

# Morphological Evolution of the Óbidos Lagoon

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## ABSTRACT

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The Óbidos Lagoon, oriented northwest-southeast, developed perpendicular to the shoreline and communicates with the ocean through a narrow and shallow channel that needs constant dredging.

This lagoon system was until the 18th century represented on the charts as an estuary which allowed navigation. Historic references indicate that the baymouth bar was formed during the medieval period, creating problems of inlet siltation.

The use of cartography and air photographs of several dates establishes a rhythm of verified siltation in the last century, which reflects a loss of lagoon surface area of about 9,600 m<sup>2</sup>/year.

**ADDITIONAL INDEX WORDS:** *Sedimentation/erosion rates; baymouth barrier.*

## REGIONAL SETTING

The Óbidos lagoon is located on the Portuguese west coast shore between Nazaré and Peniche, on the western flank of a vast area known as "Diapiró das Caldas da Rainha" limited by fault scarps related to the "Tectónica diapírica" (Figure 1). Oriented perpendicular to the coastline, the lagoon occupies a surface of 6 km<sup>2</sup>, with a depth that varies between 0 and 4 meters. The salinity values are variable; <20‰ near the mouth of Real-Arnóia rivers, "Braço da Barrosa" and on the north margin of the bay near Foz do Arelho and >25‰ in the central portion of the lagoon (FREITAS, 1989).

The communication with the sea is artificially ensured by a narrow inlet, locally known as "verga", cut through a baymouth bar covered with dunes attached both at the north and south at cliffs, Cruz do Facho (80 m high) and Rocha do Gronho (50 m high), respectively (Figure 2).

The lagoon serves as a base level for a hydrographic net extending across variable lithology. The drainage pattern is of dendritic configuration with a general direction flowing SE to NW. The main drainage system leading to the lagoon is formed by the Real and Arnóia rivers which capture the flow from 88% of the 430 km<sup>2</sup> basin. The remaining 12% of the surface is drained by small streams that have their base level in the "braços" of Barrosa, Bom Sucesso, and Ferrarias. The rainfall average in the area is about 600 mm/year.

## THE MORPHOLOGICAL EVOLUTION OF THE LAGOON UNTIL THE 19TH CENTURY

The study of the morphological evolution of the Óbidos lagoon until the 19th Century was based on the critical analysis of written documents and ancient cartography.

The first references are connected with archeological findings made by CHOFFAT (1892), who found, 1 km east-southeast of the base of St. Antão do Tojal hill (Figure 2), remains of the kitchen middens dominated by *Ostrea edulis* which he considered to belong to the Neolithic. Later, ALVES (1915) found ceramics in the archeological basal deposits of Outeiro da Assenta (Figure 2) that included vases and net weights, domestic utensils and the remaining parts of middens with species such as *Patella*, *Cardium* and *Ostrea edulis*, belonging to the Neolithic. GIRARD (1915) refers to the existence of a shellmound on a hill in front of Óbidos (St. Antão do Tojal) that, according to him, reveals the proximity of a salty water lagoon. It is possible that the population of the village was composed of fishermen and mollusk gatherers and that the saline waters of the lagoon—then a vast lagoon estuary—ran to Óbidos and to the base of the hills (now 6 m high and a slope of 0.06‰ to the sea) (Figure 3). However, the hypothesis of the food being consumed in places far from its harvest is not to be excluded. It is inferred that the general shape of this estuary must have been maintained for several centuries. This view is supported by documents depicting the Vila de







