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GSC Open File 3914

Liquefaction Collapse Features at Sand Heads, Fraser River Delta, Vancouver, British Columbia: Interpretation of Multibeam Bathymetry

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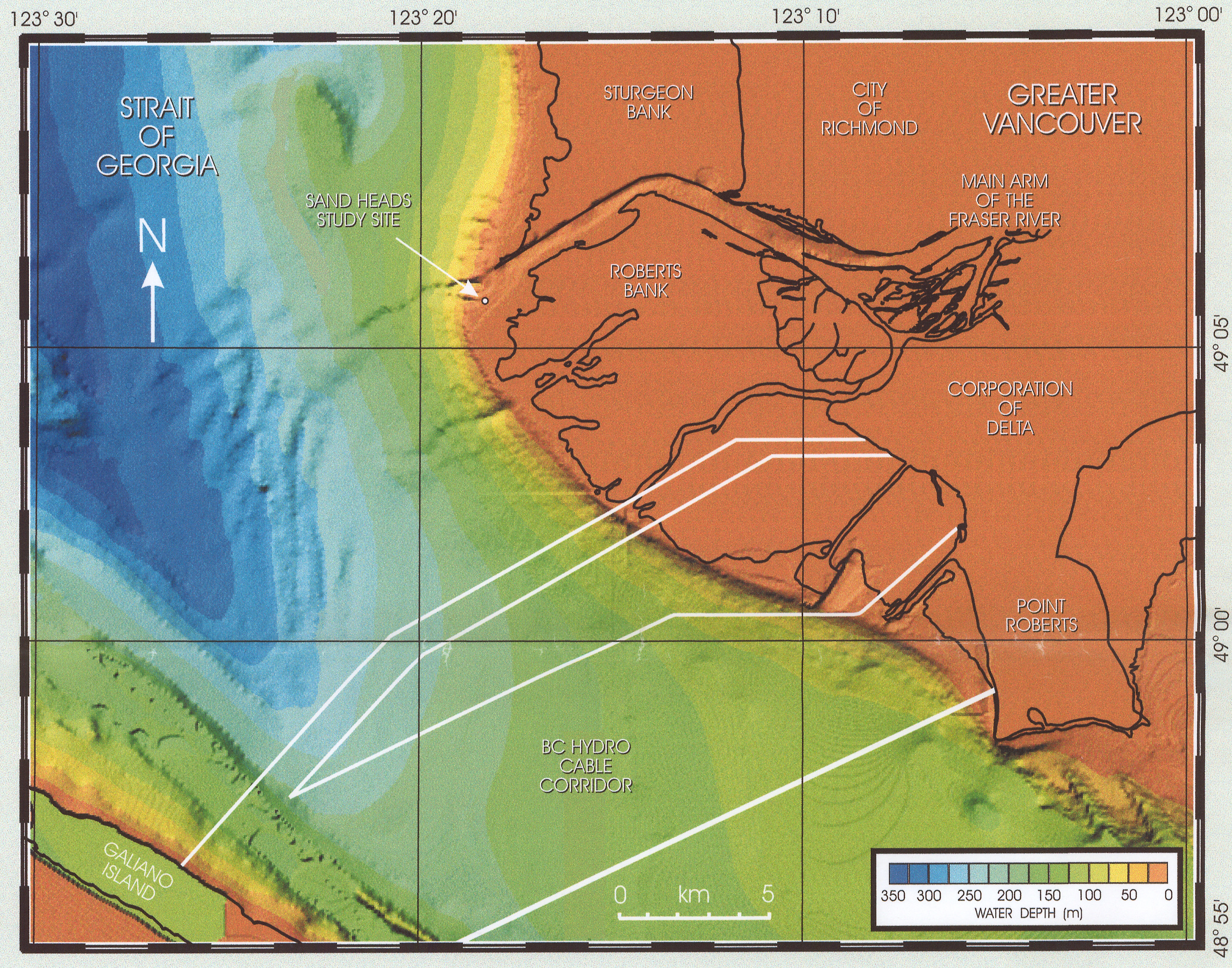
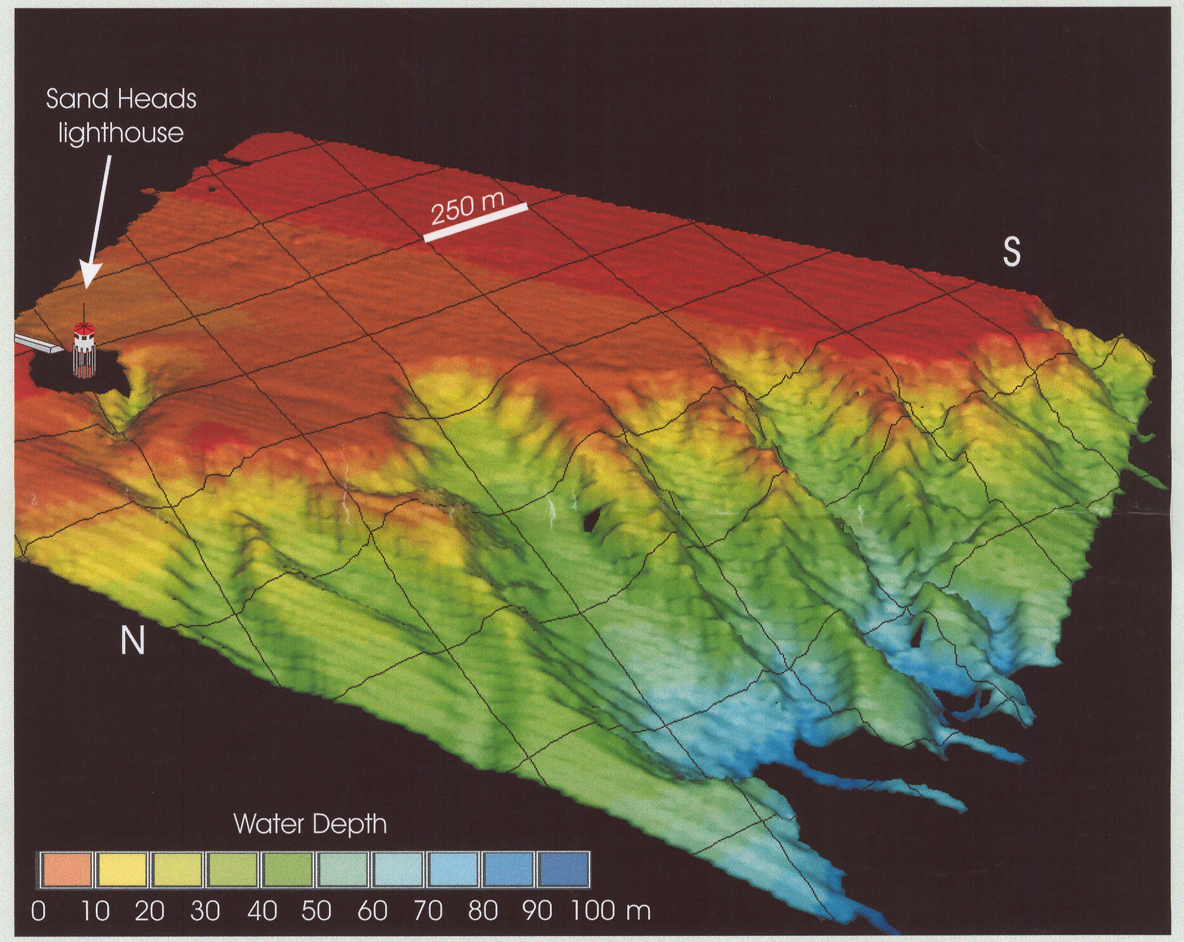
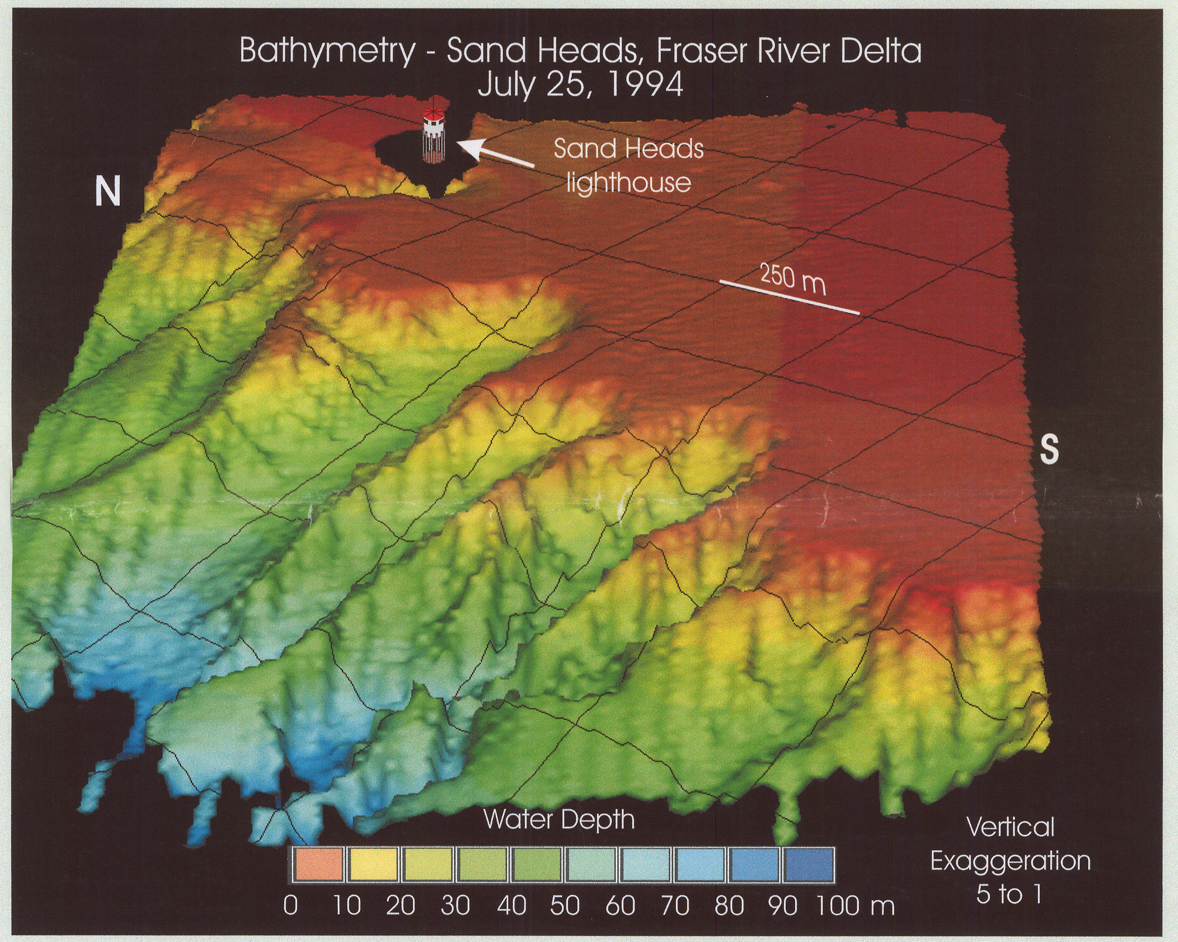


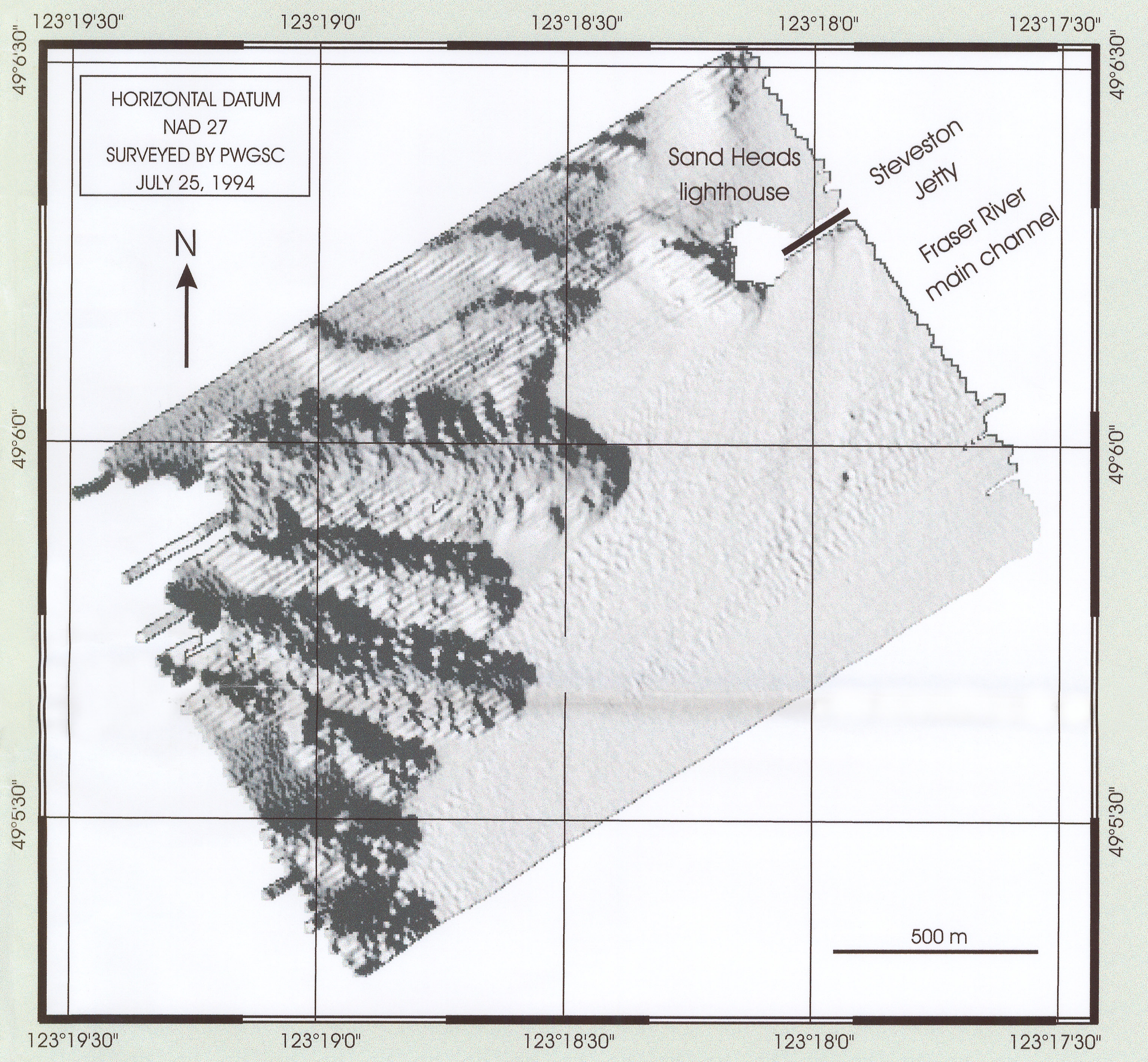
This figure is a location map for the southern Strait of Georgia, the western half of the Fraser River delta and some key features. The depth of water is shown in colour based on digitization of hydrographic charts (ca. 1985). Two extensive intertidal flats (Sturgeon and Roberts Bank) are indicated, as well as the BC Hydro submarine transmission cable corridor to Vancouver Island. The Sand Heads study site is marked at the mouth of the Main Arm of the Fraser River. Minimum water depth in the river channel and along the top of the delta foreslope is generally about 10 m. Maximum tidal range is 5.5 m.



