03 - SANDSTONE DIAGENESIS OF THE PASTOS BONS FORMATION, JURASSIC-CRETACEOUS OF THE PARNAÍBA BASIN

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ABSTRACT

The Mesozoic succession of the Parnaíba Basin include poorly understood deposits, mainly due to sparse data and lack of detailed sedimentological and petrographic informations. In this sense, this work presents the first petrographic and diagenetic discussion about the lacustrine sandstones of the Pastos Bons Formation. The diagenetic evolution of these deposits included eodiagenetic and mesodiagenetic phases, such that the main processes include clay infiltration, mechanical compaction, pressure solution, feldspars dissolution, calcite cementation and grains replacement.

***Keywords*:** Petrography; quartzarenites, mudstones, lacustrine.

INTRODUCTION

In the Parnaíba Basin, siliciclastic continental strata record the Mesozoic Era. This succession consists of desertic-lacustrine (Motuca Formation), desertic (Sambaíba Formation), fluvial-lacustrine (Pastos Bons Formation), fluvial-aeolian (Corda Formation), as well as lava flows related to Mosquito and Sardinha formations (Vaz et al, 2007). Despite recent advances, the comprehension about the Mesozoic continental deposits of the Parnaíba Basin is still poorly understood with the lack of detailed faciological and petrographic studies (Góes and Feijó, 1994; Vaz et al, 2007). In this sense, petrographic analyses of the Pastos Bons Formation, focus of this work, aims to evaluate the post-depositional modifications and the diagenetic evolution of the lacustrine sandstones from the Pastos Bons Formation. The study area is located in the southeast portion of the Parnaíba Basin, Northeastern Brazil (Fig. 1).

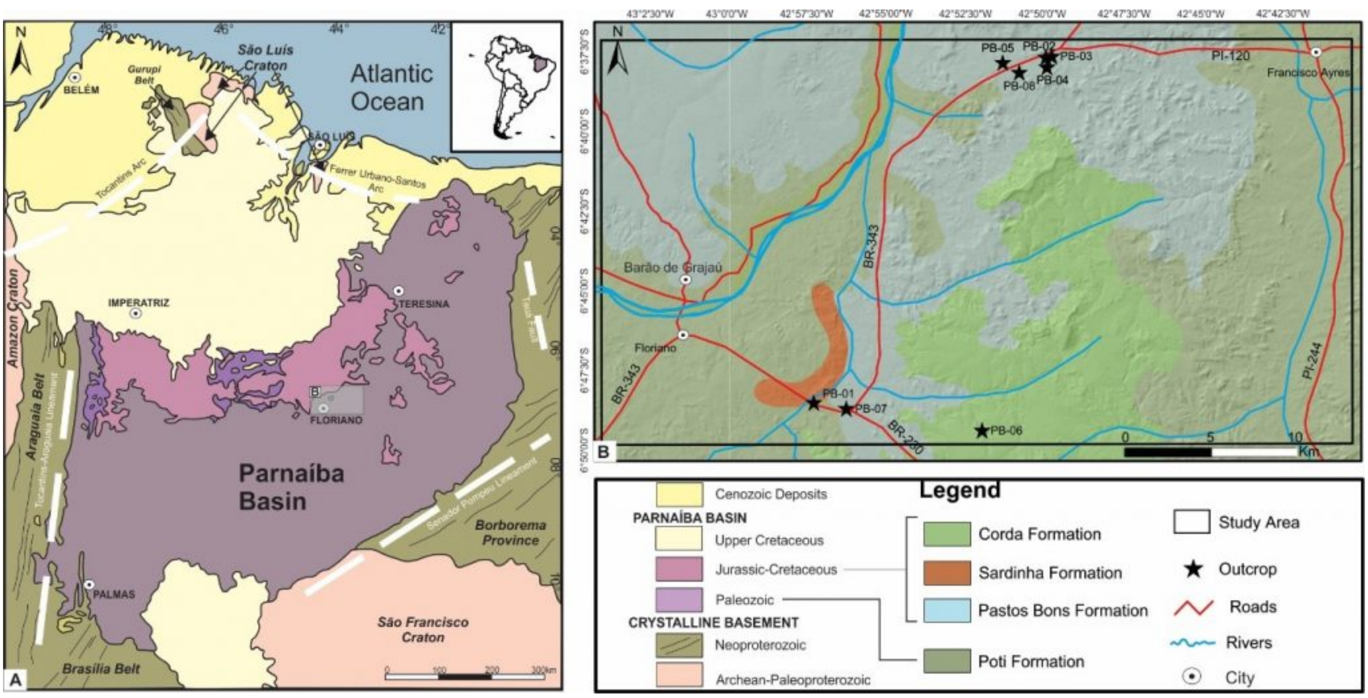

Figure 1 - Location map of the study area. A. Parnaíba Basin and main geotectonic boundaries (modified from Santos and Carvalho, 2004). B. Study area, southeastern Parnaíba Basin.

