Il Quaternario
Italian Journal of Quaternary Sciences
24, (Abstract AIQUA, Roma 02/2011), 69 - 70

Congresso AIQUA
Il Quaternario Italiano: conoscenze e prospettive
Roma 24 e 25 febbraio 2011

ON THE RELATION BETWEEN EXTENSIVE PEAT BED AND CLIMATE FLUCTUATION DURING THE LAST GLACIAL IN VENICE

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ABSTRACT: Zecchin M. *et al*., *On the relation between extensive peat bed and climate fluctuation during the last glacial in Venice*. (IT ISSN 0394-3356, 2011)
Core and seismic data from the Venice lagoon area allow a detailed investigation of the Late Pleistocene continental succession accumulated during the last glacial. These deposits consist of an aggrading alluvial plain, some tens of metres thick, which is locally incised by river channels, while both patchy and continuous peat layers complete the succession. One of these peat layers (P1), up to 1 m thick, is well recognizable in the whole lagoon area in both cores and seismic lines. ^{14}C datings of P1 reveal an age ranging between 22 and 24 cal ka B.P., confirming its lateral continuity. All these elements suggest that P1 developed after an episode of marked moisture and large scale cut-off of terrigenous sediment, probably due to enhanced arboreal vegetation cover, leading to the establishment of generalized paludal conditions during the Laugerie interstadial. The present evidence may integrate the current knowledge to establish a correlation between cycles recorded in fully continental deposits and those recognizable in ice cores and marine successions.

RIASSUNTO: Zecchin M. *et al*., *Sulla relazione tra un esteso livello di torba e variazione climatica durante l'ultimo glaciale a Venezia*. (IT ISSN 0394-3356, 2011)
Dati sismici e di carota dall'area della laguna di Venezia permettono uno studio dettagliato della successione continentale tardo pleistocenica accumulatasi durante l'ultimo glaciale. Questi depositi consistono in una piana alluvionale aggradante, spessa alcune decine di metri, che localmente è incisa da canali fluviali, mentre livelli di torba sia continui che discontinui completano la successione. Uno di questi livelli di torba (P1), spesso fino ad 1 m, è ben riconoscibile nell'intera area lagunare sia con carote che con linee sismiche. Datazioni con ^{14}C del livello P1 rivelano un'età compresa tra 22 e 24 ka B.P. calibrati, confermando la sua continuità laterale. Tutti questi elementi suggeriscono che il livello P1 si sia sviluppato in seguito ad un episodio marcatamente umido accompagnato da una diminuzione di apporto sedimentario a larga scala, probabilmente dovuta ad un aumento della copertura arborea, che ha dato luogo all'instaurarsi di generalizzate condizioni palustri durante l'interstadiale Laugerie. La presente evidenza può integrare l'odierna conoscenza per stabilire una correlazione tra cicli registrati in depositi continentali e quelli registrati in carote di ghiaccio ed in successioni marine.

Key words: interstadial, Peat, Venice

Parole chiave: interstadiale, torba, Venezia

The present study is aimed to recognize the signature of climate shifts related to the younger stadial and interstadial phases in the Late Pleistocene continental succession of the Venice area. Relatively high sediment supply and regional subsidence favoured the accumulation of several tens of metres of continental deposits. The present setting allowed changes in sedimentation style due to glacial advancements and retreats to be recorder in the succession. Our objective is therefore to highlight features directly associated to shifts from stadials to interstadials and vice-versa, with particular reference to that occurred across the Laugerie interstadial (DE HEINZELIN, 1961; LEROI-GOUHRAN, 1980). Such a brief phase of climate improvement, having a conventional ^{14}C age of 19.2 ka B.P. (SERANDREI-BARBERO *et al.*, 2005), was originally defined in French continental deposits.