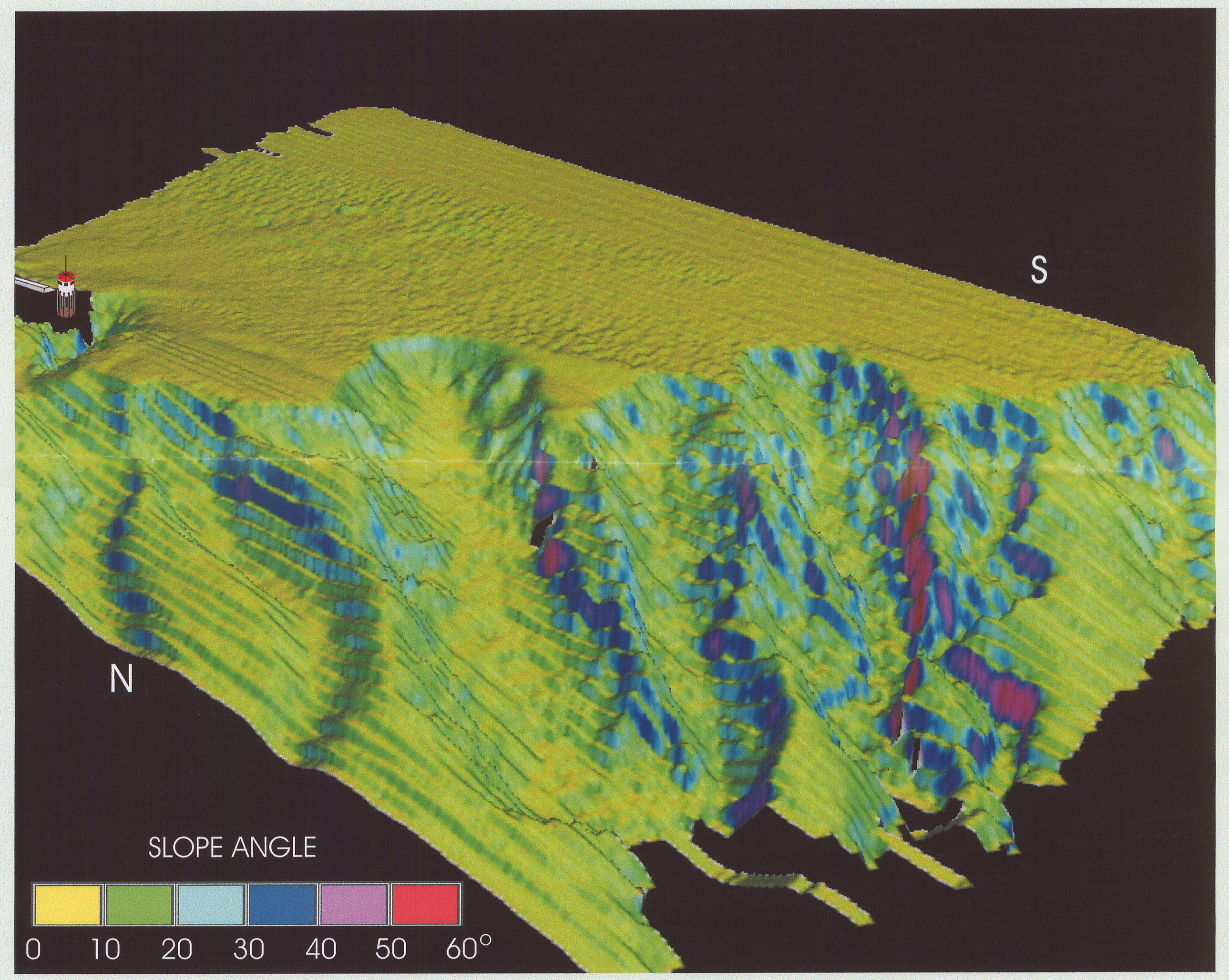
Vertically-exaggerated oblique image of the Sand Heads sea valley system, created within a GIS based on multibeam bathymetry data collected in June, 1994 by Public Works Canada, as part of an ongoing dredging and monitoring program.



