NATURAL AND HUMAN-INDUCED ENVIRONMENTAL CHANGES IN THE LAND-SEA INTERFACE OF THE IONIAN SEA - THE LAMINATED SEDIMENTARY RECORD OF LAKE BUTRINTI (ALBANIA)

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Abstract

Lake Butrinti, located in the Ionian Sea shore of southwestern Albania, contains laminated sediments reflecting regional environmental history. A sedimentological and geochemical dataset combined with an excellent chronology indicate that these lacustrine sediments are recording not only changes in Mediterranean climate but also historic anthropogenic and tectonic events affecting the region during the last 260 years.

Keywords : Ionian Sea, Coastal Systems, Global Change, Eutrophication, Geochemistry.

Coastal areas in the Mediterranean realm provide ideal archives of past and present natural and human-induced environmental changes along the land-sea interface. Lake Butrinti, located in southwestern Albania near the Greek border, is a lacustrine archive containing a perfectly laminated sedimentary succession reflecting regional environmental history [1]. On its shore, the antique city of Butrinti, an UNESCO world heritage site, is a unique archaeological example representing a microcosm of Mediterranean history from the archaic Greek until the Venetian cultures providing an unusual source of continuous documentary data. In addition, a meteorological station located in Corfu -relatively close to the lake- provides instrumental data to calibrate the modern response of the lake system to the most recent changes in climate (e. g., precipitation). Our results indicate furthermore that the lake system is responding not only to changes in Mediterranean climate and historical anthropogenic impact on the catchment but that it is also sensitive to the documented regional seismic activity.

Water column data and a first set of sedimentary cores were recovered in summer 2000 within the framework of an Albanian-Swiss cooperative project. Physical properties (density, sonic velocity and magnetic susceptibility) allowed the correlation of a set of sedimentary cores throughout the basin. The recovered cores with a maximum length of 2 m consist of a continuously laminated sequence covering the last 260 years as confirmed by Cs-137 isotopes. Each annual lamina is composed of three characteristic layers. One layer consists of authigenic carbonates, a classical source of lacustrine chemostratigraphy in hard water lakes and one of the best paleoenvironmental archives. The dominant climate of the region is typically Mediterranean combining dry and hot summers with cold and wet winters. This seasonality provides ideal conditions to promote the precipitation of carbonates in the water column that are in turn preserved in the sediments as fine laminae. The microstratigraphical analyses of the sequence using a wide range of techniques such as SEM, X-ray microfluorescence and X-ray diffraction showed distinctive sediment types and a variable composition and morphology of the authigenic carbonates. Next to the carbonate laminae, the varves are composed of layers with organic-rich biogenic constituents and of dominantly detrital particles, respectively.

These results together with C and O stable isotopes in both authigenic carbonates and organic matter, as well as bulk organic matter pyrolysis, have been used to reconstruct the climatic and anthropic influence on Lake Butrinti sediments. They revealed a hypereutrophication trend increasing towards the end of the 20th century and a decadal cyclicity in the varves thickness that might be partially controlled by the North Atlantic Oscillation (NAO) and/or ENSO-like phenomena. Additionally, a comparison of distinctive and well-dated turbidites with historically recorded seismic events indicate that earthquakes may have triggered their formation. Supplementary field investigations, however, are still needed to confirm the influence of these frequent tectonics events in the Balkanic region on the formation of the mass-wasting deposits.

Further retrieving of long cores in Lake Butrinti will provide a potentially varved section of environmental change punctuated by historic anthropogenic impact, covering the late Holocene period on a decadal and even annual scale. In particular the construction of a few-km long channel, already initiated during the ancient Greeks and maintained during Roman and later periods, connected the antique City of Butrinti and the lake to the Mediterranean Sea. This sedimentary archive, hence, might also offer new insights into linking coastal lacustrine deposits and the Mediterranean system.

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