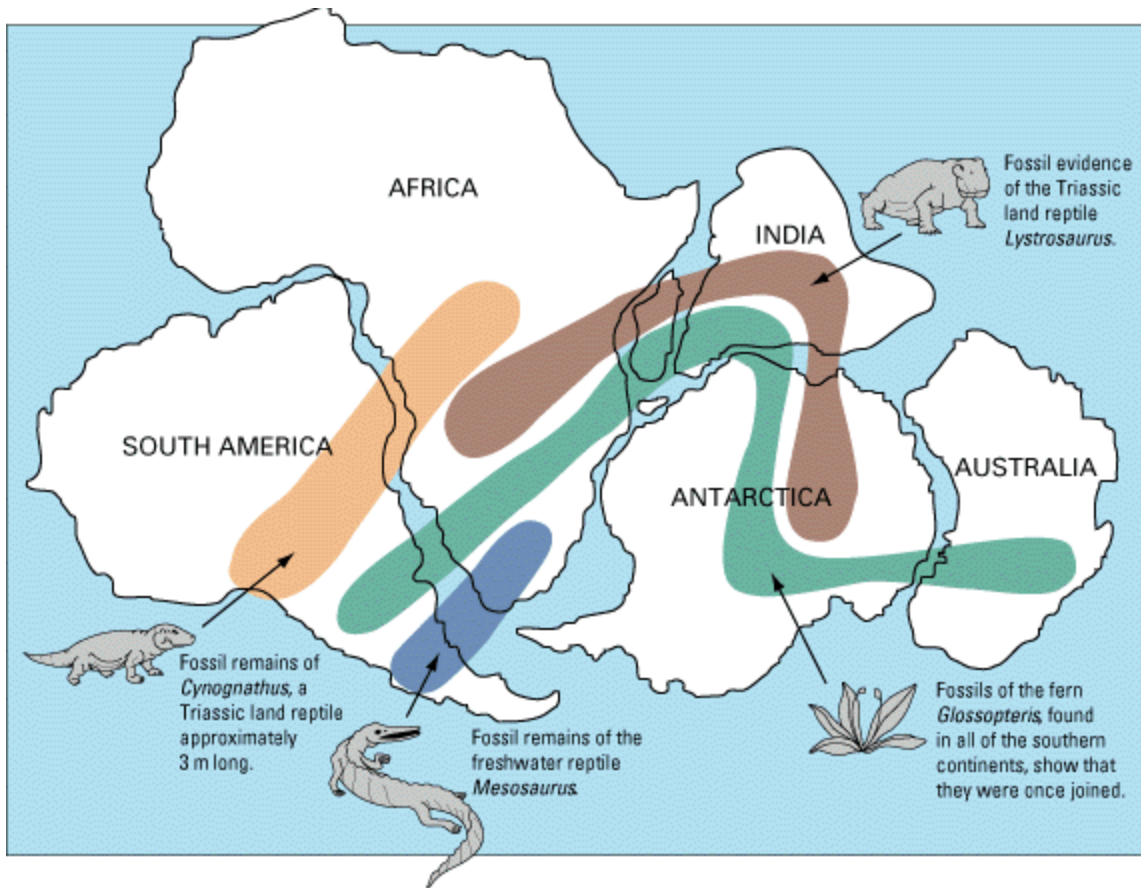


Figure 1. Classic, Snider-Pellegrini - Wegener Pangaeian reconstructions:

(<http://pubs.usgs.gov/gip/dynamic/continents.html>). Compare the S. America – Africa reconstruction with Fig. 5.

Plate Tectonic understanding of sea-floor spreading maintains that (Jurassic – Recent) crust below the oceans is basaltic, apart from local occurrences of extended continental crust adjacent to continents. However, abundant samples of continental material, some as old as Precambrian - Palaeozoic, have been cored and dredged from deep oceans (see compilations by Vasiliev & Yano, 2007; Yano et al., 2009, 2011). Moreover, mid-Jurassic to Miocene shallow-water deposits and sub-aerially weathered rocks occur at depths of one to seven kilometers in the Atlantic, Indian and Pacific, evidencing late and considerable subsidence (Ruditch, 1990). Palaeoproterozoic age zircons occur on the Laccadive–Chagos Ridge and Southern Mascarene Plateau (supposedly a volcanic chain formed over a mantle plume over the past 65.5 million year) in the north-central and western Indian Ocean, respectively, (Torsvik et al., 2013). Dredging and submarine

investigations found large masses of granite and quartz sand on the Rio Grande Rise (also a supposed hot spot track) in 2011, 2013 (Alden, 2013).

