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Basin analysis in the Southern Tethyan margin: Facies sequences, stratal pattern and subsidence history highlight extension-to-inversion processes in the Cretaceous Panormide carbonate platform (NW Sicily)

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ABSTRACT

In the Mediterranean, the South-Tethys paleomargin experienced polyphased tectonic episodes and paleoenvironmental perturbations during Mesozoic time. The Cretaceous shallow-water carbonate successions of the Panormide platform, outcropping in the northern edge of the Palermo Mountains (NW Sicily), were studied by integrating facies and stratal pattern with backstripping analysis to recognize the tectonics vs. carbonate sedimentation interaction.
The features of the *Requienid* limestone, including geometric configuration, facies sequence, lithological changes and significance of the top-unconformity, highlight that at the end of the Lower Cretaceous the carbonate platform was tectonically dismembered in various rotating fault-blocks. The variable trends of the subsidence curves testify to different responses, both uplift and downthrow, of various platform-blocks impacted by extensional tectonics. Physical stratigraphic and facies analysis of the *Rudistid* limestone highlight that during the Upper Cretaceous the previously carbonate platform faulted-blocks were subjected to vertical movements in the direction opposite to the displacement produced by the extensional tectonics, indicating a positive tectonic inversion.
Comparisons with other sectors of the Southern Tethyan and Adria paleomargins indicate that during the Cretaceous these areas underwent the same extensional and compressional stages occurring in the Panormide carbonate platform, suggesting a regional scale significance, in time and kinematics, for these tectonic events.

1. Introduction

During the Cretaceous time interval, both tectonics and paleoenvironmental changes conditioned the stratigraphic evolution of the successions that developed along the Tethyan margins.

At that time, the Tethyan ocean started its closure, alternating extensional and compressional tectonic phases, and giving rise to the peri-Mediterranean orogens of the Alpine system (Frizon de Lamotte et al., 2009; Roure et al., 2012 and reference therein). Positive tectonic inversion, acting as thrust or reverse faults, began modifying the paleotopography of the area, also inducing paleoenvironmental changes (Glennie and Boegner, 1981; Gillcrist et al., 1987; Williams et al., 1989; Mitra, 1993; Turner and Williams, 2004; Butler and McCaffrey, 2004).

The Cretaceous paleoceanographic and climatic changes, during which periods of global warming (greenhouse conditions) alternated with periods of cooling (icehouse), caused the formation of anoxic levels (OAEs, Arthur et al., 1990; Menegatti et al., 1998), biotic extinctions (Larson and Erba, 1999), drowning and demise of carbonate platforms (Weissert et al., 1998; Wissler et al., 2003; Immenhauser et al., 2005; Masse and Fenerci-Masse, 2013). Changes in the CO_2 availability were addressed to the tectonic and volcanic processes acting on a global scale (Larson, 1991; Tarduno et al., 1991).

Subsurface and outcropping positively-inverted basins of the Mesozoic Tethyan continental margins are described in the Alps (Ziegler, 1989; De Graciansky et al., 1989; Butler, 1989; Roure et al., 1994), the Apennines (Roure et al., 1991; Doglioni et al., 1999; Bigi and Costa Pisani, 2005; Butler et al., 2006), the Pyrenees and European foreland (Cloetingh et al., 2007), and the Atlas (Bracene and Frizon de Lamotte, 2002; Benaouali-Mebarek et al., 2006; Frizon de Lamotte et al., 2009). Many of these examples are proof of the control exerted by inherited normal faults, which usually formed during rifting tectonics, on the geometry and evolution of the subsequent fold-and-thrust belt. There are different ways to properly visualise positive tectonic inversion in the outcropping structures and subsurface inverted basins. These methods include the application of kinematics analysis, thickness variations versus time, cross-section correlations, and seismic reflection interpretations. There are fewer applications based on evidence of facies variation in inverted tectonic basins, where shallow-water carbonate sedimentation occurs (Herkat and Guiraud, 2006).