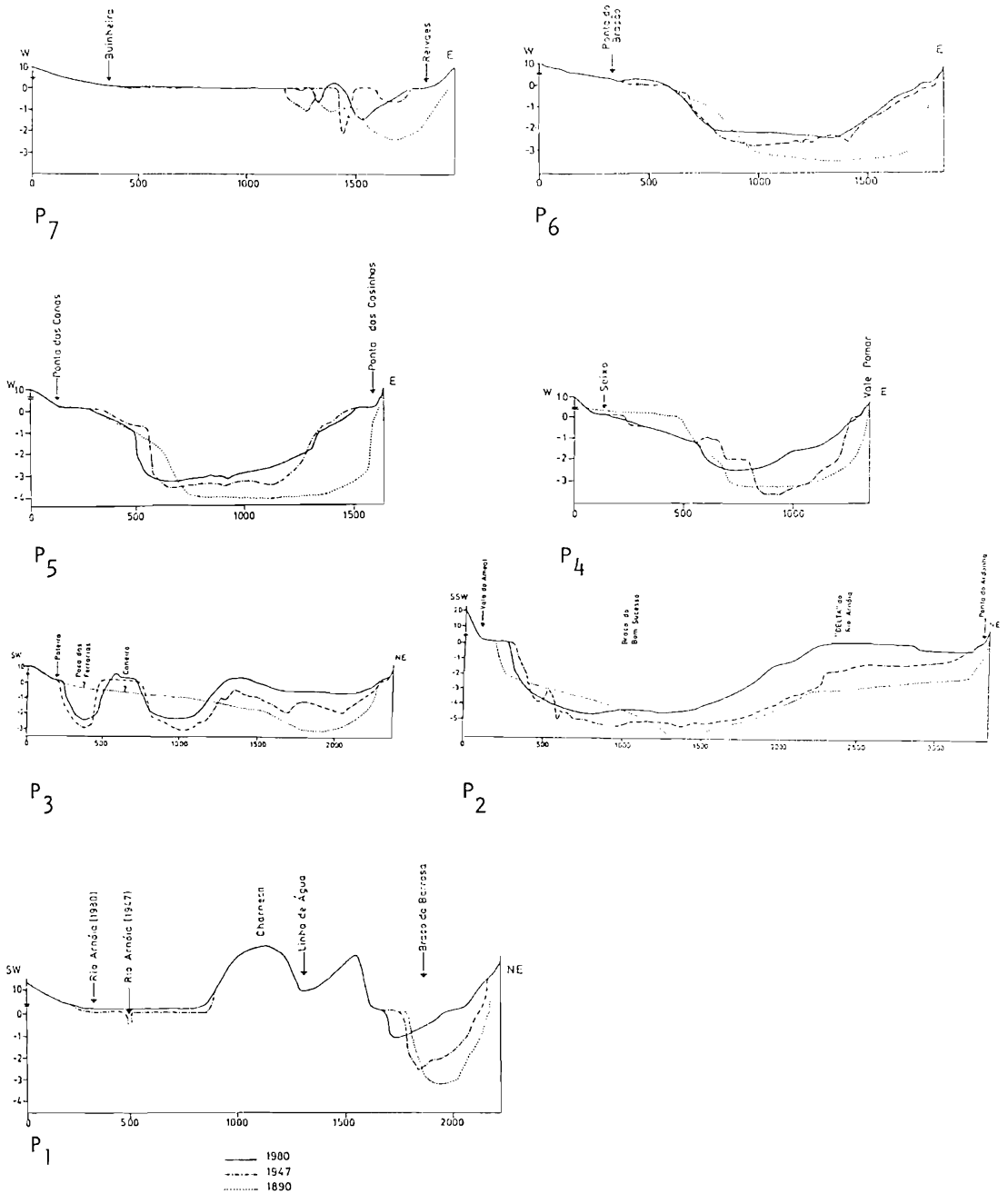


Figure 7. Bottom profiles of the lagoon.

It was determined that between 1890 and 1988 (Figure 7) there has been a 38% decrease of the lagoon's depth because of accumulation, although there have been variable rhythms in the values (Table 1).

The decrease in depth was accompanied by the migration of the deeper channels from the south-west to the west, with the exception of Poça da Ferraria where the migration was to the east into the central body of the lagoon. The depth of the



