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The carbonate mass transport deposits of the Paleogene Friuli Basin (Italy/Slovenia): Internal anatomy and inferred genetic processes

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ABSTRACT

The Paleogene carbonate "megabreccia" units of the Friuli Basin are composite deposits produced by catastrophic shallow-water carbonate platform collapses re-deposited in relatively deep-water inner foredeep settings developed at the front of the advancing Dinaric thrust system. These thick, basin-wide mass transport deposits (MTDs) record the catastrophic emplacement of bipartite slide masses, comprising a lower coherent/cohesive blocky flow and an upper grain/turbulent flow. We here present the results of micro- to outcrop-scale structural analyses, constrained by stratigraphic and sedimentologic observations, performed to identify the internal deformation mechanisms and the emplacement processes of four of the largest MTDs exposed in two large three-dimensional outcrops: the Vernasso (NE Italy) and Anhovo (W Slovenia) open-pit quarries. Our results reveal a variety of primary (sedimentary) soft sediment deformation structures testifying fluid overpressure conditions within the brecciated, fine-grained matrix that sustain, intrude and surround slide blocks and clasts. Meso-scale structural analyses unraveled paleo-transport directions toward the N for the Vernasso quarry and toward the S for the Anhovo quarry. This suggests a forced propagation of the mass transport events controlled by the shape of basin, and reinforces the interpretation of different source areas related to multiple collapses from a carbonate platform rimming the southeastern tip of the basin. These units are thought to represent exhumed fossil examples of the MTDs extensively mapped in the present-day, carbonate-dominated continental margins, and thus, considered as reliable analogues for integrated studies.

1. Introduction

Basin-wide deposits that originated from submarine landslides and slope failures largely crop out in the sedimentary record of mountain chains worldwide (see, among many others, Arnaud and Eyles, 2002; Lucente and Pini, 2003, 2008; Alonso et al., 2006; Burg et al., 2008; Callot et al., 2008a; Van der Merwe et al., 2009; Yamamoto et al., 2009; Alves and Lourenco, 2010; Codegone et al., 2012; Ogata et al., 2012a). These deposits represent either the products of a single depositional event (mass transport deposit, MTD) or composite bodies originated by subsequent superposed events (Lucente and Pini, 2003; Ogata et al., 2012a,b). The latter are defined as mass transport complexes (MTCs), following the seismo-stratigraphic definitions introduced by Weimer (1989). Each individual deposit is often partitioned in different parts characterized by specific deformational styles and interpreted as products of discrete masses moving differentially, and, more generally as the result of the coexistence of more submarine en-masse flow processes (Strachan, 2002; Lucente and Pini, 2003; Ogata et al., 2012a). From the point of view of the internal structures and kinematics, the lower slide surface and the shear zones separating the individual masses inside the body are characterized by different structural associations, ultimately suggesting different mechanisms of movement (Pini et al., 2012). Among the possible mechanisms, the dispersive force due to the grain-to-grain interactions (Middleton and Hampton, 1973; Melosh, 1987) and the interstitial fluid overpressure within a hyper-concentrated sedimentary matrix (Mutti, 1992; Mutti et al., 2006; Callot et al., 2008b; Ogata et al., 2012a,b) are the most likely.

The Paleogene carbonate "megabreccias" of the eastern Friuli (Italy) and western Slovenia are thick and laterally extensive mass transport deposits (MTDs hereafter), originated from the accumulations of heterogeneously-sized carbonate debris, with the largest bodies

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