Five cores drilled in the framework of the CARG Project, i.e. ISMAR-1L, ISMAR-2L, ISMAR-3L, OGS-1 and OGS-7, were selected for a detailed investigation along the Pleistocene interval. Seismic data have been acquired in the southern Venice lagoon within the CORILA Sub-Project 3.16, which implemented a very high-resolution (VHR) seismic system adapted for the very shallow water, i.e. less than 1 m depth.
Both VHR seismic profiles and core data allow to investigate down to 30 m in the Late Pleistocene to Holocene sediments of the study area. This succession exhibits a suite of fully continental facies represented by fluvial channel and floodplain deposits, and by swamp sediments consisting of peat layers. Floodplain deposits are volumetrically the most abundant, and they consist

of clayey silt to fine-grained sand containing pulmonata gastropods and their opercula, oogons of *characeae*, seeds, plant remnants, and locally abundant root traces. Peat beds are up to 0.3 m thick, yet they may be grouped to form up to 1 m thick intervals separated by silty and sandy layers. Peats developed in vegetated swamps receiving scarce sedimentation and located in extensive interfluves. Fluvial channel fills are up to 10 m thick and 500 m wide, and in seismic profiles locally show lateral accretion highlighted by well-developed clinoforms. The fill consists of medium-grained sand to silty sand showing a characteristic fining-upward trend. Metre-scale laminated silty clay to silty sand containing pulmonata gastropods, oogons of *characeae*, seeds and plant remnants are locally found, and they have been interpreted as levee deposits.

A well-developed peat layer, locally forming a composite interval up to 1m thick, is recognizable in the whole Venice lagoon area from 10 m below the lagoon floor in the northern sector to 19 m in the southern one, and is lacking only where it has been truncated by fluvial channels. The correlation of P1 in the whole Venice area is sustained by ^{14}C datings, showing an age ranging between 22 and 24 cal ka B.P. The occurrence of a regionally extensive peat layer having a conventional age of ca. 19 ka B.P. was already noted by CORREGGIARI *et al.* (1996) in cores from the Adriatic shelf in front of the Venice lagoon.

Peat layers may result by local processes of river avulsion producing sheltered wetlands (e.g. MIOLA *et al.*, 2006), as well as by larger scale controls such as climate changes. Other possible factors producing wetlands include a decrease of terrigenous supply from the hinterland and the lack of meltwater drainage due to the presence of permafrost (RAVAZZI, 2006). For its extensive development, covering an area exceeding that of the Venice lagoon, a genesis of P1 related to local river meander shifting should be ruled out, and therefore a linkage with large scale controls is inferred. In particular, as pollen data by CANALI *et al.* (2007) revealed that interstadial periods were characterized by an increased arboreal vegetation, probably preventing a significant terrigenous supply, swamps characterized by peat accumulation developed. The correlation between phases of climate improvement and peat formation is reinforced by the determined age of P1, witch fit well with that of the Laugerie interstadial. Such a correlation is generally considered valid also for northern European sites (see FLETCHER *et al.*, 2010 and references therein).

Present data, therefore, suggest that in the Venetian area, Late Pleistocene laterally extensive peat layers tended to develop during phases of climate improvements (i.e. interstadials) due to increased arboreal vegetation cover, which promoted a marked decrease of terrigenous supply from the hinterland. In contrast, active floodplain aggradation occurred during stadial phases, characterized by intense fluvioglacial activity and by a less pronounced vegetation cover. The present results may be very useful to the development of a clearer picture on environmental changes related to climate oscillations during the last glacial at middle latitudes, as well as their linkage with records from ice cores and marine sequences.

ACKNOWLEDGEMENTS

This work was developed in the framework of the following researches: CORILA “Sub-project 3.16, VHRS”; Venice Water Authority-CORILA “Sub-activity 2, SHALLOW”; VECTOR “Action 3, Work Package 5, CLIVEN”. Thanks to CARG Project funded by ISPRA (formerly APAT) and by Regione del Veneto for the provided sediment cores.

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Ms. received: *January 15, 2011*
Testo ricevuto il *15 gennaio 2011*