

The Adriatic Sea Evolution

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The Pleistocene continental sedimentation

During the Pleistocene Würm glacial period about 20,000 years B.P. the Adriatic Sea level was from 90 to 130 m lower than the present and the coastline was about 300 km further south (fig. 1) leaving an emerged plain in the northern part of the Adriatic region. The Late Pleistocene continental complex is formed mainly by interbedded layers of clay, sand and peat; the continental origin of which is confirmed by the textural characteristics of the sediment layers and their paleontological contents. Studies by Bortolami *et al.* (1977) on pollen, obtained from samples from different cores in the Lagoon of Venice and the Lower Po Valley, provided important information on the subsidence and climatic fluctuations in the northern Adriatic region. Their study briefly indicates:

- 1) following a continuous subsidence and sedimentation rate of about 1.3 mm/yr from before 40,000 to 22,000 years B.P., the least glacial peak, the sedimentation rate increased drastically to at last 5 mm/yr, probably caused by an accelerated downward movement of the basin, i.e. an isostatic effect;
- 2) a sedimentation gap ends the Pleistocene (18,000-7,000 years B.P.), and
- 3) an episode of emergence that corresponds to the compaction and overconsolidation of a clay layer considered as an indicator of the Holocene/Pleistocene boundary.

Bortolami *et al.* (1977) also found that the Pleistocene peat samples consist of the same type of Cyperaceae peat throughout the stratigraphic column indicating that the growth conditions, i.e. the hydrologic situation, must have been approximately the same during each period of peat development. Furthermore the authors suggest that a good correlation between age and depth of the sediments implies that the sedimentation was strictly related to the subsidence of the basin floor.

Palynologic analyses gave important indications on the climatic variations and on the related vegetational phases for the time span between 40,000 and 18,000 years B.P.

A study by Bortolami *et al.* (1977) on pollen from peat samples from the Northern Adriatic basin gave a C14 date of 39,000 B.P. and indicates the following five climatic phases:

- (1) a Gramineae steppe period with *Juniperus*, *Artemisia*, *Ephedra* and some scattered pine trees indicating a cold and dry climate;
- (2) sixty percent increase in tree pollen percentage such as oak forest elements, traces of beech (*Fagus*), fir (*Abies*), pines (*Pinus*), birch (*Betula*) and spruce (*Picea*); between 38,000 to 34,000 years B.P. could be attributed to warmer and more humid conditions with some climatic changes within the same period.
- (3) with the occurrence of steppe vegetation such as Gramineae. Chenopodiaceae and few pines at 33,000 years B.P. a change to cold climate could be recorded;

(4) between 32,000 and 23,000 years B.P., 50% increase in pine pollen with fairly high value for Gramineae, *Artemisia*, *Ephedra* and *Juniperus* indicates an open pine forest in the steppe with a dry climate. But between 31,000 and 29,000 years B.P. more humid conditions were developed as indicated by the presence of oak (*Quercus*), elm (*Ulmus*) and poplar (*Populus*), and

(5) a steppe type vegetation with up to 70% Gramineae, *Artemisia*, *Juniperus* and *Chenopodiaceae* characterized the 22,000-18,000 years B.P. period with very dry and cold climate.

The authors also report a striking resemblance, despite the great distance, when they correlate the vegetation phases of the Venetian region with those from other locations in the Mediterranean area.

Pleistocene emergence

The Pleistocene period ends with a phase of no sedimentation (18,000-7,000 B.P.) in the Venetian lagoon. During the final phase of the Pleistocene period the shallow argillaceous deposits are drained, compacted and oxidized to form the overconsolidated levels known in the Venetian lagoon as "caranto" and representative of the Holocene/Pleistocene limit. The lack of sedimentation corresponds to the beginning of the deglaciation, the Flandrian transgression.

The Flandrian transgression

With the climate improvement that started in about 17,000 B.P. and reached its maximum in about 6,000 B.P., the sea level began to rise and the coastline moved progressively northwards over the Adriatic palaeoplain until it reached approximately the present position in roughly 6,000 B.P. That period was characterized by an intense and prolonged alluvial phase. Wave motion and sea current reworked and dispersed the fluvial sediments carried to the sea.

Recent climatic variations

In addition to the described long-term climatic variations during the geological times, we have record of recent time's short-term climatic fluctuations. At the end of the last century, Brukner (1890) published a study pointing out a sequence of climatic fluctuations based on the comparison of meteorological data, which had similar results, for the same period in different parts of the Northern Hemisphere. Using geological, geomorphological, glaciological, palaeobotanical, archaeological and historical investigations, it has been possible to reconstruct the sequence of climatic variations with accuracy for the historical times.

For the last 3,000 years, five cold and humid periods have been recognized that had a great impact on the Mediterranean basin. The periods were: 1400-1300 B.C.; 900-300 B.C.; 400-750 A.D.; 1150-1300 A.D.; 1550-1850 A.D.

These cold/wet periods were alternated with warm/dry periods and they have been well identified by the dendrochronological curves. Within these "large scale" periods, small climatic fluctuations of 10-35 years continued with cold/wet and warm/dry cycles up to present time. The influence of these climatic changes on the environmental evolutionary trend is obvious considering the variations of the shoreline along the Adriatic coastal zone.

The present day morphology of the Adriatic Sea

At the present time the Adriatic Sea may be divided into 3 parts from North to South:

- Northern Adriatic Sea from the Trieste gulf to the Ancona promontory;

- Central Adriatic Sea from the Ancona promontory up to the Gargano promontory;
- Southern Adriatic Sea from the Gargano promontory up to Otranto.

