

Different styles in configuration of the contouritic drifts in the northern sector of the Argentine Continental Margin: implications in slope stability and geohazard

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Abstract: *The northern sector of the Argentine Continental Margin includes areas with significant differences in the morphosedimentary configuration of the contouritic drifts. In the northernmost part (MP area) they are represented by relatively continuous deposits not deeply affected by gravity downslope processes, whereas in the southernmost part (BB area) they are discontinuous and highly dissected by mass-transport and turbiditic deposits. These differences can be addressed to local conditioning factors manifested in a different morphology of submarine canyons, tectonic influence and sediment dynamics, which have relevant implications in slope stability and geohazard.*

Key words: *Argentine Continental Margin, contouritic drifts, sediment dynamics, slope instabilities, geohazard.*

INTRODUCTION

The Argentine Continental Margin (ACM) contains one of the largest contouritic depositional systems (CDS) worldwide (Hernández Molina *et al.*, 2009). In the passive sector of the margin (36 to 50°S) the CDS extends along ~1600km at water depths between 400 and 4000m, shaping the continental slope and rise that together reach a maximum width of ~500km (Fig. 1). Other contouritic systems develop off the continental rise in the Argentine basin at depths >5000m. All these systems are genetically linked to the activity of the different branches of the Antarctic-sourced water-masses that form the regional oceanographic system of the South Western Atlantic Ocean (Antarctic Bottom Water, Circumpolar Deep Water, Antarctic Intermediate Water and Malvinas Current), in whose interfaces high dynamic with strong currents produce erosive and depositional processes that modelate alongslope terraces characterizing the margin morphology.

The extension of the CDS and the diversity of geotectonic settings where it develops are evidenced in distinct morphosedimentary configurations. In the present contribution two key areas in the northern sector of the CDS are described, one of them deeply affected by slope instabilities as a result of interaction among diverse conditioning factors. This research highlights the implications of contouritic deposits as important tools for assessing the geohazard in the ACM.

REGIONAL CHARACTERISTICS OF THE CDS

The ACM depicts two major configurations. In the southern region (central and south Patagonian Margin) the margin cross-section has a convex shape; the CDS is there represented by wide contouritic terraces mainly formed by mounded and sheeted drifts of good lateral continuity, shaped in five stepped subhorizontal mixed (erosive and depositional) features, separated by inclined erosive surfaces (Hernández Molina *et al.*,

2009). Large submarine canyons with strong evidences of contouritic affectation develop in the northernmost part of this southern region.

The northern region (north Patagonian margin and Rio de la Plata cratonic margin) shows a concave-shaped cross-section, composed of extended contouritic terraces in the middle and upper slope formed by mounded drifts; an erosive inclined surface develops seaward of the middle slope, whereas the lower slope is mainly composed of plastered drifts that grade offshore to turbiditic complexes and mass wasting deposits that dominate in the continental rise (Hernández Molina *et al.*, 2009; Violante *et al.*, 2010; Krastel *et al.*, 2011; Preu *et al.*, 2012; 2013). Submarine canyons with varied morphologies and sizes are present in this region.

MORPHOSEDIMENTARY FEATURES IN THE NORTHERN SECTOR OF THE CDS

Ongoing research activities in the northern sector of the Rio de la Plata cratonic margin (37-42°S), led to find significant differences between two key areas: Mar del Plata -MP- and Bahía Blanca -BB- (Fig. 1). MP area is characterized by relatively continuous and well developed contouritic drifts with few evidences of affectation by gravitational downslope processes, except close to the large submarine canyons (e.g. Mar del Plata canyon) and also individual landslides and slumps. Instead, BB area depicts discontinuous, highly dissected contouritic bodies cut by numerous small canyons and features associated to sedimentary instabilities like large landslides, mass transport, debris flow and turbidite deposits, as well as normal and thrust faults affecting the drifts. The Bahía Blanca canyon seems to be the most active transverse-to-the-margin feature in this area.