GEOLOGIC SETTING

The Parnaíba Basin is a Paleozoic intracratonic basin, situated in the northern portion of the South American Platform, Northeastern Brazil (Góes and Feijó, 1994). This basin comprises approximately 600.000 km² and 3.4 to 3.5 km-deep. The basement includes igneous, metamorphic and sedimentary rocks (Vaz et al, 2007), which belong to the Araguaia-Tocantins Belt, Amazon and São Francisco cratons, Borborema Province, as well as Riachão and Jaibaras basins, with Archean to Ordovician ages, formed and/or reworked during the Brazilian Cycle (Castro et al, 2014). The Pastos Bons Formation, focus of this research, consists of reddish to greenish mudstones interbedded to sandstones with cross-stratifications/laminations. These deposits were inserted in the Mearim Group, which is also constituted by fluvial-aeolian Corda Formation and volcanic flows of the Mosquito and Sardinha formations (Góes and Feijó, 1994).

MATERIALS AND METHODS

The textural, mineralogical and diagenetic analyses were performed in 15 sandstone thin sections, following the counting of 300 points, according to the ribbon counting tecnique (Galehouse, 1971), and classified according to Folk (1968). The thin sections were made in the Laboratório de Laminação of the Faculdade de Geologia in the Universidade Federal do Pará.

RESULTS

The Pastos Bons Formation defines a fluvial-lacustrine succession, constituted by mudstones and sandstones. The latter are represented by fine to medium-grained quartzarenites, arkoses and greywackes. They may present even-parallel lamination, normal-to-reverse grading and normal grading. The lithotypes may be cement-supported and cement-and-grains-supported, with rounded to sub rounded and subordinately subangulose grains, well to moderately-sorted. The grains float in poikilotopic calcite cement. Sandstones exhibit open to normal packing, with grain-no grain, punctual, rectilinear and compromise contacts and, rarely, concave-convex contacts.

Monocrystalline and, subordinately, polycrystalline quartz grains are the main constituents of the sandstones. Monocrystalline quartz grains are well-rounded, with abrupt extinction or weak to strong undulose extinction. Feldspar grains are present in lower proportions and are represented by microcline and plagioclase (albite and labradorite), which may be partially or completely replaced by sericite, calcite cement or clay minerals. Lithic fragments include subrounded to rounded grains, derived from metamorphic, igneous and sedimentary rocks. Quartzite fragments and schists occur locally, with elongated morphologies and sub rounded boundaries. Basalt lithic fragments are rounded grains, commonly altered to clay minerals. Sedimentary lithic fragments include sandstone, pelite, chert and pseudomatrix. Other depositional constituents in the sandstones include are clayey matrix, contorted mica flakes and heavy minerals.

Calcite cement occurs as poikilotopic crystals, often in compromise contacts. The cement may partially to completely replace quartz and feldspar grains. Porosity is defined by secondary pores, mainly moldic and intracrystalline porosity. Grains with corrosion features and sandstones with heterogeneous packing are common. Clays are present as alteration of plagioclases, pseudomatrix and clay mineral films. The latter marks the morphology of replaced grains and it may border moldic porosity.

