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The relationships between soft-sediment deformation structures and synsedimentary extensional tectonics in Upper Triassic deep-water carbonate succession (Southern Tethyan rifted continental margin — Central Sicily)

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ABSTRACT

We describe soft-sediment deformation structures into the Upper Triassic cherty limestone outcropping in the Pizzo Lupo section (Central Sicily, Italy), pertaining to the deep-water palaeodomain of the Southern Tethyan margin.

In the study section, mainly consisting of thin-bedded mudstone/marl alternations with bedded chert intercalations, some lithofacies have been separated on the basis of the abundance of the calcium carbonate/clay content and the overall textural features.

The deformational structures, displaying different deformational styles as folded and faulted beds, disturbed layers, clastic dikes, and slumps occur mainly in the deformed horizons that involve marl-dominated lithofacies. Small-scale water-escape structures involve beds with nodular fabric. Synsedimentary faults affect the mud-limestone dominated lithofacies, which are characterized by fault-rotating blocks producing lateral thinning. These bodies appear to have moved coherently along an overall planar surface.

We relate these soft-sediment deformations to slump sheets, associated with down-slope sliding of sedimentary masses. The deformation mechanism and driving force for these soft-sediment deformations are due essentially to gravitational instability and dewatering. Detailing, rotational (slump) and translational (glide) slides and water-escape are the main processes causing the distinguished deformational styles.

The synsedimentary extensional tectonics that affected the Upper Triassic pelagic deposits was the triggering process responsible for the instability of the seafloor inducing loss of coherence of the unconsolidated sediments on the sea bottom, developing a large number of gravity-driven slides.

The analysis of both of these SSDSs and their relationships with the structural scenario allow us to hypothesise that they are seismically-induced.

1. Introduction

Soft-sediment deformation structures (SSDSs) record sedimentary and tectonic processes in most depositional environments as far as they occurred during/after sedimentation and before complete lithification (Seilacher, 1969; Lowe, 1975; Allen, 1982, 1986; Maltman, 1984, 1994; Leeder, 1987; Pratt, 1994; Obermeier, 1996; Van Loon, 2009; Audemard and Michetti, 2011).

They develop when primary stratification is deformed by a system of driving forces (sensu Owen, 1987), such as gravitational instability, overloading, wave-induced stress, and reverse density gradient, while the sediment is temporarily in a weakened state due to the action of a deformation mechanism such as liquefaction or fluidization (Allen, 1982; Owen and Moretti, 2011; Moretti et al., 2011).

The classification of the SSDSs is based on morphological features: load casts, drop and flame structures, clastic dykes, disturbed laminites, convolute laminations, slumps, recumbent folds, and synsedimentary faults (Montenat et al., 2007; Van Loon, 2009; Owen et al., 2011; Moretti and Van Loon, 2014).

Among the various SSDSs, those induced by earthquakes can be related to the tectonic activity. Thus, seismites (Seilacher, 1969) are common on passive continental margins, in trenches at subduction zones, and in strike-slip environments. Because rocks from all these tectonic environments could be incorporated into orogens, often they occur also in fold and thrust belts (Waldron and Gagnon, 2011).

In ancient deep-water pelagic deposits the stratigraphic signature evidencing coseismic deformation (i.e. earthquakes) and synsedimentary tectonics is not easily recognized due to their peculiar depositional

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setting, characterized by low-angle and uneven physiography. Several examples of seismically-induced slides and slumps related to low-angle slope irregularities at the water–sediment interface have been reported from deep-water deposits (Field et al., 1982; Kastens, 1984; Martinsen, 1994; Moretti et al., 2001; Morsilli et al., 2002; Vernhet et al., 2006; Bergerat et al., 2011; Odonne et al., 2011) and have also been reproduced through liquefaction in laboratory shaking-table experiments (Owen, 1996; Moretti et al., 1999).

This study deals with the SSDSs occurring in the Upper Triassic deep-water carbonates, outcropping in the easternmost Sicanian Mts (Central Sicily, Fig. 1) that in the present-day setting appear as a strongly shortened rock succession. In this paper we analysed in detail the SSDS of the lowermost part of the Mesozoic section of Pizzo Lupo, partly described in Basilone et al. (2014). With respect to the previous study, major field observations in near areas have permitted us to define the occurrence of several soft-deformed intervals, their typologies and internal deformations, and to better define their genetic mechanisms, framed in a large-scale environmental-palaeophysiographic model. These features accompanied by synsedimentary faults help us to evaluate the active deformation during the study time interval.

