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CONFLUENCE BAR OF THE SÃO PEDRO BROOK IN THE PARANÁ RIVER: GENESIS AND ENVIRONMENTAL IMPORTANCE[1]

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Introduction

Research on drainage confluence sedimentation are rare in literature, especially in large rivers. Roy and Bergerson (1990) remark the importance of to understand the processes involving confluence bars, the geometric and compositional knowledge of their deposits and their relationship between the drainage basin in the environmental management.

In spite of their importance, confluence bars do not receive sufficient attention when compared to other elements in the drainage network. This is probably due to their discrete area and their genetic complexity.

This paper provides an analysis of the geometry, composition and sub-environments of a bar at the mouth of the São Pedro brook in the Paraná and emphasizes its importance on the river ecosystem. The studied area is São Pedro do Paraná, PR - lat. 22° 50'S, long. 53° 13'W. (Fig. 1). São Pedro brook's basin has an area of 217.25 km² covered by Dark Red Latosoil and Yellow-Red Podzolic to Dark Red Soil, originated from sandstones of the Caiuá Formation. Sandstone crops out in brooks bed and at all the left bank of the Paraná River. Basin has a

discrete to wavy relief (0 –20 % declivity) with steeper gradient in the area close to the São Pedro brook's mouth. Only a small remnant of the native woodland (< 3%) has been preserved and almost the whole area is pastureland.

The valley of the São Pedro brook is wide with average channel slope of 7.9 m/km and flow velocity around 0.59 m/s for a discharge of 1.6 m^3/s. In the last 5 km of its course the channel has excavated a canyon directly on the Caiuá Formation where flow presents rapids and falls. Slope in this reach is up to 75%. On the other hand, the Paraná River has an average width of 3,000 m, depth from 4 to 8m reaching 14 m in the talweg, and an average discharge of 8,000 m^3/s. Flow velocity near the bar varies from 0.6 to 1.2 m/s.

Methodology

A basin map was produced by aerial photographs (Scale 1:25,000 - 1980) and computer program SITIM SGI (System of Geographical Information). Sampling points for discharge and bed load were located in the main confluences of São Pedro tributaries. The topographical bar maps were obtained by using conventional topography (with theodolite) and echobathimetric survey (Fig. 1 and 2a). Sediment samplings were taken by modified sampler Petersen and by vibrocoring. A IH flow meter was used to measure speed and flow direction. Measurements of discharge of São Pedro stream were made in the field, while those of the Paraná River were obtained from the fluvial station of the Port São José, 6 km upstream from the studied area. Sediments were submitted to grain size analysis and clay was analyzed by x-ray diffractometry.

Results

By using the same criteria suggested by Roy & Bergerson (1990) four sub-environments were identified in the confluence bar: mouth, channel, upstream and downstream sites. The latter corresponds to a

protected zone in bar where an inversion of current direction may occur and flow velocity is almost nil. At this place sedimentation is restricted to fine material, water is rich in nutrients with high oxygen rates and high density of benthic organisms (Fig. 1). Studies undertaken by Stevaux & Takeda (1996) showed that density of benthic organisms in other places of the Paraná River is significantly reduced when compared to those of sub-environment of the downstream site. Confluence bar is essentially formed by sand and its morphology is controlled by the hydrological cycle of the Paraná River (Fig. 2 a).