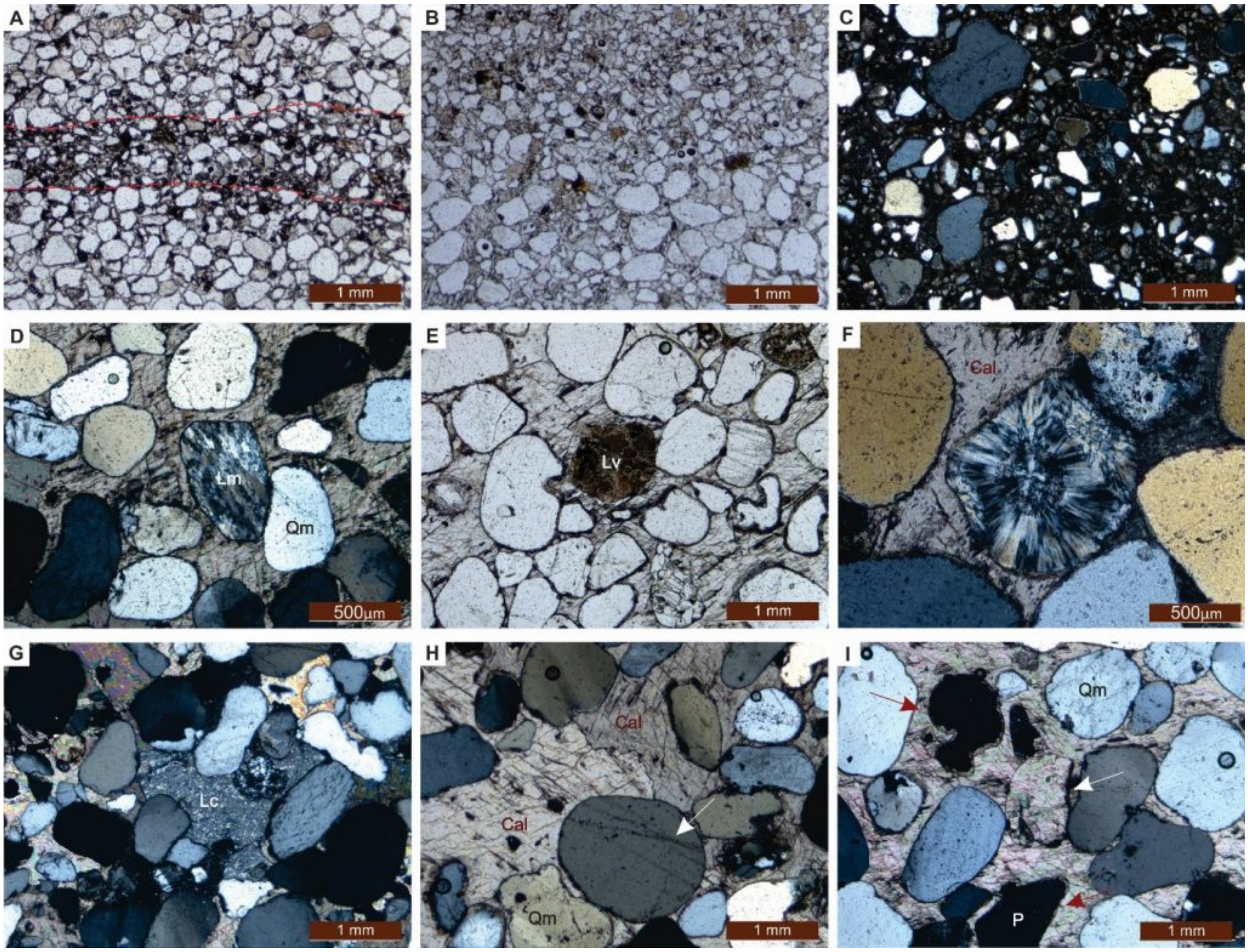

Figure 2 – Petrographic aspects of lacustrine sandstones. A. Even-parallel lamination and normal-to-reverse grading. B. Normal grading in quartzarenite. C. Greywacke, with poorly sorted and sub angulose grains floating in clayey matrix. D. Quartzite lithic fragment. E. Rounded basaltic fragment. F. Rounded chert fragment (chalcedony). G. Deformed chert fragment in concave-convex contacts. H. Compromise contacts between poikilotopic calcite crystals. Arrow indicates fluid inclusions. I. Grain replaced by calcite cement (white arrow). Moldic porosity occur locally (red arrows) (Qm = monocrystalline quartz; Lm = metamorphic lithic fragment; Lv = volcanic lithic fragment; Lc = chert fragment; Cal = calcite cement; P = moldic porosity).

DIAGENETIC EVOLUTION

The recognition of depositional and diagenetic characteristics allowed the proposal of a diagenetic sequence for sandstones of the Pastos Bons Formation. The sequence comprises eodiagenesis and mesodiagenesis, summarized in Fig. 3. The eodiagenesis is marked by kaolinite infiltration as replacement of feldspars. Contorted muscovite and chert fragments indicate mechanical compaction. Pseudomatrix and pressure solution features (concave-convex contacts) characterize the transition of eodiagenesis to mesodiagenesis (De Ros and Moraes, 1984). Carbonate cementation is recorded by poikilotopic calcite crystals, whose Ca^{+2} ions were probably provided by the dehydration of mudstones and dissolution of Ca-feldspars, whereas $CO3^{2-}$ was provided by decarboxylation of the organic matter. This phase was also influenced by percolation of basalts. Cement is absent in greywackes due to the early filling of the pore spaces by clay matrix. Locally, feldspars grains were completely replaced by calcite cement. The diagenetic sequence of the Pastos Bons Formation sandstones is remarkable distinct than the zeolitic sandstones from Corda Formation in the western portion of the basin. These differences are probably a result of the overlain rocks, such that Pastos Bons deposits overlie a sedimentary Paleozoic basement, whereas Corda Formation overlies Triassic volcanic rocks.