DISCUSSION AND CONCLUSIONS

Differences between MP and BB areas represented by distinct configurations of the contouritic drifts and the varied influence of gravity downslope processes,

allows defining the sectors of the margin affected by major slope instabilities. Since the adjacent coastal areas are densely populated with large industrial, port and tourism facilities, the nearby presence of a potentially unstable sea-floor is important for assessing the geological hazard in the entire region.

The conditioning factors differentially affecting MP and BB areas must be addressed to local, rather than regional, conditioning factors, having into consideration that they belong to the same relatively stable morphosedimentary and tectonic setting corresponding to the “Rio de la Plata cratonic margin” (Hernández Molina *et al.*, 2011). Local conditioning factors that favour the increasing of downslope processes in the BB area are, considered in a possible order of importance: 1) a dense set of small submarine canyons that interfere in the alongslope sediment dynamic, increasing the concentration of instability points subjected to gravity downslope processes; 2) the inclusion of this area in a region of possible higher tectonic activity related to the presence of a major fracture system of the margin’s deep structure (Ventana Transfer Zone, Franke *et al.*, 2010); although other major fracture system (Salado Transfer Zone) is close to the MP area, morphosedimentary evidences seem to show more activity in the BB area; 3) strong influence of fluvial activity during lowstands through a paleo-Colorado river fluvial system (Violante *et al.*, 2014), that could signify more sediment supply to the shelf-slope transition, increased sediment accumulation subjected to gravity instabilities and rapid translation to the deep ocean through the dense set of submarine canyons.

Based on these conditions and the way that contouritic deposits are affected by gravity processes, the BB region is considered as a potential source for slope instabilities with implications in geohazard.

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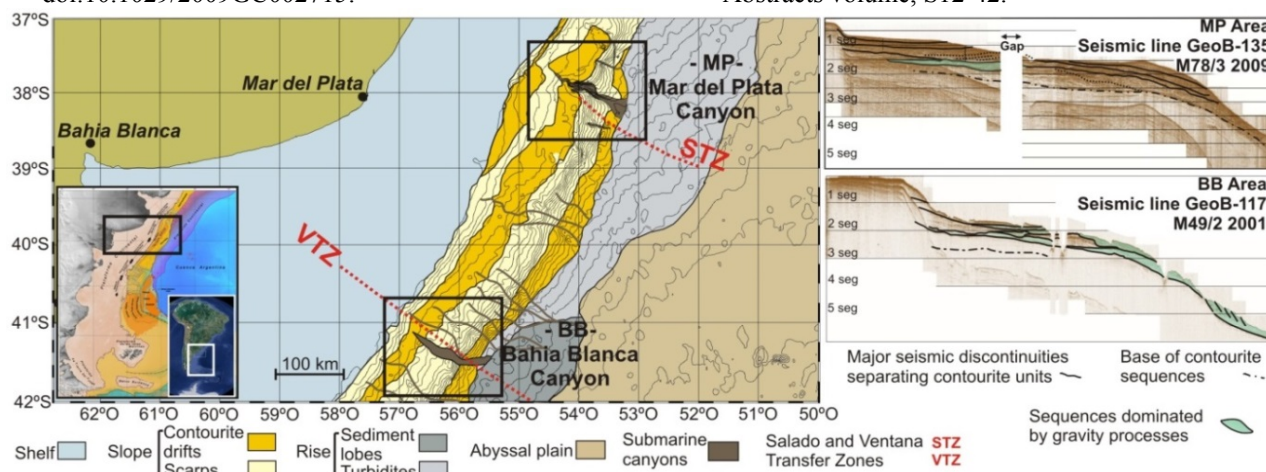


FIGURE 1: Regional map and examples of seismic lines characterizing MP and BB areas. Note the dissected relief and the significant influence of gravity downslope processes in BB area in relation to MP area. Location map includes the CDS defined by Hernández Molina *et al.* (2009).