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Seismic-stratigraphic approach to Late Pleistocene/Holocene evolution of Lagoa dos Patos, Southern Brazil

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The response of coastal barrier-lagoon systems to sea level change is a significant focus in contemporary geomorphology. Most modern barrier lagoon systems originated as incised valley systems formed during the Last Glacial Maximum (LGM). The lower portions of these valleys were drowned during the Post-Glacial sea level rise, transforming drainage basins to depositional basins such as estuaries and lagoons.

The Lagoa dos Patos (LP) lagoon is the largest barrier-lagoon system in the world, it covers 10,000 km^2 and can be subdivided into four geomorphologic cells. It is bounded by a 300 km-long barrier and has one permanent connection with the open sea (Rio Grande channel). Based on approximately 1000 km of high-resolution (3,5 kHz) seismic data, the seismic-stratigraphy of the lagoon is described and the Late Pleistocene/Holocene evolution of the system is interpreted.

The analysis of seismic reflectors was based on Mitchum et al. [1]. The seismic facies were located in specific system tracts within the stratigraphic regional framework. Three Standard Penetration Test (SPT) cores in key points of different cells enable a more detailed facies description. The mainly muddy transgressive deposits permitted good acoustic signal penetration and high definition of sediment bodies. Ravinement by tides or ocean waves is inhibited because the lagoon is in a microtidal setting (tidal range = +/- 0,5 m) and is sheltered by a composite Pleistocene and Holocene sandy barrier whose position has been largely stationary during the Holocene.

The seismic and sedimentological records identified two distinct geomorphologic portions of the lagoon, the central basin and the margins of each cell. The mapping revealed the presence of stream and river facies in the central portion of the cells within former incised valleys. These channels appear to have been fixed, likely because of the stiff Pleistocene substrate which restrains the lateral migration. In the central area the largest accommodation space was created in the deeper portion of the incised valleys. These have mainly been infilled by muddy lagoonal deposits with high rates of deposition during the mid-Holocene.

Topographic highs in the lagoon represent the former valley interfluves. They have experienced low rates of deposition during the Holocene and were only completely covered during the maximum flooding event. The antecedent topography is masked by the high Holocene deposition rates in the central part of the cells, but the interfluve areas can still be recognized in the current bathymetry of the lagoon. At present the paleointerfluves are stable banks (slight erosion) that provide fixed points for the development of modern sandy spits.

The lagoon originated as a complex of incised valleys, and associated interfluves that was flooded during the Late Holocene. The seismic data reveals that the incised valleys are compound features some of which originated before the LGM and were reoccupied. This geological inheritance is also evident in the modern lagoon where the palaeotopography exerts a dominant control on the modern hydrodynamics and sedimentology

References:

[1] Mitchum R. et al. (1977) In: Seismic Stratigraphy – Applications to Hydrocarbon Exploration. **AAPG Memoir**, 26:117–133.