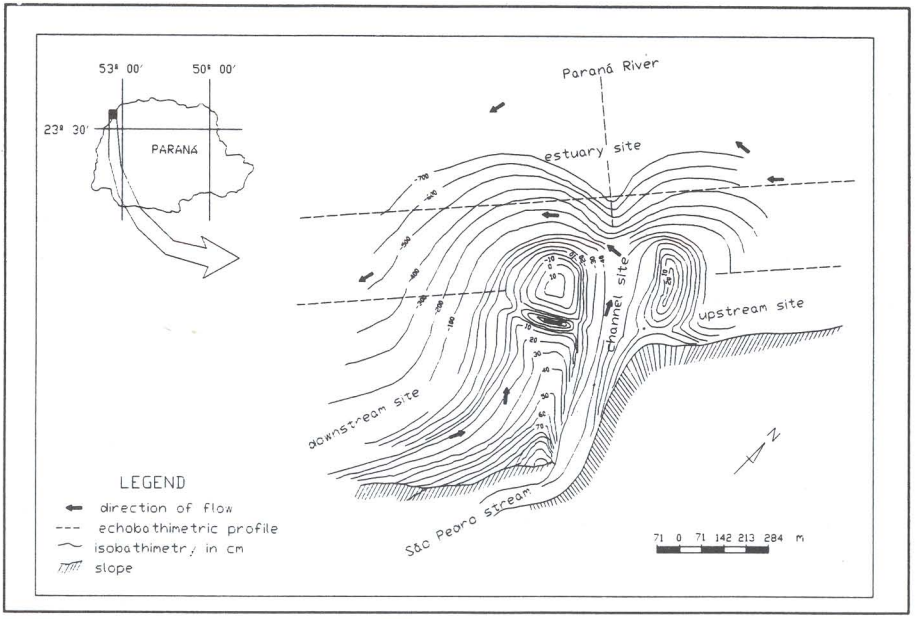


Fig. 1. Confluence bar at São Pedro brook and Parana river: morphology, flow pattern and sub-environments.

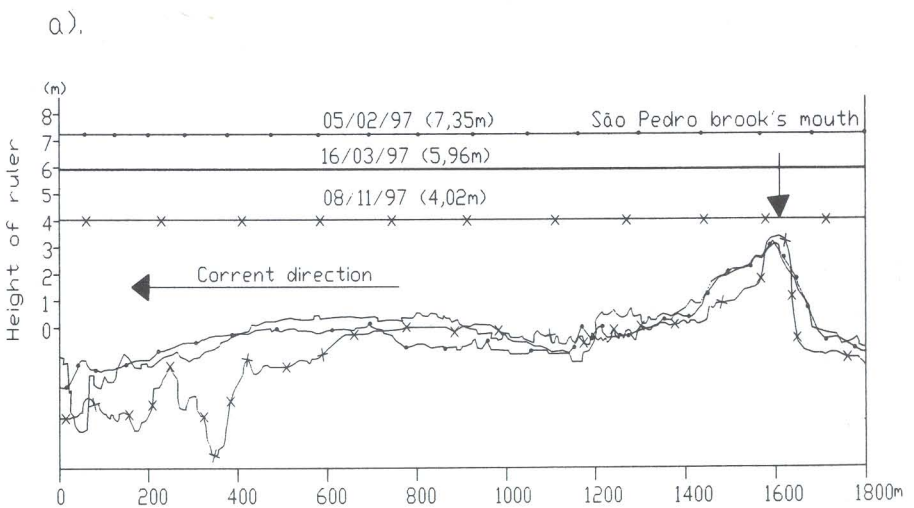
Comparative study in granulometry of sediments from São Pedro's bed load, confluence bar and Paraná River's channel shows that the majority of bar sediments come from the São Pedro brook (Fig. 2 b).

Indeed, map in Figure 1 shows that water flow (and sedimentary load) of the Paraná river is deviated toward the middle of channel by São Pedro's water. On the other hand, clay is not deposited at the bar, but it is carried as suspended load directly to the Paraná River. X ray diffractometry analysis shows that the main clay of the drainage basin soil is kaolinite. The same material is found in great quantities in the suspended load of the Paraná River and clay content in bar sediment is not significant.

Conclusion

The occurence of a confluence bar in the mouth of São Pedro brook is mainly controlled by a) its sedimentary load, b) the deviation of the Paraná river flow that farms a zone of low flow velocity and c) the Paraná river's hydrological cycle.

Granulometric, morphological and diffractometric analyses show that confluence bar is essentially sandy and most sediment comes from the drainage basin of the São Pedro brook.



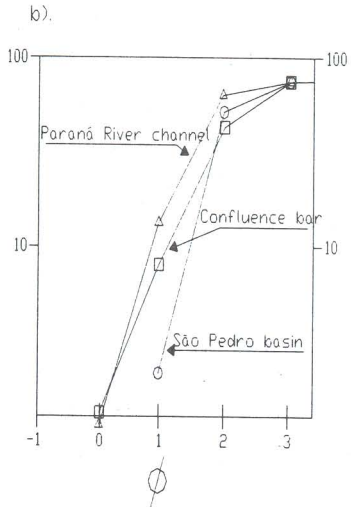


Fig. 2: a). Enchobathimetric survey showing changes in morphology of the confluence bar during the hydrological cycle of the Paraná River.

b) Granulometric accumulated frequence curve of the São Pedro confluence bar deposits. Bar and drainage curves show great proximity and suggest same provenence.

The confluence bar of the São Pedro brook can be divided into four different sub-environments: channel, mouth, upstream and downstream sites. Due to its hydrodynamic and sedimentary characteristics downstream site is extremely important for river ecology because it presents a high density of benthic organisms which form the food network. It should be considered a preservation and environmental protected site in the management of drainage basins;

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