Mass Transport Deposits on the Southwestern Newfoundland Slope: Eastern Canada

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There is global recognition of the importance of mass failure processes in the evolution of passive continental margins as demonstrated in the modern seafloor geomorphology of Canada's eastern continental slope. Investigation of the Cenozoic section of Newfoundland's SW slope will help quantify the importance of these processes in this region, providing both depositional models for the area as well as helping to identify potential geohazards. This margin is an active exploration frontier and the location of the tsunami-inducing 1929 Grand Banks Landslide. Seismic facies analysis of recently acquired multibeam, 2D and 3D seismic data from the SW slope provides evidence of successive mass failures at a variety of scales. The occurrence of stacked, regionally extensive mass transport deposits (MTDs) indicates that this was an important process during the Cenozoic evolution of the SW Newfoundland margin. The largest MTD on the margin covers an area of 900 km^2 and is mid-late Miocene in age. It has thicknesses as much as 500 m and using an average thickness of 250 m, the estimated volume for this MTD is 225 km^3. Overlying this MTD, there is a stack of up to 9 MTDs that occur between the mid-late Miocene and Middle Pleistocene. The largest of these MTDs covers an area up to 400 km^2 and has thicknesses between 85 and 150 m. Their volumes are estimated to be as much as 60 km^3. MTDs that occur above the Middle Pleistocene are typically localized failures and have thickness between 20-30 m with volumes less than 1 km^3.

Historic earthquake data demonstrate that the region is susceptible to increased seismicity over most of the Canadian east coast margin, perhaps actuated by latent tectonic structures, such as the Cobequid-Chedabucto fault system. The 1929 submarine landslide was clearly activated by a M7.2 earthquake in this area. It is concluded that MTDs in this region were generated by ground accelerations due to earthquakes. Nonetheless, pre-conditioning factors are required to prepare the sediments for failure, and it is perhaps these factors that explain the difference in the size of MTDs. Regionally extensive sediment mass failures that occurred during the Miocene to the early Pleistocene are clearly linked to seaward dipping faults (10°) between a top Cretaceous unconformity and a mid-late Miocene marker. In addition, there is a strong possibility that sedimentary sections became over steepened in response to ongoing salt tectonics. The smaller Middle Pleistocene to Recent MTD's were likely in response to high sedimentation rates during Pleistocene deglacial cycles and seismicity; likely more frequent during isostatic rebound in early post-glacial phases.

In total, MTD's form on the order of 30 to 40 % of the sedimentary section in this region; thus the mass failure process is a significant one in the development of the margin. This prevalence speaks to their significance as a potential geohazard in offshore development and to coastal regions of Newfoundland. It also underscores the importance of these processes in understanding continental margin sediment delivery mechanisms and their role in deep water exploration models.