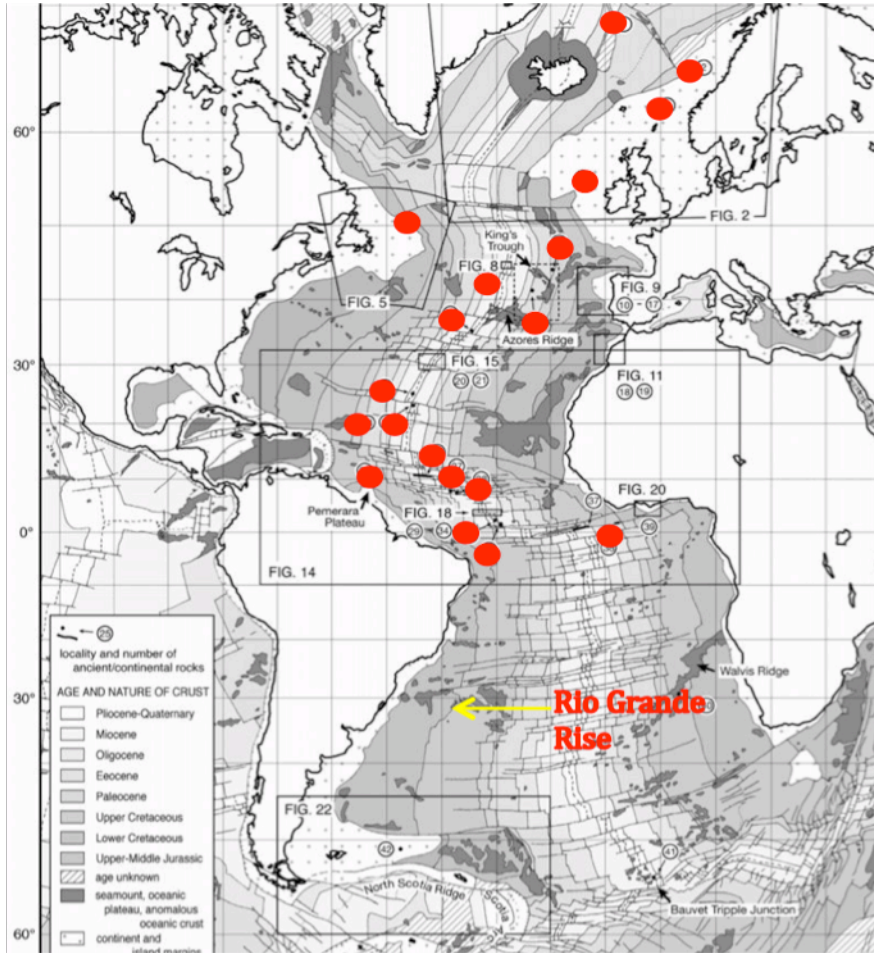


Figure 2. Locations of ancient and continental rocks retrieved from the Atlantic (Yano et al., 2009).

Magnetic stripes in oceanic crust are seen to be record reversals in the Earth's magnetic field, calibrated only back to 4.5 Ma - on Iceland - and extrapolated back to 84 Ma, largely based upon South Atlantic data and assuming constant spreading rates (Heirtzler et al., 1968; Larson & Pitman, 1972; Cande & Kent, 1995). Oceanic areas lacking

magnetic striping between 84 and 125 Ma are attributed to a Cretaceous “Quiet Period” of stable magnetic polarity. The oldest known “oceanic” crust is 170 Ma.

The world magnetic compilation map (Korhonen et al., 2007) shows a strong contrast in signature between nuclear/crystalline cratonic areas, such as northern Eurasia and North America, and areas that have suffered extension, such as Europe south of the Teisseyre-Tornquist Line (Fig. 3).

