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## SEDIMENTARY FACIES AND ABANDONMENT PROCESSES: AN EXAMPLE FROM THE PARANÁ RIVER

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### Introduction

There are many processes that make a river change the course of its channel. The chief causes of these changes may be climatic, tectonic and anthropic (dams, channel rectification and others).

Studies on channel changes are abundant in literature and involve geomorphological, hydrological and sedimentological characteristics of the system. Although, many research works come from temperate climates where the river systems were impregnated by factors derived from the last glacial period.

This investigation studies the sedimentary history of a channel abandonment in the Paraná river, Porto Primavera region (PR), Brazil, which occurred during the Holocene. In the region above mentioned the Paraná River is multichannel with an anastomosed pattern and a wide flood plain on its right margin. Besides natural levees, swamps and lakes in the flood plain identification of abandonment channels and islands is possible. At present they correspond to oxbow lakes or a secondary channel of the Paraná river called Baía River (Suguio *et al.* 1984).

Geomorphological, sedimentological and <sup>14</sup>C dating studies characterized the chronology and the sedimentary contents of deposits

generated by the abandonment of a channel in the Paraná river together with its framing in the Quaternary evolution suggested by Stevaux (1997) and Stevaux & Souza (1996) for the same region.

### **Characteristics of the area**

The area comprehends the present flood plain of the Paraná river in the region between the mouth of the Paranapanema river and Porto Primavera dam (long. 53°00"W and lat. 22°30'S), on the boundary of the states of Paraná, Mato Grosso do Sul and São Paulo (Fig.1). In this region there are two geological units: the Mesozoic sandstone of the Caiuá Formation on the left bank and Quaternary sediments which compose the flood plain on the right bank. Upper Paraná river flows through regions with tropical and sub-tropical climate with average monthly temperatures higher than 15° C and with rainfall of 1,500 mm/year (IBGE, 1990). At this point the river has a multichannel anastomosed pattern with many islands and secondary channels and a 9-km wide flood plain where shapes of natural levees, oxbow lakes, swamps and the secondary channel of the Baía river are prominent. The Baía river is not more than 25 m wide with expansion in the stretch corresponding to the Rodrigo lake where its width is over 1,000 m. In this place Baía river occupy an ancient channel of the Paraná river (Fig.1)

Spatial distribution of vegetation in the flood plain of the upper Paraná river includes *forest* and *non-forest formation*. In the former the semi-deciduous forest and the sub-mountain semi-deciduous seasonal forest are present. The latter consists of pioneer formations with river influence occurring along the river plains and around alluvial depressions (swamps, lagoons and lakes) (Campos & Souza, 1997).

The shapes of paleo-channels and paleo-islands in the system are very sharp in aerial photographs, especially when observed by morphological and textural differences. On the ground these shapes are very much discrete and are better perceived by topographical and vegetation difference. The evolution of the river system in the studied stretch is

inserted at the end of the Pleistocene and the beginning of the Holocene. Oldest dating obtained by Stevaux & Santos (1998) for deposits associated with the Paraná river do not go beyond 40,000 years B.P.

### Results and conclusion

About 130 granulometric analyses and 3 dating were provided from 12 vibro-cores (36 m) and auger sampling.

Many sedimentary deposits identified in the flood plain showed predominance of fine sand granulometric fraction (3  $\phi$ ) followed by very fine sand to clay (4 and 9  $\phi$ ). The occurrence of gravels was common at the base of many cores.

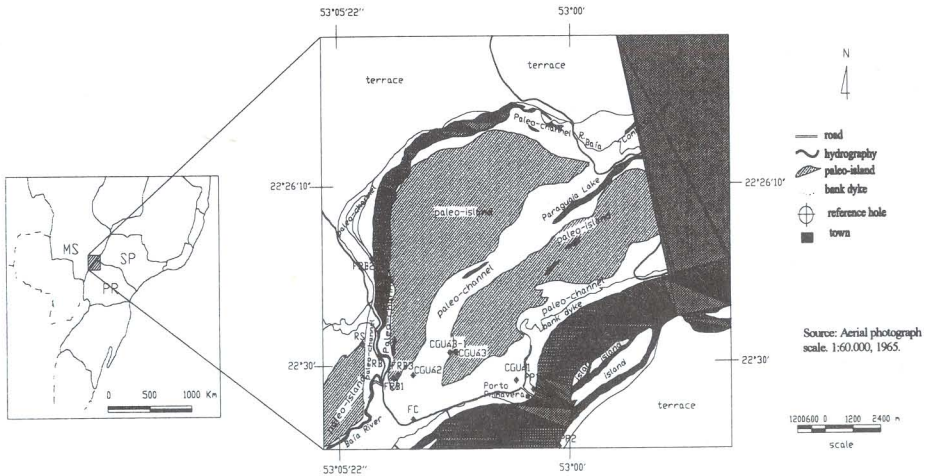


Figure 1 - Area showing flood plain shapes of paleo-islands and paleo-channels, Rodrigo Lake occupying a paleo-channel and reference holes identified as FRB2, FRB3, FRB1, RB, FC, CGUA1, CGUA2, CGUA3, CGUA3.1, PP1 E PP2. Region of Porto Primavera, MS, Brazil.

