3D PALAEOCHANNEL RECONSTRUCTION IN THE LAGOON OF VENICE THROUGH GEOPHYSICAL EXPLORATION

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Abstract
From 2003 to 2009 an extensive survey in a large area of the Venice Lagoon was carried out by means of acoustic techniques. The measurements were performed in extremely shallow water (up to 0.5 m). The acoustic data revealed the presence in the sediments of a complex network of buried palaeochannels and palaeosurfaces confirmed by numerous ground truth analyses carried out on the cores extracted in the area. In this note, a high spatial resolution sub-bottom mapping of the central Venice lagoon is presented.
Keywords: Lagoons, Geomorphology, Acoustics, Mapping

Introduction
The Lagoon of Venice is the result of natural processes and intense human activities that determined its morphological evolution. The shallowness of the lagoon environment (average depth of about 1m) has for long time prevented the use of acoustic methods in this area. However, recent studies demonstrated that the use of sub-bottom profilers can be very useful to describe different phases of the lagoon evolution ([1], [2], [3] and refs. therein). In this contribution, we present the results concerning ultra shallow water (<1m) acoustic survey in the central lagoon between the industrialised area of Marghera and the city of Venice. The aim of our work is to reconstruct the complex subbottom architecture of a very anthropized environment through a multidisciplinary approach using acoustic and environmental data.

Methodology
With this purpose, a high spatial resolution survey was carried out using a traditional 30 kHz ELAC echosounder (with vertical resolution of about 10 cm) together with a DGPS system. Given the complexity of the buried morphologies, a 50 m parallel line survey grid was carried out in south-north direction (fig. 1).

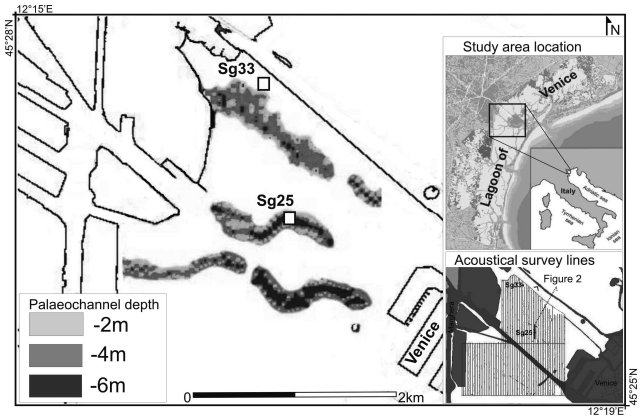

Fig. 1. Study area and acoustic survey line grid (on the right), quasi 3D palaeochannels reconstruction (on the left) and cores SG33 and SG25 position.

In correspondence with interesting acoustic discontinuities, several ground cores were extracted. Here, we present the results of the two cores SG25 and SG33, drilled inside and outside the palaeochannels, respectively.

Results and discussion
The high spatial resolution grid of the acoustic survey allowed a 3D reconstruction of three palaeochannels. Their meandering paths is presented in fig. 1, where, at the same time, the information about the palaeochannel acoustic signal depth is mapped. In particular, the central palaeochannel was intersected by the core SG25. The SG25 stratigraphic record presents mainly clayey-silty sediments from -1.2 to -5.2 m and sandy sediments from -5.2 to -6.60 m from the mean sea level (m.s.l). The ^{14}C dating taken at -5.2 m between the two facies allows the reconstruction of the palaeochannel shape of about 1600 ± 90 cal yrs BP (grey line in fig. 2). The inclined reflectors in the southern side of the acoustic profile correspond to the palaeochannel point bar migration. The grey line seems to separate two different phases: an earlier high energetic regime with sand deposition and channel migration and a later low energetic regime with a finer filling and apparently no migration. The two phases can be related to a change of the area hydrodynamics due to a climate worsening between the IV and VI century AD [4].

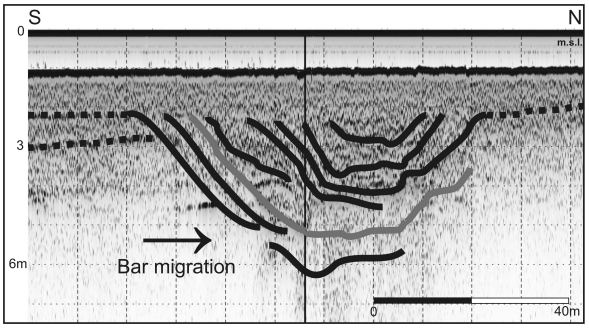

Fig. 2. Buried palaeochannel intersected by the core SG25 (black vertical line). The thick black lines show the channel point bar migration and stratification, while the dashed lines indicate palaeosurfaces. The grey line corresponds to the channel's shape about 1600 ± 90 cal yrs BP.

These palaeochannels probably incided the alluvial sediments, as, in this area, we found the lagoonal sediments down to about 2-3 m from m.s.l.. In particular, the core SG33 shows a transgressive sequence related to the expansion in historical age of the lagoonal margin over the mainland. This sequence is underlined by an environmental succession that goes from the alluvial to the high salt-marsh (at -1.47m) and, eventually, to the low salt marsh environment (at -0.77m m.s.l.).
This multidisciplinary approach allows for the first time a very detailed 3D reconstruction of palaeochannel paths and internal structures, of their meandering behaviour and of the palaeosurfaces evolution related to possible change of the central lagoon hydrology.

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