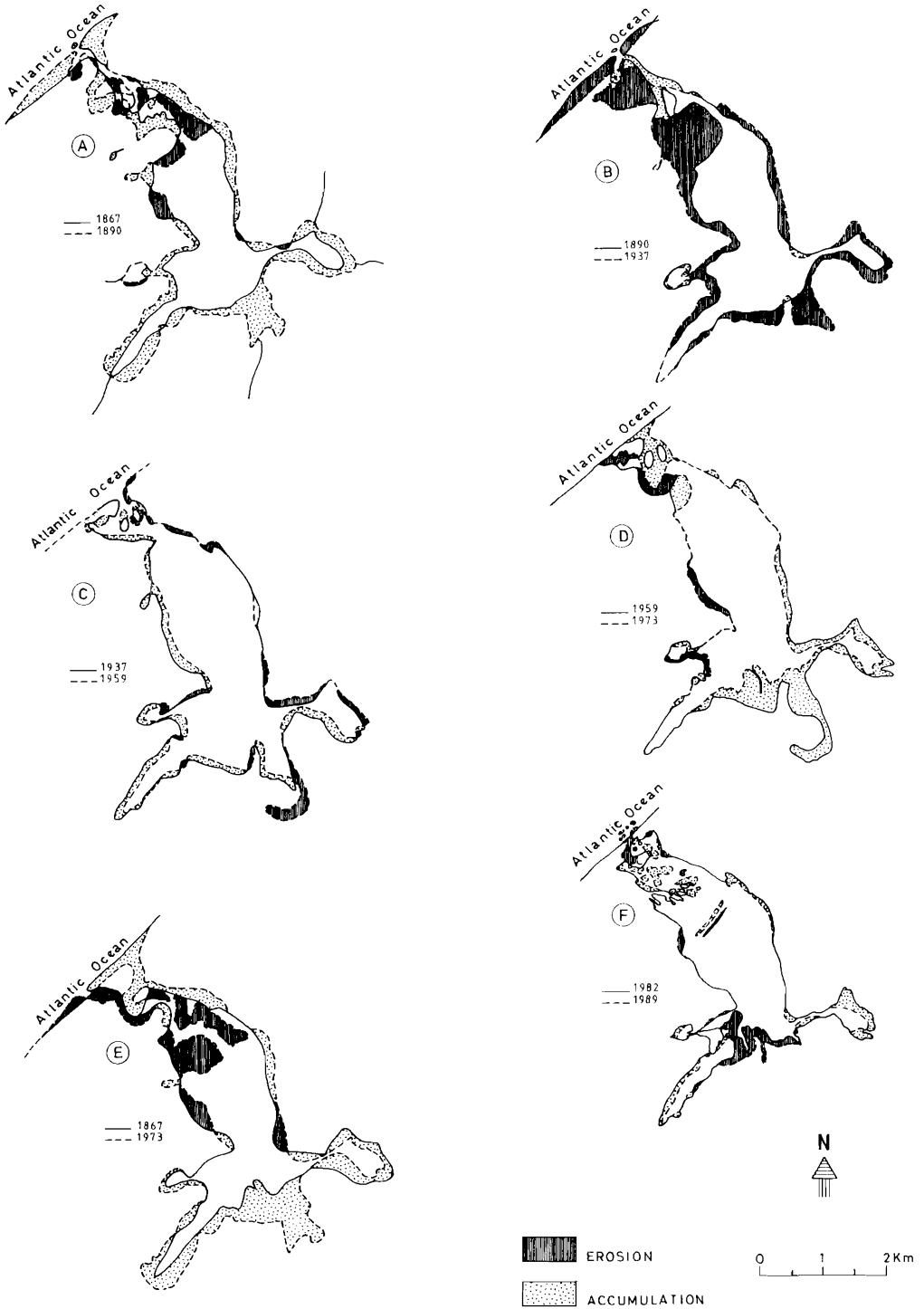


Figure 8. Changes in surface area of the lagoon. 1867, "Carta Topográfica de Portugal", F. Folque; 1890, "Planta Hydrographica da Lagoa de Óbidos" (Girard, 1915); 1937, "Carta Militar de Portugal", S.C.E.; 1959, "Carta Geológica de Portugal", D.G.M.S.G.; 1973, "Carta Corográfica de Portugal", I.G.C.; and 1982-1989, Air Photographs.