Fluid composition modifications allowed the generation of secondary porosity in late mesodiagenesis, which is recorded by partially solved feldspars and, punctually, calcite crystals. These compositional changes were probably caused by the smectite-illite conversion during burial and decarboxylation of organic matter, which resulted in acidification of the pore waters (Boggs Jr., 2009). Secondary porosity is corroborated by grains with corroded edges and heterogeneous packing (Tucker, 1991).

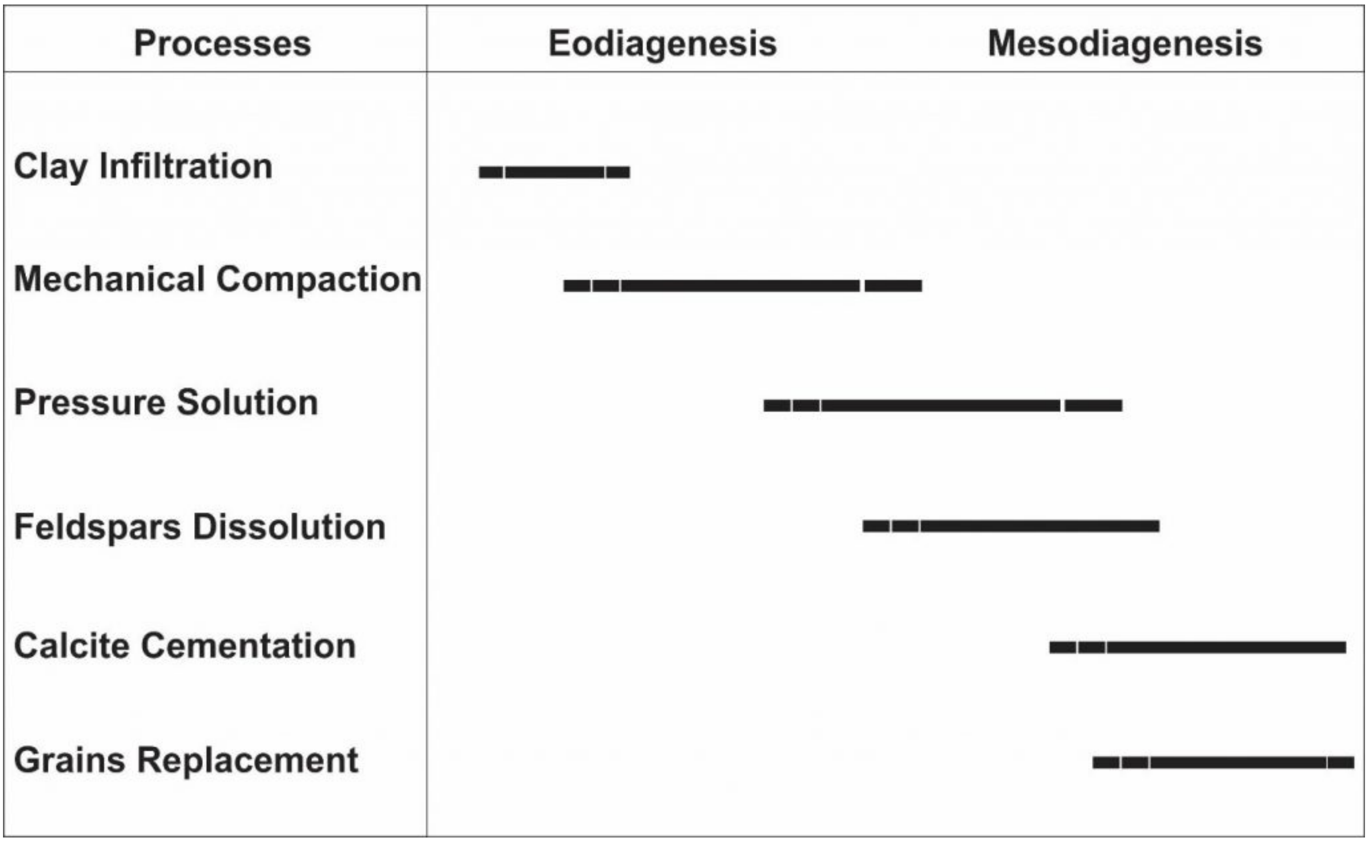

Figure 3 - Diagenetic sequence of sandstones from Pastos Bons Formation.

CONCLUSIONS

This work presented petrographic data and a diagenetic evolution model for lacustrine sandstones of the Pastos Bons Formation, Jurassic-Cretaceous of the Parnaíba Basin. These deposits exhibit eodiagenetic and mesodiagenetic features, associated with clay infiltration, mechanical compaction, pressure solution, feldspars dissolution, calcite cementation and grains replacement.

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