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Parnaíba Basin: overview of one of the great interior synclises of Western Gondwana

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In the South American platform, the Parnaíba Basin of northeast Brazil, is one of the major interior synclises, with an area of about 600,000 km². It was surveyed in the first half of the twentieth century and from revaluations made over the last twenty years there has been renewed interest in hydrocarbon exploration, leading to the recent discovery of gas in the Paleozoic section. Here we present a review of the stratigraphic and paleontological data of the basin, which resulted in the redefinition of the Mesozoic section.

The Precambrian basement of the Parnaíba Syncline is mostly constituted by the Parnaíba Block that is totally covered by its sedimentary rocks. It is surrounded and limited by the Borborema Province to the east, the São Francisco Craton to the south, the Araguaia-Tocantins Belt to the west and the Ferrer-Urbano Santos Structural High to the north. Sedimentation in the basin started after the Brasiliano orogenic events, with the deposition of the Serra Grande Group, with periglacial, fluvio-glacial and shallow marine sediments, from the late Ordovician to early Devonian. At the top of this group, a major erosional unconformity relates to the Caledonian Orogeny. The overlying Canindé Group (mid-Devonian to mid-Carboniferous) consists of sediments from deltaic environments in a continental shelf, gradually evolving upward to shallow marine environments with the record of currents and storms, and changing to an estuarine setting with periglacial influences. Another unconformity marks the top of this group, related to the early Hercynian Orogeny. Subsequently the Balsas Group (mid-Carboniferous to mid-Triassic) initiated a continental sedimentation with coastal influences, under hot arid conditions. The aridity aggravated over time, with the presence of flint and stromatolitic limestone ultimately covered by aeolian dune sands from a desert environment, coeval with the collision of Gondwana with Laurasia to form Pangea. An erosional unconformity related to the Alleghenian Orogeny, marks the end of the sedimentation of that group. The Paleozoic section is the thickest of the basin, with about 3,000 m.

In contrast to the other large Brazilian interior basins, the Parnaíba Basin records two distinct basic magmatic pulses, dated by K-Ar and Ar-Ar methods. The oldest is the Mosquito Formation from the Early Jurassic (178 Ma), and the youngest, Sardinha Formation is generated during the Early Cretaceous (124 Ma). The magmatic bodies of these formations occur in the central part of syncline. With a total thickness of about 250 m, these magmatic intrusions are interpreted as a response to the fragmentation process of Pangea. The Mesozoic section of the basin is almost 1,000 m thick, unconformably overlying the Paleozoic rocks and the effusives, and predominantly dated to the Cretaceous. The succession records initial continental desertic conditions with a fluvial-lacustrine system and then a marine transgression coming from the northwest in the Late Aptian, which resulted in a restricted marine environment associated with deltaic sediments under warm conditions. Fluvial sedimentation practically ended the sedimentary history of the basin.

Under the tectonic-sedimentary point of view, the filling of the basin was controlled by pre-existing structures in the Precambrian basement and, according to current knowledge; they would have been reactivated, especially during the Pangea/Gondwana break-up.

