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Mass-Transport Complexes (MTCs) and Their Sequence Stratigraphic Context: A 3-D Seismic Reflection Case Study From the Santos Basin, Offshore Brazil

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ABSTRACT

Sediment is typically delivered to submarine slopes by a combination of wave-, tide- and river-processes, and strike-fed slope belts. Interaction of these processes drive the construction and progradation of continental margins. However, slope degradation and collapse is also common on continental margins, with MTC stratigraphic emplacement controlled by base-level variations or other dynamic triggers (e.g. seismicity). The resulting remobilisation of previously deposited material as MTCs has profound implications for slope-basinfloor geomorphology and sediment dispersal patterns. Understanding of how these processes vary temporally and spatially and their impact upon petroleum systems development, has been greatly enhanced by field-based studies. Nevertheless, these studies are limited to observations from broadly two-dimensional outcrop belts. As such, strike variability in slope degradation and progradation, and the dispersal of sediments to the lower slope and basinfloor, is often poorly constrained. Here, we use a 3D seismic reflection survey located in the Santos Basin, offshore Brazil, to investigate the role that outer shelf-to-upper slope collapse, MTC emplacement, and subsequent slope re-establishment have on margin progradation. These data image a series of early Palaeogene, south-eastward prograding clinoforms. Periodically, large tracts of the outer-shelf-to-upper slope collapsed, forming a strongly scalloped margin. Margin collapse resulted in the emplacement of at least two slope-attached MTCs on the proximal basinfloor. The basal shear surface of the lower MTC is characterised by deep (c.10 m), slope parallel grooves, whereas more irregular relief defines the top of the composite MTC body. Within the MTCs, we identify a range of kinematic indicators associated with extensional and compressional domains. Margin collapse generated accommodation on the outer shelf-to-upper slope; this accommodation was healed by clinothems that nucleated at the headwall scarp, and prograded basinward, downlapping onto the underlying MTCs. We show that numerous degradational and constructional processes control net-progradation of continental margins, and that 3D seismic data is a vital tool in documenting the associated processes and their products. By integrating previous 2D seismic stratigraphic studies and our own observations, we propose a predictive model for MTC emplacement and assess the implications for stratigraphic trapping and basin evolution.