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POST-LGM FEATURES ALONG THE IONIAN CALABRIAN MARGIN (SOUTHERN ITALY)

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ABSTRACT: Zecchin M. *et al*., *Post-LGM features along the Ionian Calabrian margin (southern Italy).* (IT ISSN 0394-3356, 2011)
CHIRP subbottom profiles performed on the Ionian Calabrian margin, southern Italy, allow the recognition of an irregular seabed topography. It shows both concave-up and concave-down profiles in any dip section and a local stepped geometry, with gradients between 1° and >20°. The steeper slopes are interpreted as relicts of palaeo-coastal cliffs generated by wave action during the post-LGM relative sea-level rise. In particular, the formation of a slope locally exposed between ca. 75 and 100 m water depth is inferred to be related to the melt-water pulse (MWP) 1A (14.3 - 14.0 ka BP), whose depth range corresponds closely with that of this slope, assuming no subsidence or uplift. A transgressive model for high-gradient settings and stepped sea-level rise is proposed. Coastal cliffs develop and retreat due to wave erosion during phases of slow relative sea-level rise. During phases of very high rate of relative sea-level rise, coinciding with melt-water pulses, cliffs tend to be overstepped, drowned and not completely eroded. The present model may be effective in reconstructing stepped sea-level rises and the evolution of shelf areas during Late Quaternary time.

RIASSUNTO: Zecchin *et al*., Caratteristiche successive all'ultimo massimo glaciale lungo il margine ionico della Calabria (Italia meridionale). (IT ISSN 0394-3356, 2011)
Profili sismici CHIRP rilevati lungo il margine ionico della Calabria, Italia meridionale, permettono di riconoscere una irregolare topografia del fondo mare. Essa mostra profili con la concavità rivolta sia verso l'alto che verso il basso in ogni transetto orientato perpendicolarmente alla linea di costa, e localmente una geometria a gradini, con gradienti tra 1° e >20°. I pendii più inclinati sono interpretati come relitti di paleofalesie generate dall'azione dell'onda durante la risalita del livello relativo del mare successivo all'LGM. In particolare, la formazione di un pendio localmente esposto tra circa 75 e 100 m di profondità è interpretata essere collegata al "melt-water pulse" (MWP) 1A (tra 14.3 e 14 mila anni fa), la cui variazione di profondità corrisponde con quella di questo pendio assumendo ne subsidenza ne sollevamento. E' proposto un modello trasgressivo per contesti di gradiente elevato ed innalzamento del livello del mare a passi successivi. La falesie si sviluppano e retrocedono a causa dell'azione erosiva dell'onda durante fasi di lenta risalita del livello relativo del mare. Durante le fasi in cui il tasso di risalita del livello relativo del mare è molto elevato, coincidenti con i "melt-water pulses", le falesie tendono ad essere oltrepassate, annegate e non completamente erose. Il presente modello può essere efficace nel ricostruire risalite a gradini del livello del mare e l'evoluzione delle aree di piattaforma continentale durante il tardo Quaternario.

Key words: Calabrian continental shelf, post-LGM transgression, CHIRP subbottom profiles

Parole chiave: piattaforma continentale calabra, trasgressione successiva all'ultimo massimo glaciale, profili sismici CHIRP

The present study is focused on features developed during the post-LGM transgression on the narrow, high-gradient shelf off the Crotone area (southern Italy) and on the southern part of the Amendolara palaeo-island (API). In particular, peculiar features such as submerged coastal cliffs and a seabed typified by irregular step-like geometry characterize the present area. We recognized this area as suitable to develop a transgressive model for very high-gradient settings characterized by coastal cliff development and irregular topography. Such a model may be useful in recognizing and understanding the features and style of transgression and variations in its rate, particularly for the post-LGM glacio-eustatic rise.

