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Sedimentary structures offshore Ortona, Adriatic Sea — Deformation or sediment waves?

Christian Berndt [a,*], Antonio Cattaneo [b], Magdalena Szuman [a,1], Fabio Trincardi [c], Doug Masson [a]

[a] *National Oceanography Centre, European Way, Southampton, SO14 3ZH, UK*
[b] *Ifremer, Centre de Brest, Plouzané, France*
[c] *ISMAR–CNR, Bologna, Italy*

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Abstract

The late Holocene mud wedge on the Adriatic shelf offshore Ortona, Italy, shows undulating sub-parallel seismic reflector sequences which extend several kilometres along strike and 100–200 m down-dip in water depth between 20 and 80 m. The amplitude of such undulations is up to 5 m and the undulations continue as stacked sediment packages downwards throughout the 35 m thick mud wedge. The undulations are separated by 4° to 5° dipping boundary zones and at first glance these sediment undulations resemble the seafloor sedimentary structures visible in the Humboldt Feature offshore California. There is an ongoing debate whether seafloor undulations are the result of deformation processes or sediment deposition and/or reworking due to submarine shelf currents. A dense net of recently reprocessed and digitally interpreted high-resolution Chirp seismic data on the Adriatic shelf favours an interpretation that these undulations developed, in the upper part of the stratigraphic section through sediment reworking rather than through deformation. There are three lines of evidence for this: (1) the spatial extent of the undulations coincides with higher seabed reflector amplitudes than found both on the shelf and in the distal part of the shelf. If the features were solely caused by slope failure there should be no change of amplitudes, (2) the seabed reflector amplitude is generally higher on the gently dipping or flat upslope limbs than on the steeper downslope limbs, supporting a current origin that causes preferred deposition of sediments with higher acoustic impedance on the top, (3) the boundaries between the undulations are dipping at angles that are much lower than the angle of internal friction of these sediments excluding that a simple model like the Mohr–Coulomb under gravitational loading could describe the undulations as sediment deformation and failures.

Keywords: sediment waves; submarine creep; seismic amplitudes; Adriatic Sea

1. Introduction

The seafloor is frequently affected and shaped by instabilities as a result of gravitational forces and other forces including earthquakes and waves. The resulting mass movements are controlled by diverse processes and take the form of rotational slumping, debris flows or turbidity currents (Mulder and Cochonat, 1996). In

* Corresponding author. Tel.: +44 23 80596545; fax: +44 23 80596554.
E-mail address: cbe@noc.soton.ac.uk (C. Berndt).
[1] Now at: Department Geology and Petroleum Geology, University of Aberdeen, UK.

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addition, it has been proposed (Hill et al., 1982) that submarine slopes can also “creep” to explain the observation of stacked packages of marine sediments that are separated by seaward dipping boundaries. Creep is defined as slow plastic deformation of rocks under a continuous load (e.g. Leet, 1982). It is a common

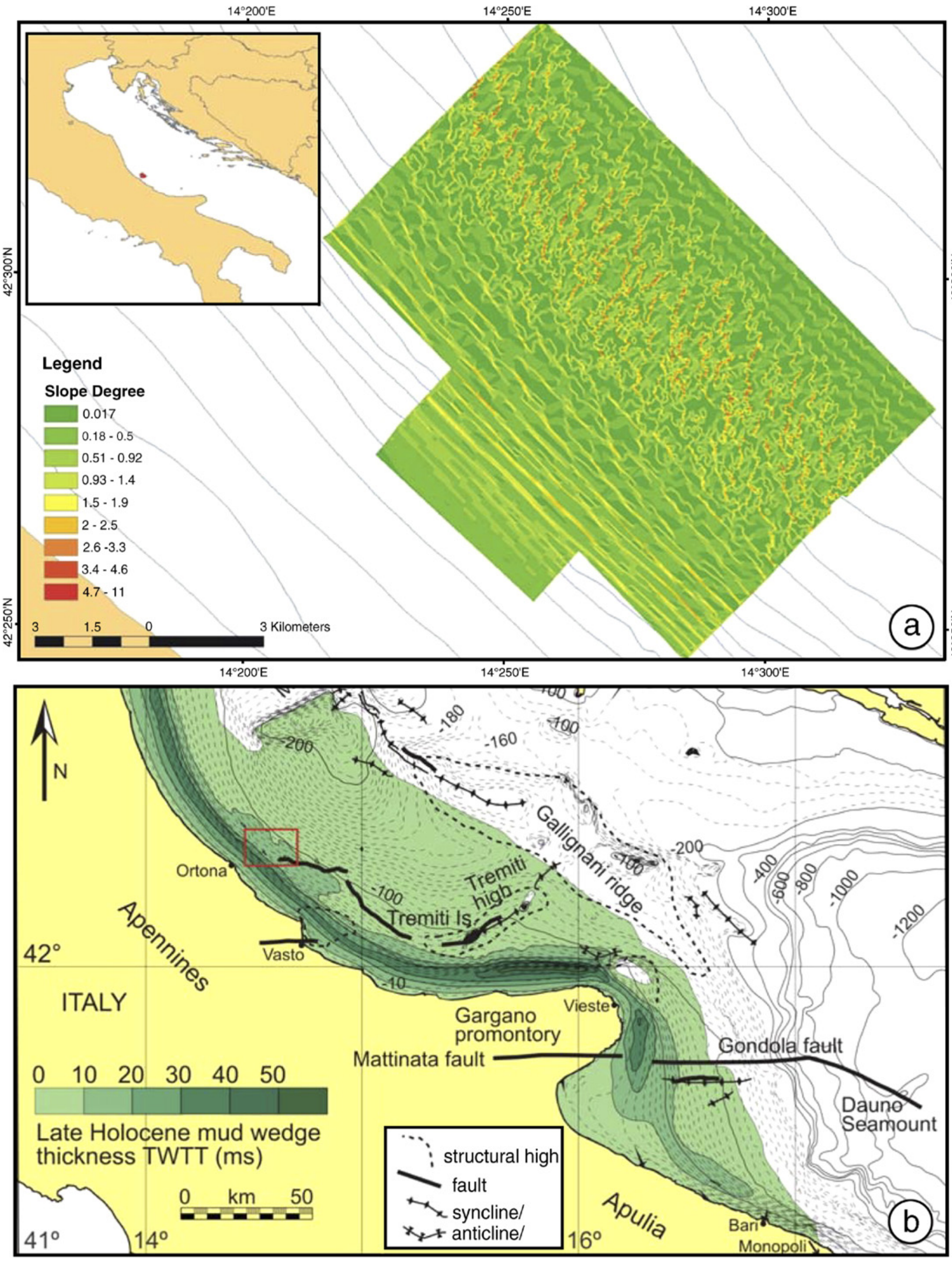

Fig. 1. The study area (red box in b) is located in the western central Adriatic Sea (regional map) and comprises the late Holocene high-stand systems tract whose thickness is reported in green shades from Correggiari et al. (2001) in b. a) is the multibeam bathymetry derived slope gradient map showing the pronounced difference between the NW–SE striking undulations in the foreset and the SW–NE striking mud relief structures in the distal part. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)