Cyclic depositional processes on a mixed turbidite-contourite system in northern Campos Basin, SE Brazil

Bruna Teixeira Pandolpho[*1,2], Antonio Henrique da Fontoura Klein[3], Isadora Dutra[4], Michel M. Mahiques[5], Adriano R. Viana[6], Gilmar Vital Bueno[4], Arthur Antonio Machado[7], Yuri L. Camargo[8], Cízia M. Hercos[9], Yhaohannah Lima[10], Antonio Fernando H. F. Filho[11], Carlos E. Theodoro[9]

[*1]Graduate Program in Oceanography, Coastal Oceanography Laboratory, Federal University of Santa Catarina, Campus Trindade, Florianópolis/SC, Brazil (b.pandolpho@gmail.com).
[2]GEOMAR Helmholtz-Centre for Ocean Research Kiel, Wischhofstrasse 1-3, 24148 Kiel, Germany (bpandolpho@geomar.de) – *Corresponding Author*
[3]Coastal Oceanography Laboratory, Federal University of Santa Catarina, Campus Trindade, CP 88040-900, Florianópolis/SC, Brazil.
[4]Geosciences Institute, Fluminense Federal University, Rio de Janeiro/RJ, Brazil.
[5]Oceanographic Institute, University of São Paulo, São Paulo/SP, Brazil.
[6]Exploration/Exploration Projects, Petrobras, Rio de Janeiro/RJ, Brazil.
[7]Geoscience Institute, Room 318A1, Federal University of Bahia, Salvador/BA, Brazil.
[8]Schlumberger, Rio de Janeiro/RJ, Brazil.
[9]CENPES, Petrobras, Rio de Janeiro/RJ, Brazil.
[10]Graduate Program in Oceanography, Ocean Dynamics Laboratory, Federal University of Santa Catarina, Florianópolis/SC, Brazil.
[11]Ocean Dynamics Laboratory, Federal University of Santa Catarina, Campus Trindade, CP 88040-900, Florianópolis/SC, Brazil.

Abstract

A new mixed turbidite-contourite system is described in the northern Campos Basin, southeastern Brazilian margin. This system is developed in a middle slope setting, and was formed through non-synchronous interaction between the turbidity current and a contour current in the same stratigraphic interval (Miocene). Based on seismic attributes, seismic facies, and isochron maps, diagnostic features on alternating cycles of downslope and alongslope processes were identified in the study area, along with an intermediate stage with features from both processes also referred to as a mixed system. Seismic units were then associated with the dominant type of current responsible for their depositional process. The two main currents activity and processes, along- and downslope, can be distinguished through the acoustic characteristics (root-mean-square (RMS) amplitude values), internal architecture, and external geometry pattern of their deposits. While alongslope currents deposits consist of mainly low RMS amplitude values clinoforms with an alongslope trend; the downslope gravity deposits present high-amplitude or chaotic seismic facies, usually higher values of RMS amplitude, channel or channel-lobe features, erosive surfaces,

and a basinward depositional trend. The first and oldest seismic unit, S1, was interpreted as a dominantly alongslope system, with low-amplitude aggrading sigmoidal clinoforms, commonly associated with fine-grained deposits and interpreted as a plastered drift. Basinward, mass transport deposit derived from previous drift instability are identified. Seismic unit S2 represents the intermediate stage where both gravity-driven and along-slope currents act asynchronously. It is referred to as a mixed turbidite-contourite sequence that shows high-amplitude sediment waves migrating upslope and a moat feature carved in its upslope front. The interfingering between high- and low-amplitude reflectors, distal chaotic facies, together with sediment waves and a channel moat, points to a sand-rich deposit that was reworked by northward-flowing contour currents. Seismic units S3 and S4 show downslope features with chaotic facies (S3) and paleochannels with coarse basal lag deposits interpreted after the high RMS amplitude values (S4). In S4, a series of long-lived submarine channels formed. The last seismic unit, S5, referred to as the second plastered drift sequence, is marked by a terraced and low-amplitude clinoforms that thin basinward. Important information on the paleocurrents' direction was also made based on the final deposits display (e.g. terraces, sediment waves and paleochannels). Research on alternating dominant processes and transitional stages or mixed depositional systems may provide a better understanding of deep-water depositional processes. Because these processes do not always fit previous depositional models that are mainly described for synchronous systems, new insights on cyclic non-synchronous mixed systems can improve our understanding of how mixed systems are organized through time and space. Through these systems we can also determine which were the dominant processes that controlled the sedimentation by indicating periods where the margin was mostly submitted to sediment transfer from continent to the basin and periods where the oceanic currents prevailed by redistributing sediments along the isobaths. Setting new models on cyclic deposits and intermediate stages can have a future economic impact on potential hydrocarbon reservoir architecture.