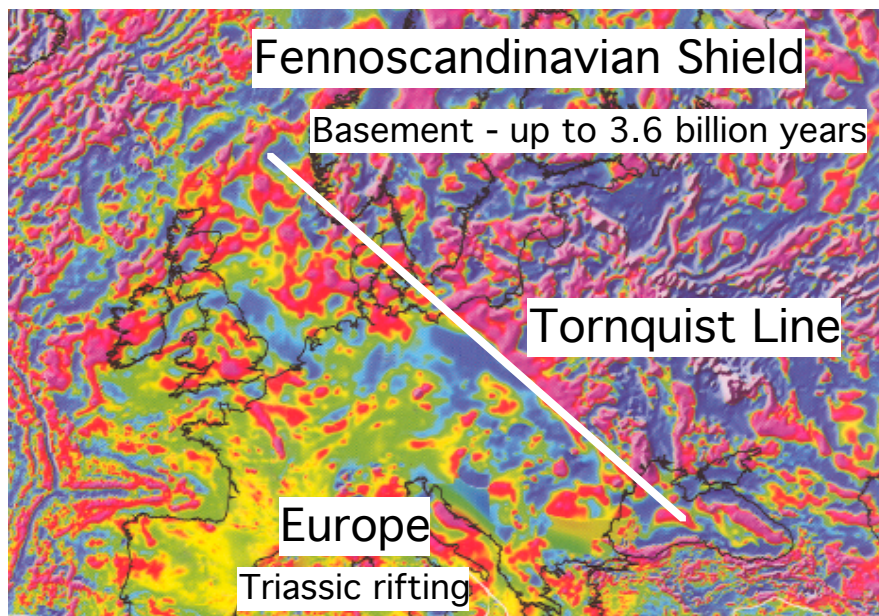


Figure 3. Extract from the world magnetic map (Korhonen et al., 2007) over northern Europe, showing the change in intensity between the ancient rocks of the shield to the north and rifted/extended continent south of the Teisseyre-Tornquist Line.

The latter signature occurs over large areas below seas adjacent to continents such as South America and Africa (Fig. 4). Seismic data in such areas show highly extended continent, typically with wedges of reflections suggesting (in some cases – Rockall, eastern offshore N America - calibrated) rotation of basins along listric faults. Commercial drilling has penetrated shallow water sedimentary rocks several kilometres below water as deep as 2 km (e.g. shallow marine or lacustrine Cretaceous carbonates, now at 7 km depth offshore Brazil (Fig. 4), fluvio-deltaic Palaeocene sands in the deep

Gulf of Mexico, both below salt), evidencing great continental subsidence. The discoveries are remarkable not only for their size (Brazil - 3<sup>rd</sup> largest oil field in the world, largest petroleum system in the Gulf of Mexico, respectively) but also for their unsuspected geology, heralding great surprises to come.