The Northern Adriatic Sea is comprised in the continental shelf. The bottom slope is oriented to S-E with values 0,25-0,60 m/km up to the isobath 100 m at the southern limit of this part of the Adriatic Sea. The velocity of sedimentation is about 4 mm/year. The main part of sediment yield is due to the Po River.

The central Adriatic Sea is again comprised in the continental shelf, but with a bottom slope from 0,75 to 12 m/km. It is characterized by some relieves, sometime emerged to give isles, and by a large depression (the mesoadriatic depression) formed by three small basins oriented NNE-SSW with depth around 270 m. This depression is recognized like the emerged border of the Po paleoplain during the upper Pleistocene.

The Southern Adriatic Sea is completely different. It is divided in three physiographic units: the continental shelf, the continental slope and a bathial plain at the border with the Ionian Sea.

The continental shelf extends up to the depth of 180 m. The continental slope, in the superior part, is interested by submarine canyons and valleys. In the inferior part of the continental slope there are some seamounts; the largest of them is the Dauno seamount (-m 725).

After the inferior limit of the continental slope (-1150 m) the bathial plain extends with the maximum depth of 1216 m and bottom slope inferior 3 m/km.

A ripid channel, maximum depth 800 m, gives the connection between the southern Adriatic Sea and the Ionian Sea.



Fig. 1 —The Upper Adriatic Palaeoplain during the Würmian.

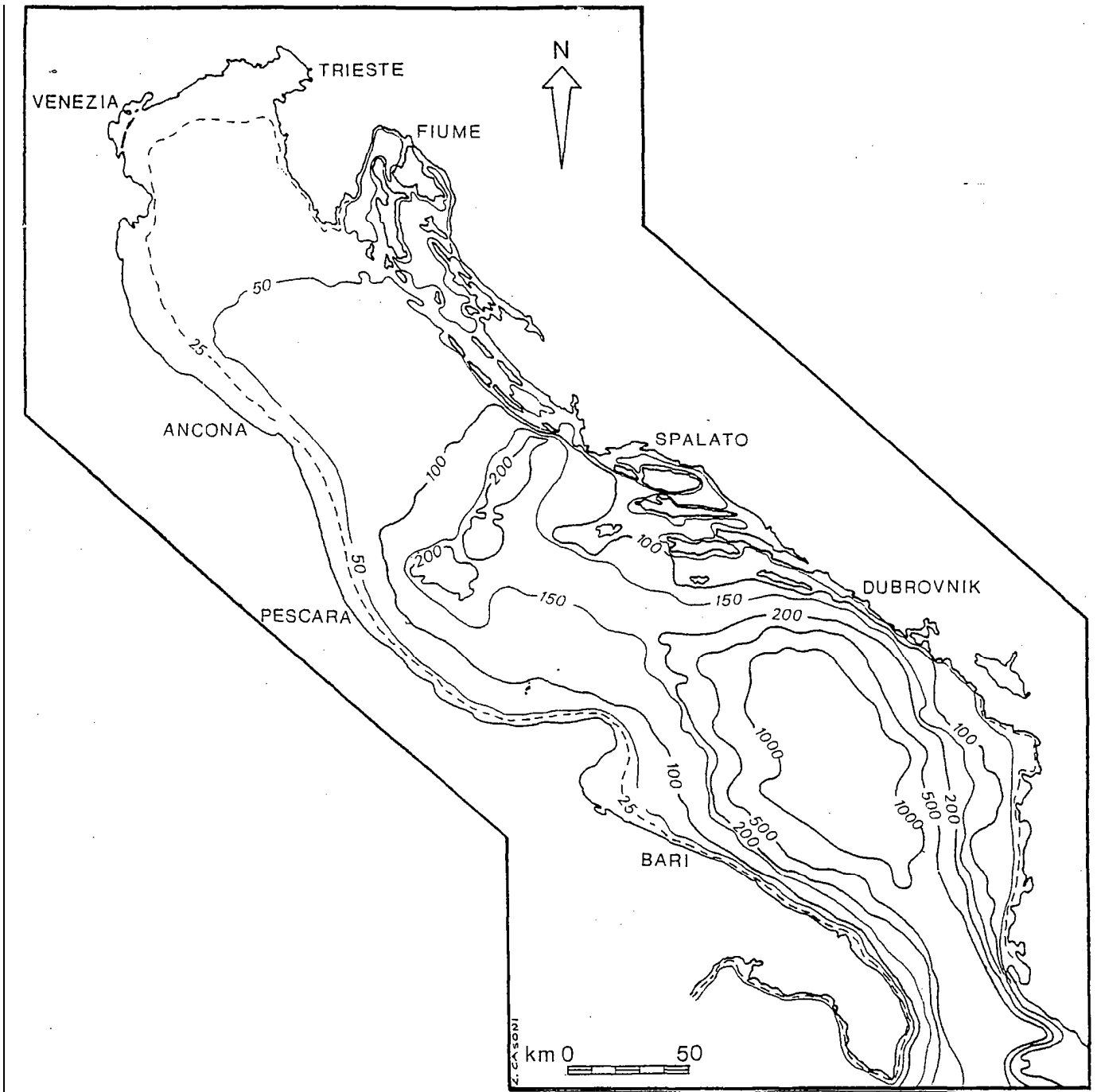


Fig. 2 — Bathymetric map of the Adriatic Sea

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