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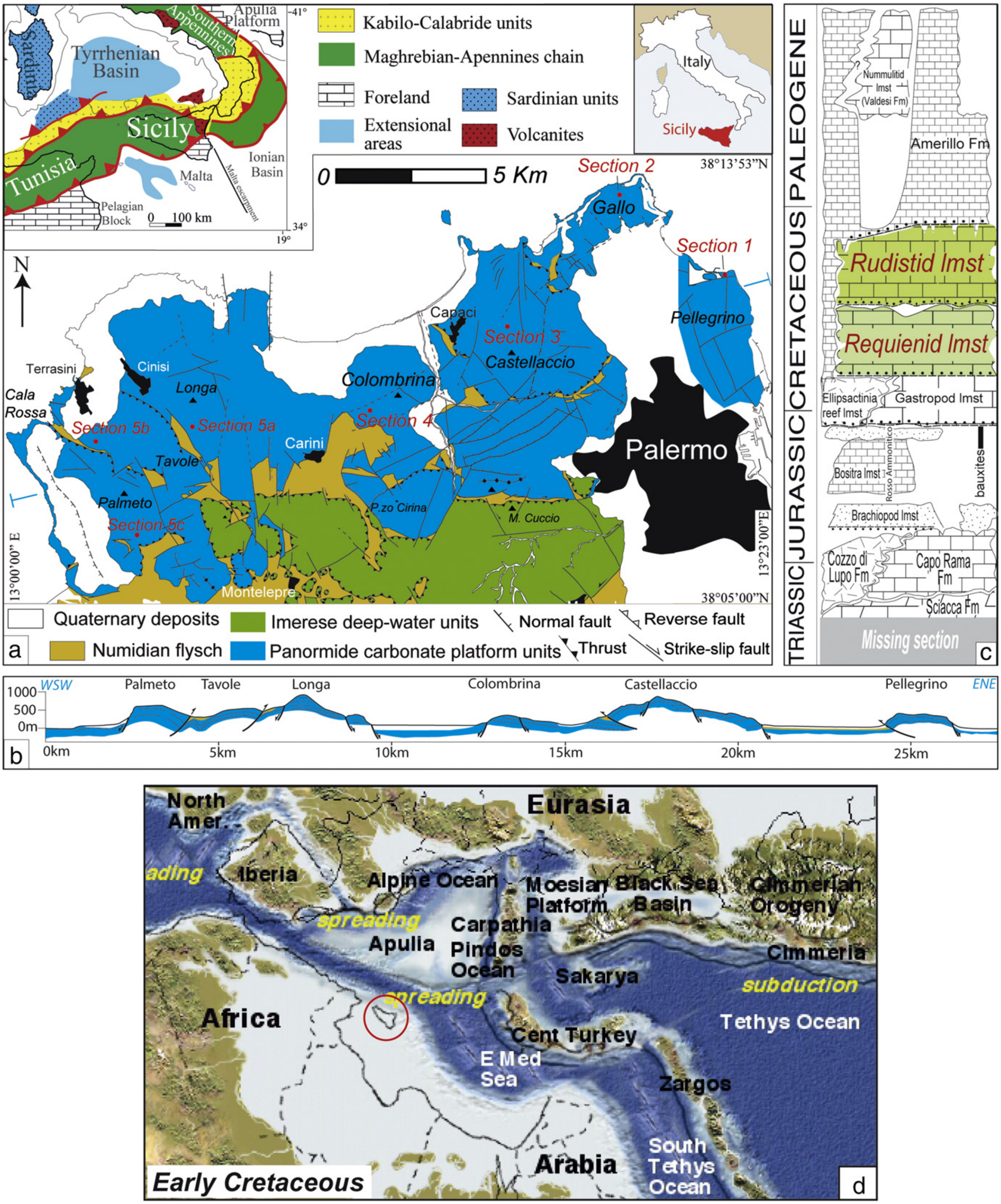

Fig. 1. a) Tectonic map of the Palermo Mts. and location of the study area (after Catalano et al., 2013b). Inset tectonic map of the Central Mediterranean; b) ENE-WSW cross section (see trace in Fig. 1a) showing the Panormide tectonic units outcropping in the northernmost area of the Palermo Mts. (Fig. 1a) imbricated along N-S and NW-SE trending thrusts; c) lithostratigraphy of the Mesozoic Panormide carbonate platform succession outcropping in the Palermo Mts.; d) Mediterranean paleogeography during the Early Cretaceous, modified after http://jan.ucc.nau.edu/~rcb7/globaltext.html. Sicily (red circle) is a sector of the Southern Tethyan passive margin adjacent to an oceanic crust subjected to spreading. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)
Panel a is after Catalano et al. (2013a). Panel c is after Basilone (2018).