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# Submarine landslides on the Great Barrier Reef margin, north-eastern Australia: Preliminary characterization of their morphology and behaviour

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The socioeconomic importance of submarine landslides is linked to their tsunamigenic potential and potential damage to seabed infrastructure, and thus scientific and economic efforts are focusing on better determination and quantification of their causes and effects. Seafloor mapping and morphometric characterization of slope failures is the first step to infer what may trigger them and when they may occur. Submarine landslides are ubiquitous features on continental slopes worldwide, on either passive or active continental margins, including glacially-influenced, river-dominated, volcanic and carbonate slopes. However, studies on submarine mass-wasting are relatively scarce in mixed carbonate-siliciclastic margins, which are characterized by variable lithologies with different rheologic properties that also vary spatially and temporally.

We present the preliminary results of the study on a unique slope submarine landslide dataset (slide areas >1 km$^2$) on the Great Barrier Reef (GBR) margin, north-eastern Australia, which represents the largest extant carbonate-siliciclastic depositional system in the world. We used high-resolution multibeam bathymetry and GIS spatial analysis to perform a morphometric characterization of the submarine landslides in three distinctive regions of this archetypal margin, which are characterized by different shelf and slope morphologies, from north to south: Ribbon Reefs (RR), Noggin Passage (NG) and Palm Passage (PP).

Landslides in RR and PP are overall semicircular in shape, and are slightly more elongated in NG. The top of headwalls deepen progressively to north, from median values of 500 m in PP to 1500 m depth in RR, and the failed mass extends down to average depths between 1000 m and 1850 m. The median slope angle in the source area of the failures increases from 4° in PP to 7° in RR, steeper than the median values of the well-studied submarine landslides in the North Atlantic. However, slope gradient is not related with the landslide size and, as in many cases worldwide, the largest failures are located on gentler slopes, showing a strong negative correlation in the PP region. In all cases, slope gradient increases after the failures, leaving median headwall gradients of 10° to 12°. Mobility of the mass movements in the study regions have been estimated using the height/length (H/L) vs volume (V) and the ratio of headscarp height (D) to runout distance (L). The relation H/L vs V for most landslides is within the range observed in submarine landslides in the North Atlantic, although some failures in RR show values close to subaerial landslides. D/L ratios suggest that the viscosity of the mass movements is higher in RR and decreases towards the south.

The Great Barrier Reef margin hosts abundant small slides (<1 km$^3$ of remobilized material) but also a few much larger slope failures. The most significant ones are: (1) the Gloria Knolls landslide, the largest on the GBR margin (>30 km$^3$), which excavated ~174 km$^2$ (about 20 km along- and 8 km across-slope) area of the slope, forming a large re-entrant indentation of the shelf at this location; and (2) the Bowl landslide (>5 $km^3$), which is excavated into the upper slope close to the outermost shelf-edge reefs, presumably related to the paleo-Burdekin River delta.

Our results expand the current knowledge of the existence of submarine landslides, and advance our understanding of the sedimentary processes, preconditioning factors and triggering mechanisms for mass-wasting along continental margins by providing a new mixed carbonate-siliciclastic regional case study.