The seabed morphology of the Ionian Calabrian margin reflects the complex interplay between the south-eastward migration of the Calabrian accretionary wedge since mid-Miocene and the rapid uplift of onshore and shallow shelf areas since mid-Pleistocene (MALINVERNO & RYAN, 1986; BONARDI *et al.*, 2001). The uplift, documented by a staircase of marine terraces in the subaerial Crotone Basin, still continues today, and it has been characterized by a rate that, in this area, approximated 1 m/ka (ZECCHIN *et al.*, 2004; ANTONIOLI *et al.*, 2006).

The geophysical data used for this study consist of CHIRP subbottom profiles (SBP) acquired across the Ionian shelf margin (ISM) and the southern side of the API. The information coming from the acoustic character of the SBPs have been combined with the morpho-bathymetric information coming from a high-resolution multibeam dataset.

Two seismic units (Unit 1 and Unit 2), separated by a key stratal surface (Unconformity *U*) are recognizable in the considered SBPs, both along the ISM and API.

Unit 1 is the lower unit, and is truncated above by *U*. This unit is almost opaque along the ISM, but it may show basinward-inclined to variably folded reflectors along the API. A prograding wedge, typified by basinward-inclined oblique reflectors that downlap on a less inclines reflector, is recognizable between 90 and 130 m water depth at the margin of the API and locally along the ISM.

The unconformity *U* separates the older Unit 1 from the younger Unit 2, and is characterized by both concave- and convex-up profiles in dip direction. It exhibits a variable dip from 0.5° to a maximum of ca. 30° at relict scarps locally exposed. One of these features is recognizable between ca. 75 and 100 m water depth along both the ISM and API.

Unit 2 is up to 30 m thick and locally appears as a prograding wedge whose reflectors downlaps on the unconformity *U*. In other cases, it shows onlap relationships with *U*.

The unconformity *U*, which truncates a unit characterized by variably inclined reflectors (Unit 1), is overlain by a younger unit (Unit 2), and is locally exposed forming scarps, represents a surface of regional significance. In particular, it is interpreted as a wave ravinement surface (WRS), produced by wave erosion on the shelf during the post-LGM transgression, truncating a Plio-Pleistocene unit. The prograding wedge located between 90 and 130 m water depth in Unit 1 is interpreted as the lowstand wedge. The deposition of Unit 2 above *U* has been related to the post-LGM glacio-eustatic rise.

The scarp recognizable between 75 and 100 m water depth along both the ISM and API is interpreted as a partially preserved palaeo-coastal cliff. Moreover, such a depth closely matches with the depth range of melt-water pulse (MWP) 1A, during which the eustatic sea-level rose from 96 to 76 m below present sea-level, between 14.3 and 14.0 ka BP (Liu & Milliman, 2004). This suggests a correlation between the stepped sea-level rise following the LGM and the preservation of coastal cliffs along the continental margins. In particular, it is suggested that the palaeo-coastal cliff recognized between 75 and 100 m water depth generated and started to recede during a phase of slow eustatic rise, and was then overstepped and partially eroded during a subsequent phase characterized by very rapid eustatic rise (i.e. the MWP 1A), otherwise its progressive dismantling would have occurred. This consideration is valid assuming a rough balance between regional uplift and subsidence of glacio-hydro-isostatic origin as shown by Pirazzoli *et al.* (1997). Younger accelerations and decelerations of sea-level rise, such as MWP-1B (58-45 m below present sea level, 11.5-11.2 ka BP), could be responsible for the formation of some shallower scarps found in our SBPs.

A transgressive model for high-gradient shelves during the post-LGM glacio-eustatic rise is proposed. Where the transgressed topography is very steep, coastal cliffs developed and retreated during the initial phase of relatively slow sea-level rise, due to wave erosion acting at the toe of the cliff. During phases of very high rate of sea-level rise, coinciding with melt-water pulses, cliffs tended to be overstepped and not completely eroded by the WRS. This model needs further testing in other contexts characterized by high-gradient shelf topography, but it has the potential to be useful in recognizing variations in the rate of sea-level rise and in general in reconstructing the Late Quaternary evolution of shelf to coastal areas.

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