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CLIMATIC AND ENVIRONMENTAL CHANGES OF THE SANTA GILLA LAGOON (CAGLIARI) DURING THE HOLOCENE

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ABSTRACT: Porcu A. M. *et al., Climatic and environmental changes of the Santa Gilla Lagoon (Cagliari) during the Holocene.* (IT ISSN 0394-3356, 2011)
Through the study of two boreholes was possible to reconstruct the environmental and climate evolution of the last 10,000 years B.P. of the Santa Gilla Lagoon. The data obtained are based on microfauna and palynomorphs analysis, integrated with geochemical analysis carried out on foraminifera calcareous shells. Radiometric analysis were also performed to obtain a well-defined geochronology scale of sedimentary succession.

RIASSUNTO: Porcu A. M. et al.: *Variazioni climatiche e ambientali della Laguna di Santa Gilla (Cagliari) durante l'Olocene.* (IT ISSN 0394-3356, 2011)
Attraverso lo studio di due sondaggi a carotaggio continuo è stato possibile ricostruire l'evoluzione ambientale e climatica degli ultimi 10.000 anni B.P. della Lagna di Santa Gilla. I dati ottenuti sono basati sull'analisi della microfauna e dei palinomorfi, integrati con analisi geochimiche effettuate sui gusci calcarei dei foraminiferi. Sono state inoltre compiute analisi radiometriche per ottenere una scala geocronologica ben definita della successione sedimentaria.

Keyword: Foraminifera, Palynology, stable isotope analyses

Parole chiave: Foraminiferi, Palinologia, analisi isotopiche

Multidisciplinary study on the marine and continental microfacies from two boreholes of the Santa Gilla Lagoon allowed to reconstruct the environmental, climate and vegetation changes that occurred in the Gulf of Cagliari during the Holocene. Palynologic (pollen and spores analyses), micropaleontologic (benthic foraminifers) and isotopic data ($\delta^{18}O$ and $\delta^{13}C$) over the past 10.000 years B.P. from this transitional-coastal sequence show a series of shift leading to the establishment of different climatic conditions. The investigated archives included lagoonal organic shales, *Posidonia* peat and coastal, fine and medium sandstone.
Radiocarbon dating and multiproxy analyses were performed on 30 meters of succession. The radiometric analysis allowed to date the sedimentary series, placing the beginning of the lagoon silting process from moments immediately after the Younger Dryas (ORRÙ *et al.,* 2004; ANTONIOLI *et al.,* 2007) and to compare the sedimentary succession to the Northern European chronostratigraphy.
The coastal sediments are the reservoir of biological and lithological information on mutual relations continent-sea. Any sea level change, both eustatic and isostatic and tectonic, left its marks on the fossil faunal and microfaunal composition.
Through the foraminifera study and according to the knowledge on their ecology (SGARELLA & MONCHARMONT ZEI, 1993; CIMERMAN & LANGER, 1998; FIORINI & VAIANI, 2001), have been detected environmental characteristics that have occurred during the lagoon filled. Benthic foraminifer association were identified and assembled into five main eco-groups that have shown the transition from lagoonal environment (10.000-9.000 years B.P.) to marine sublittoral with a very close lagoon (9.000-3000 years B.P.) and then return to the lagoonal but with marine influences (3.000-250 years B.P.) and re-opened to the sea (250 years B.P.-actual).
Any climatic change, if it exceeds a certain threshold, gives a change in the vegetation which is recorded in coeval sediments by the palynological record. The sequence of sporo-pollen spectra provides the vegetation evolutionary pattern of the source area of the studied basin. The palynological study allowed the vegetation spectra reconstruction (REILLE, 1992; REILLE, 1995; REILLE, 1999) showing five phases and a sub-phase, marked by an appreciable evolution in terms of frequency curves that represent the stages of the vegetation dynamics of last 10,000 years under the climate influence. The vegetational response to the amelioration of the climate in the Early Holocene (9.800 -7.600 years B.P.) resulted in the spread of the *Ericaceae macchia* (*First phase*) and the setting of the *Quercus* forest between 7.700-7.600 years B.P. (*sub-phase*). This was followed by a shift toward drier and more open vegetation mainly represented by *Chenopodiaceae* (*Second phase*) at 7.600-7.200 years B.P. At 7.200-4.800 years B.P. a more persistent peak in deciduous *Quercus* values signal a reestablishment of wetter conditions and the maximum extension of the *Quercus* forest (*Third phase*). Alternated drier (*Chenopodiaceae*)