The sedimentary facies and their respective environments and sub-environments identified in deposits may be found in Table 1.

Dating at the base of deposits in the flood plain varied from  $4,780 \pm 100$  AP in its farthest portion (Stevaux, 1994) to  $3,160 \pm 80$  AP at the closest. The difference of about 1,600 years between these demonstrates that flood plain building process was relatively quick with a rate of 2.7 m/year. This fact also suggests that the present Paraná river system has stabilized itself in the present conditions after the climatic Optimum of the Holocene around 6 to 5 ka AP in the studied area.

The abandoned channel under analysis has avulsion characteristics, or rather, it is not a continuous process like in a meandering channel case. Ten vibro cores were made in abandoned channel deposits. Dating at base and at top of deposits of the abandoned channel (Smo, Sso facies) presented  $2,810 \pm 50$  AP  $3,030 \pm 50$  AP. These data showed that the avulsion process lasted for about 220 years (Fig. 2).

**Table 1.** Code of facies for the deposits of flood plain of Paraná River at Porto Primavera, MS, Brazil.

<b>Facies Association</b>	<b>Facies Code</b>	<b>Description</b>	<b>Environment</b>
I	Fm	Mud	Floodplain
	Fmo	Organic mud	
II	Smao	Clay sand with organic matter	Abandoned channel
	Smo	Sand with organic matter	
III	Sso	Stratified sand with organic matter	Channel

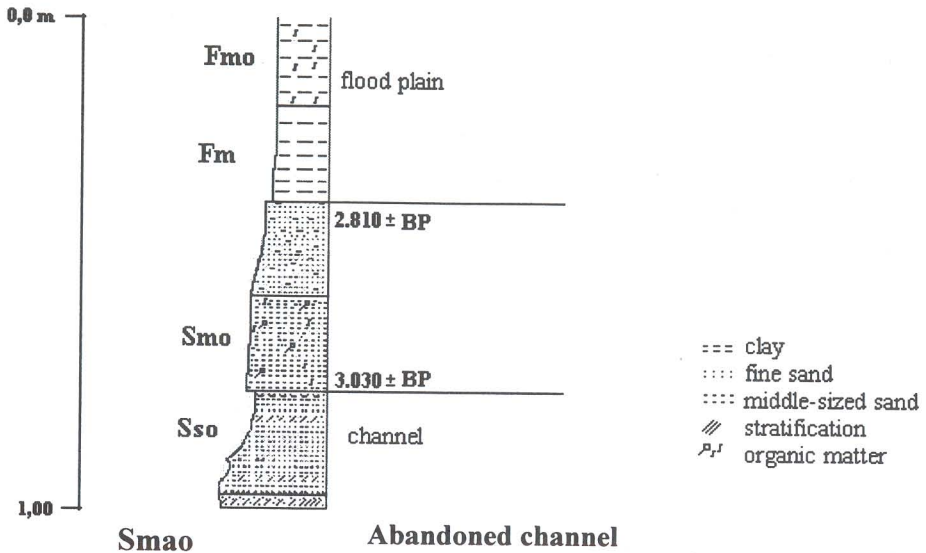


Figure 2 - Idealized lithological cross-section - facies sequence of deposits of abandoned channels in the flood plain in Porto Primavera (MS) Brazil

### Analysis of results within area context

The abandonment period discussed above is very important in the context of the paleoclimatic evolution of upper Paraná River as described by Stevaux (1994) and by Stevaux & Souza (1996). These authors admit a significant change in climatic and hydrological changes of the area between 3.5 and 2.5 ka AP. A short period of dry climatic called the Second Dry Event. On the other hand, Stevaux (1994) and Stevaux *et al.* (1997) admitted that at the end of this period there might have existed a vertical incision of the Paraná channel and a lowering of water level.

In this case, it is clear that the avulsion identified in this research could have occurred because of new hydrological conditions by the end of the Second Dry Event. Further, one must take into account the migration trend towards the left bank which the Paraná channel has shown since the Pleistocene. Many authors have attributed this characteristic to a tectonic origin. Therefore, one cannot dispose of the idea that there could have occurred tectonic components associated with climatic changes in the abandonment identified on the Paraná River floodplain.

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