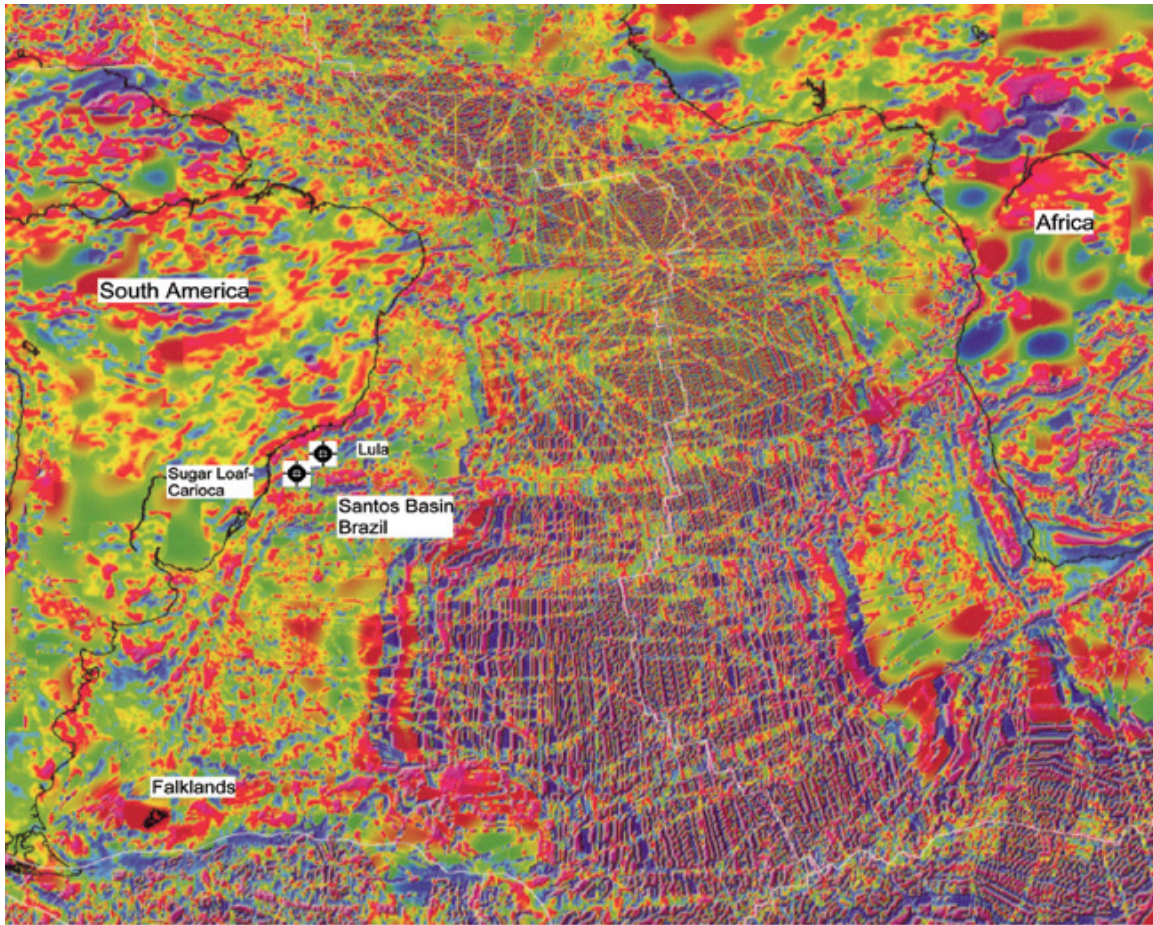


Figure 4. Extract of the world magnetic map (Korhonen et al., 2007) over the South Atlantic. Large areas of extended continental magnetic signature lie adjacent to South America and Africa. Removal of striped “oceanic crust” suggests much larger Pangaea (Fig. 5).

These areas correspond to “Quiet Period” crust. They are subsided, extended continent, not ocean spreading crust (James, 2010). Their boundaries allow a better “fit” of “continental” margins than the 1000 m contour used by Bullard et al., 1965, which had severe problems in Mexico - Central America, and Florida-Bahamas - western Africa.

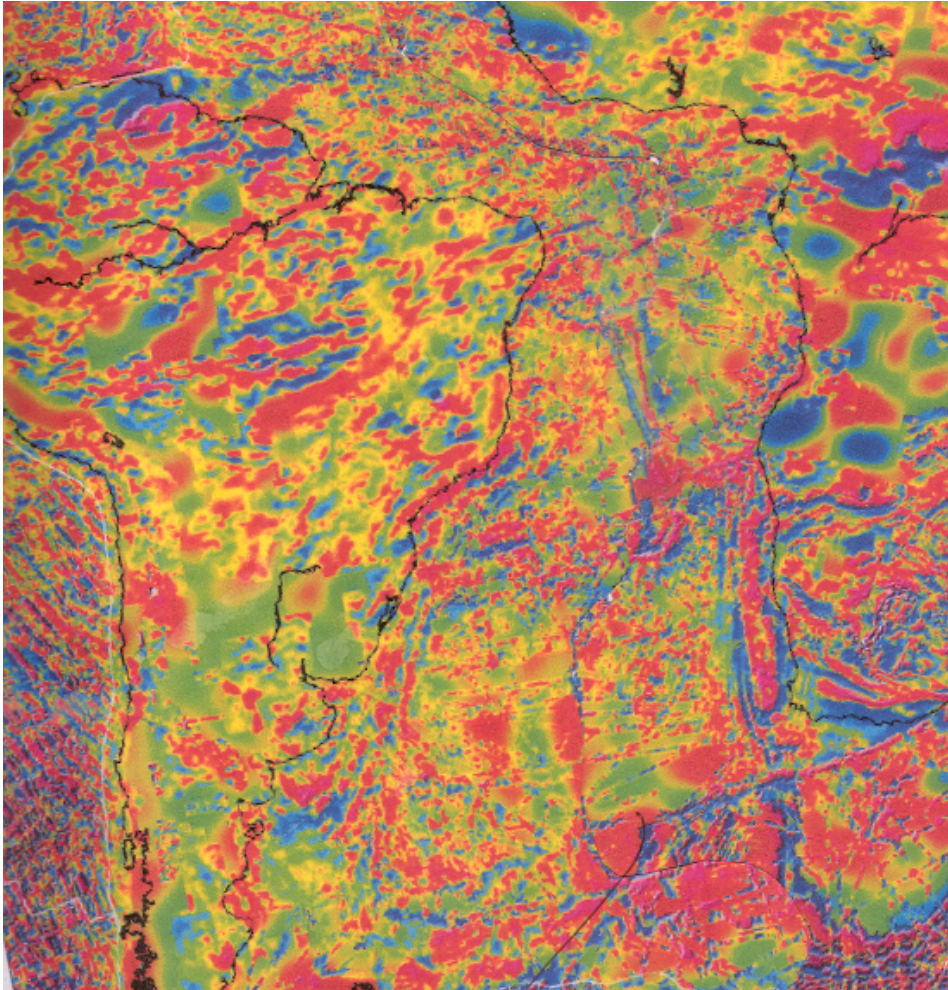


Figure 5. Extract of the world magnetic map (Korhonen et al., 2007) over the South Atlantic after removal of striped “oceanic” crust (though that also includes continental material – Fig. 2), suggesting much a larger Pangaea.

The areas show: 1) Pangaea was much larger than currently thought and 2) there were land connections between continents until the Eocene or later (up to 5 Ma). Dinosaurs,

freshwater fish and snails, lemurs, monkeys, manatees and palm trees migrated along continental connections between South America, Africa, Madagascar and India that existed well into the Tertiary (James, 2010, 2011).

Palaeontologists should assert priority of their data over Plate Tectonic models.

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