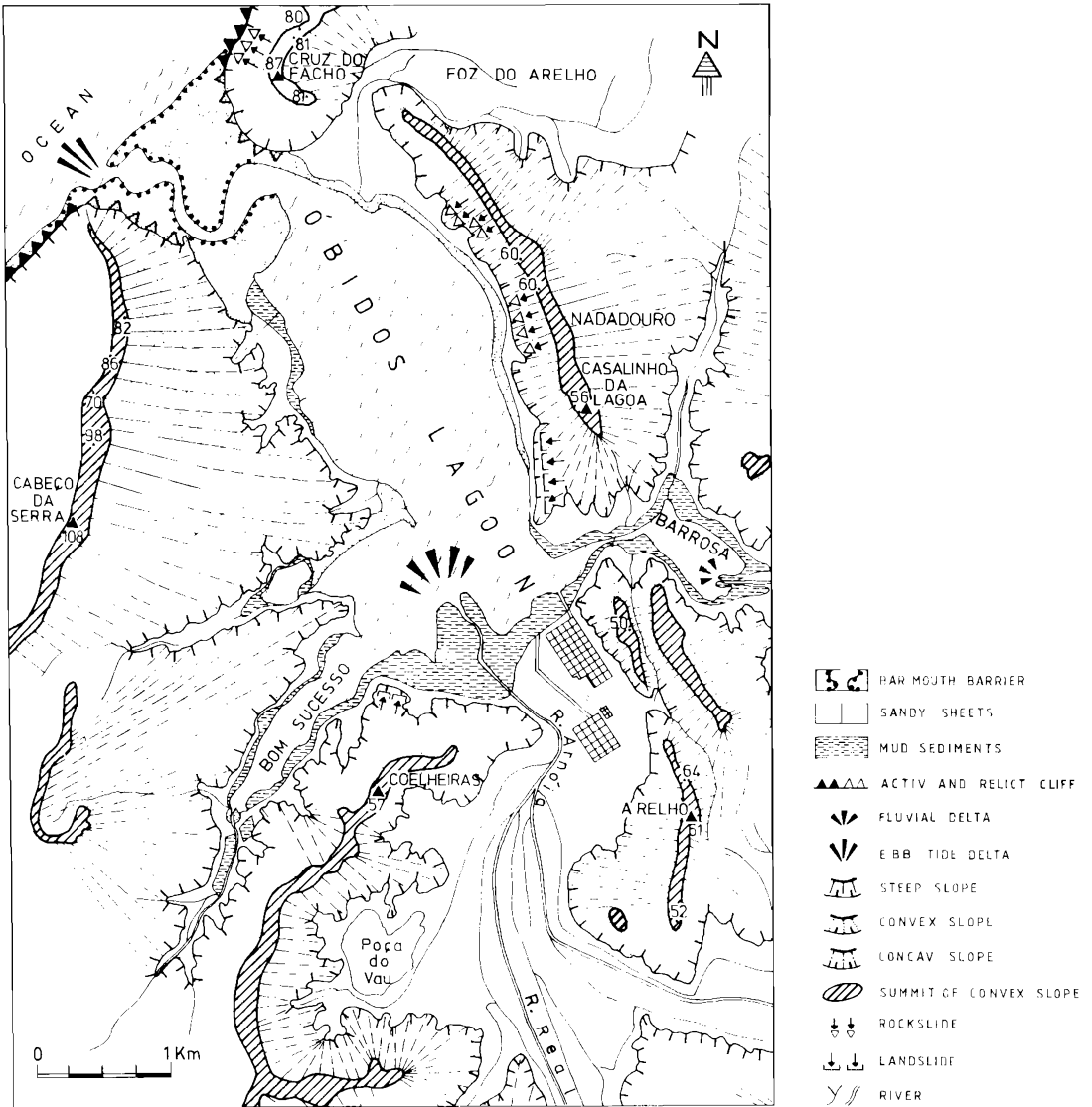


Figure 9. Geomorphology of the Obidos lagoon and its environs.

The siltation rates calculated from the 1867-1973 charts confirm the oral history that the reduction of the lagoon has increased in the decades of the 1960's. The main cause seems to be the increased agricultural mechanization on the slopes, and the mechanical cleaning of the drainage ditches in the artificial fluvial channels, at Várzea da Rainha. There is, therefore, a great amount of sediment that is moved along the slopes and carried in suspension through the main channels. The baymouth barrier that separates the lagoon

and marine environment is nourished by the materials supplied by the littoral drift and in certain climatic conditions by the wind that carries materials from the beach and the dunes connected to it. The increase of irrigated crops caused by advantageous markets requires a great amount of water, reducing even more the summer stream flow into the lagoon. The high organic pollution content has increased the primary productivity in the water, and a consequent increase of algae which facilitates the siltation.



## □ RESUMO □

A lagoa de Óbidos, orientada NW-SE, desenvolve-se perpendicularmente ao litoral e comunica com o oceano por um canal estreito e pouco profundo, aberto num cordão litoral que é necessário dragar com frequência.

Este sistema lagunar foi até ao século XVIII representado na cartografia como um estuário que permitia a navegação, embora a antiga documentação escrita refira que o cordão litoral se formara no período medieval, criando problemas graves de assoreamento.

A utilização de cartas e fotografias aéreas de várias datas permitiu estabelecer o ritmo de assoreamento verificado no último século, que se reflectiu numa perda de superfície emersa da langua, da ordem dos 9,600 m<sup>2</sup>/ano.

## □ RÉSUMÉ □

Orientée du NW au SE, la lagune d'Óbidos se développe perpendiculairement au rivage, la communication avec la mer étant assurée par une passe peu profonde (2 m), ouverte dans un cordon littoral enraciné au bas des falaises. Comme cette passe se ferme naturellement, il faut y faire des draguage.

Jusqu'au XVIIIème siècle la lagune à été représentée dans la cartographie comme un estuaire que permettait la navigation. La documentation écrite nous parle d'un cordon qui était developpée à l'époque medieval.

L'utilisation des cartes anciennes et des photographies aérienne nos à permis d'observer un rythme de sedimentation de 9,600 m<sup>2</sup>/an dans le dernier siècle.