In order to contribute to the discussion about the environmental significance of SSDSs developed in carbonate successions, the present

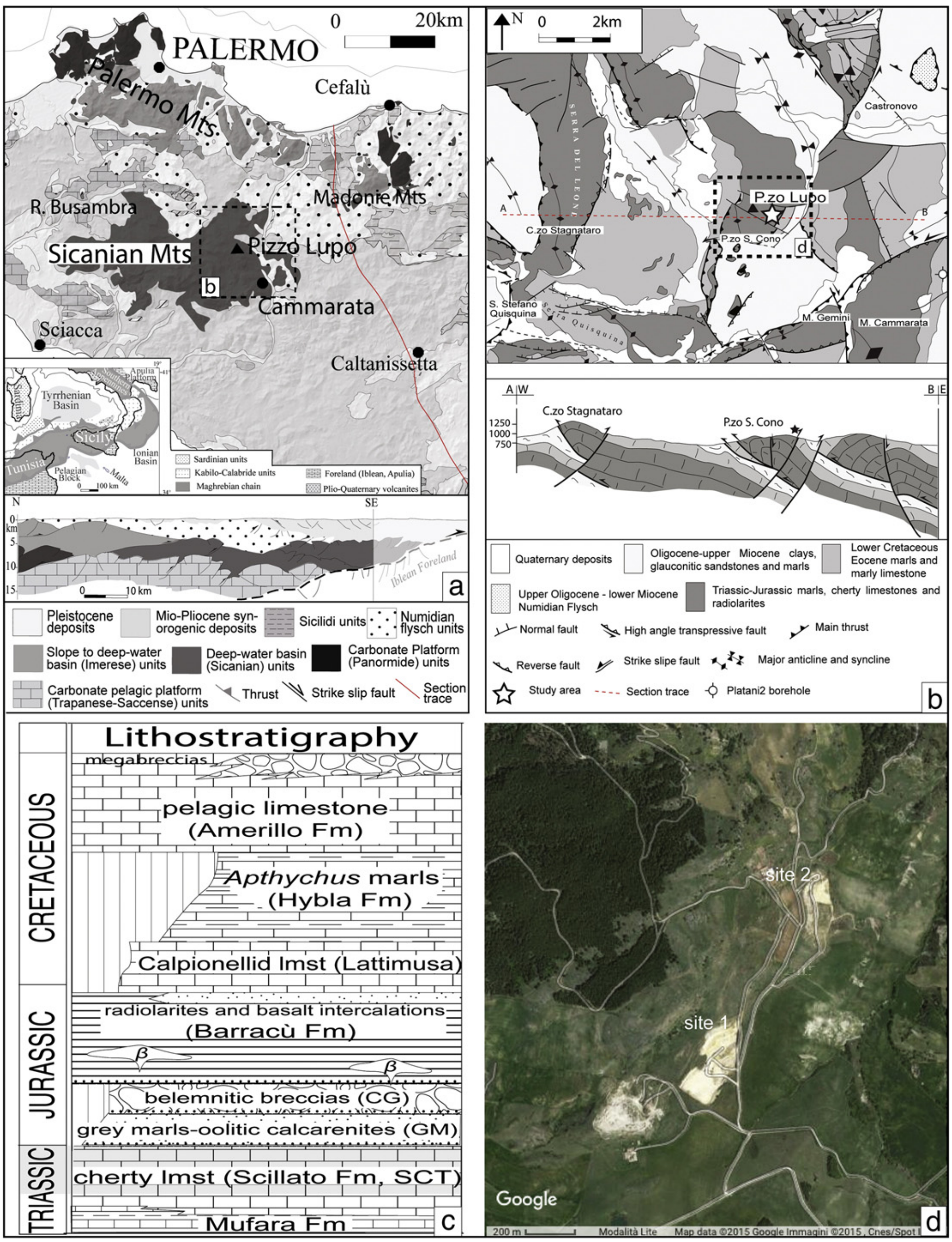

Fig. 1. a) Simplified geological map of Central Sicily (inside the tectonic map of Central Mediterranean, after Catalano et al., 2013b) and schematic geological section; b) geological map of the eastern Sicanian Mts and geological cross-section; c) lithostratigraphy of the Mesozoic Sicanian succession (from Basilone et al., 2016); d) location of the investigated quarries (Google Earth satellite map).