The Parana Panema block in the context of Rodinia and Gondwana reconstructions

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The final framework of Western Gondwana have reunited a mosaic of lithospheric segments (so-called Rodinia descendants) that were amalgamated by Neoproterozoic belts developed during the Brasiliano/Pan-African Cycle (from 880 Ma to 480 Ma). During this cycle/time interval and because its length, these segments descended from the same ancestor were then reworked under different crustal levels. Many of them survived as (Brasiliano / Pan-African) cratonic domains. Some other blocks have been reworked strongly, so forming different types of basement inliers.

Some of these blocks do not crop out, occurring beneath the major sedimentary (Gondwana) basins. This is the case of the Parana Panema block, which occurs beneath the Paraná basin. Preliminary evidence of this lithospheric block was indicated by regional geological and tectonic information, such as the occurrence of Neoproterozoic active (to the north – northwest, Arenópolis/Socorro Guaxupé arc) and passive (to the east, Apiai fold belt) margins. Additional data were obtained from deep boreholes (randomly distributed along the whole basin), including isotopic data, which have given indications for the presence of this a pre-Neoproterozoic block/fraction in the north-northwest part of the Paraná Basin basement.

A back-stripping analysis of the sedimentary sequences of Paraná Basin have identified three extensional events: of Late Ordovician, Carboniferous and Early Cretaceous ages. The last of these culminated with the eruption of the Serra Geral flood basalts.

Thermo-tectonic models have allowed determination of the stress distribution pattern that caused such extensional events. The back-stripping analysis used data from 81 deep wells (randomly distributed). The thermo-mechanical model considered the present isostatic equilibrium of the Paraná basin. The extensional events, measured by the β factor, were calculated on comparison of the subsidence curves for each lithostratigraphic unit with the curves of lithological records for the boreholes and with the corresponding theoretical curves, taking into account both the porosity and compaction of the sediments with the depth, the effect of sedimentary loading being a function of the densities of water, sediments and mantle and of the thickness of the sediments.

The gravity data include over 12,000 stations in the basin and surroundings. The Bouguer anomalies were related to the Geodetic Reference System (1967), and the value for the upper crust density was used 2.67 kg/m³. The residual Bouguer anomaly was obtained after subtracting a second degree polynomial trend surface, which represented the best fit for the regional gravity field. This residual anomaly corresponds to the crustal contribution of the gravity field. The anomalous field represents the crystalline basement as well as the sedimentary and volcanic layers that fill the basin. Isostatic modelling enables us to observe the similarity between the gravity signature of the basement and the adjacent outcropping terranes.

Calculation of the gravity residual component took into account density differences between sedimentary formations and volcanic rocks, the value of which were obtained from core samples and some outcrops (outside the basin).

A high-gravity area with an almost triangular shape, bordered by steep gravity gradients was then delineated, suggesting the existence of a subjacent rigid lithospheric block, surrounded by Brasiliano structures. Based on the geological and geophysical information, and other regional inferences, we may propose that this Parana Panema block had acted as a cratonic domain during the Brasiliano cycle.

The degree of thermal-tectonic reworking conditions of the Parana Panema block is not yet known, and many different fields of study are still being opened up. Nevertheless, from now on, all reconstructions of Rodinia and Gondwana should take into consideration this lithospheric fragment – Parana Panema – that had an original extent over 400,000 km², larger than many of the well-known homologues (e.g., the São Francisco cratonic peninsula).