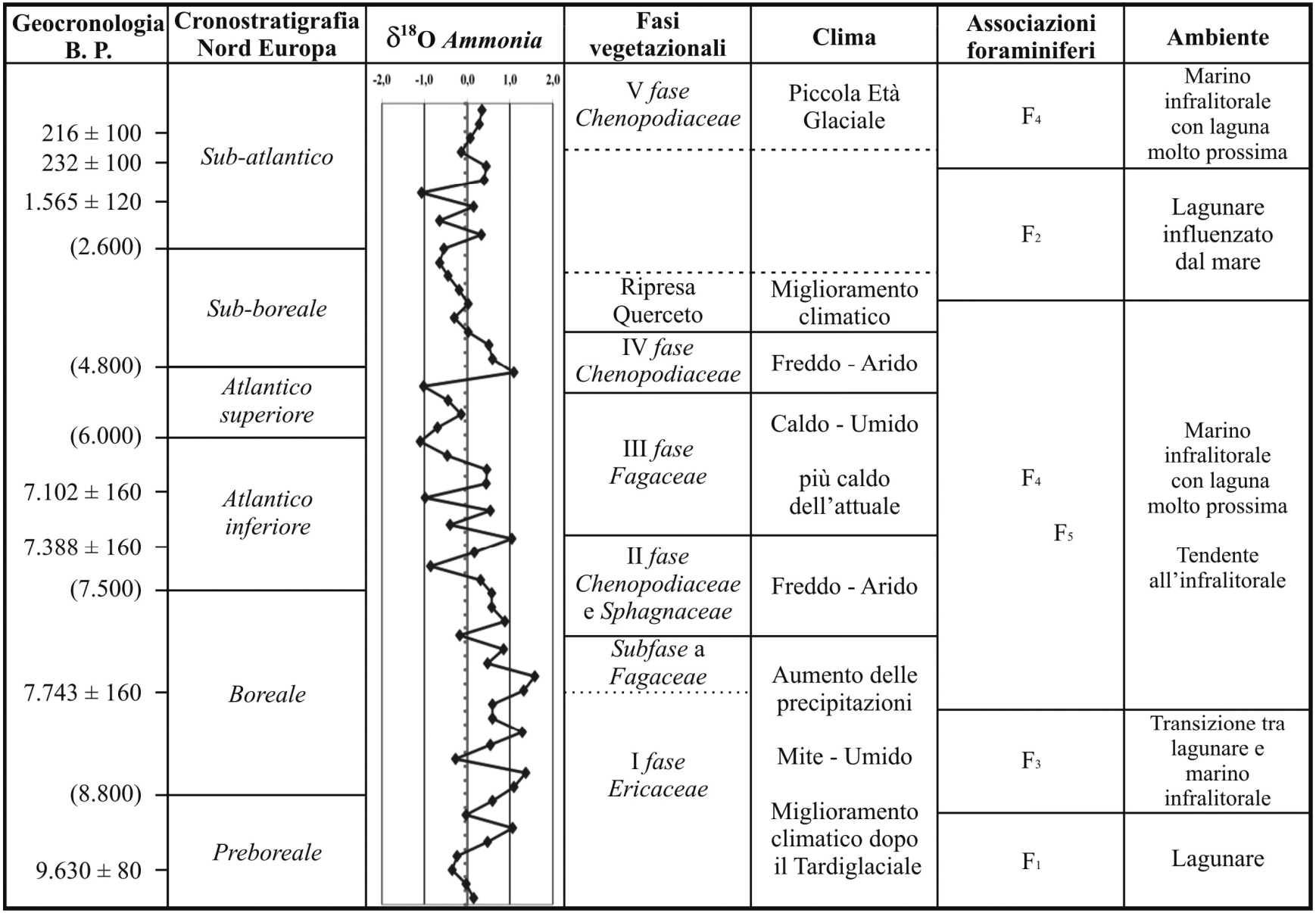

Fig.1, geochronological, chronostratigraphic, of the paleotemperatures, paleovegetation, paleoenvironmental, and paleoclimatic scheme of the studied successions.
Schema geocronologico, cronostratigrafico, delle paleotemperature, paleovegetazionale, paleoambientale, e paleoclimatico delle successioni studiate

and wetter phase with developpement of *Quercus* orest even in the coastal plains followed. The last *Chenopodiaceae* arid and cold phase (*Fifth phase*) fitted with the Little Ice Age (216±100 years B.P.).

Because eustatic changes are not always depend on climate, but climate change almost always produce eustatic changes, the integrated study of microfauna and continental flora provides a much valuable investigation means in the evolution reconstruction of coastal areas and climate evolution of a region.

Climate change producing water temperature and salinity variations, which are recorded in the lagoon from microfaunas through the relation changes of oxygen and carbon isotopes.

The isotopic analysis ($\delta^{18}O$ and $\delta^{13}C$) were carried out on the shells of two species of foraminifera, *Ammonia tepida* and *Elphidium granosum*, good indicators of lagoon and estuarine environments (CRONIN *et al.,* 2005). Were obtained two types of scales for each species: a multi-decadal scale and a multi-centennial scale, obtained by the method of 5-point running average. The long-term variability of $\delta^{18}O$ values (multi-centennial, 200-400 years, time-scales) indicate a variable positive trend from 9.450 to 7.500 years B.P. approximately, and a negative trend from approximately 7.100 to 2.000 years B.P. The multi-centennial time-scale of the $\delta^{13}C$ values indicates a variable decreasing negative trend from 10.00- to 7.700 years B.P., that we regard reflecting increasing salinity waters culminating with the remarkable marine rising of the Holocene Optimum Climaticum. Higher $\delta^{13}C$ negative values from 7.500 to 3.850 years B.P. are regarded as indicative of higher precipitation with higher organic influx of terrestrial origin; whereas the succeeding higher $\delta^{13}C$ values up to 1.850 A.D. are indicative of increasing water salinity. Variable amplitude fluctuations at multi-decadal time-scale, 20-30 years, are superimposed on these long-term trends.

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