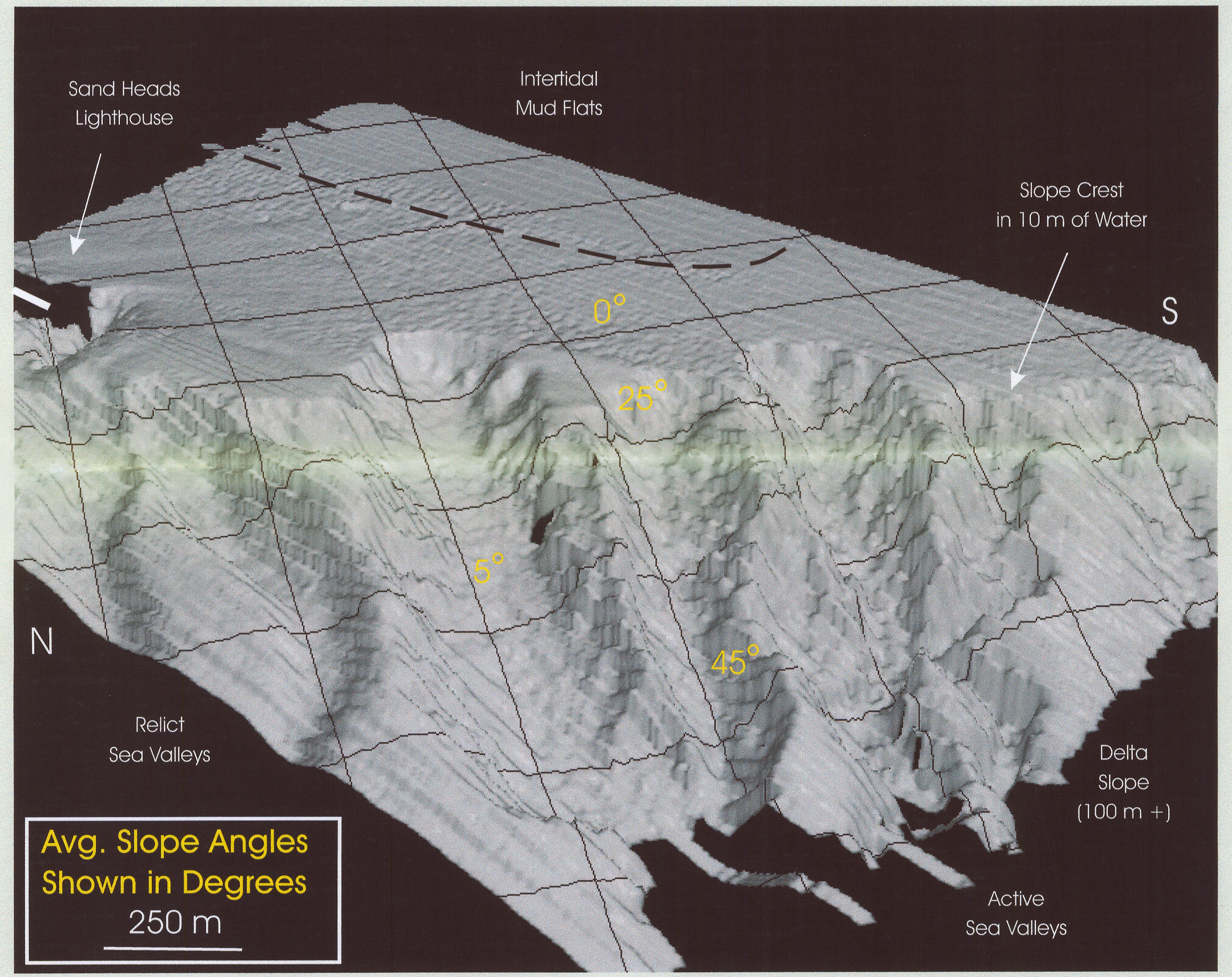
Oblique shaded-relief colour-coded bathymetric image, from a southern perspective. Vertical exaggeration is by a factor of 5:1. Water depths range from less than 10 m in the riverbed to over 100 m where sea valleys coalesce into a single, flat-bottomed debris channel.



Plan view shaded-relief bathymetric map of Sand Heads, at the mouth of the Main Channel of the Fraser River. The seaward end of the Steveston Jetty, a river-training structure is also the site of a key navigational aid, which was nearly lost in a 1985 spontaneous seafloor mass wasting event, involving 1M cubic metres in total of sand and silt.



Oblique view of the sea valley system, where slope angles are shown as a coloured overlay. Slopes are markedly asymmetric, locally exceeding 40 degrees on western valley walls, due to toe erosion by channelized debris flows. Small flow-liquefaction slides develop spontaneously in the valley headscarp regions, on slopes averaging 23 to 25 degrees, forming sandy debris flows. Statically-triggered failures on slopes less than 40 degrees in sand are common in marine environments but are difficult to explain.



Summary of key areas within the sea valley system, wherein slope instability would be anticipated. Average slope angles are shown in numerical values. Major seafloor failures recur about once a decade on average and are not correlatable to known seismic events. Many such underwater failures have been observed around the world over the past 50 years. Existing theories until recently assumed that internal porewater pressures played no role, since sands drain freely.

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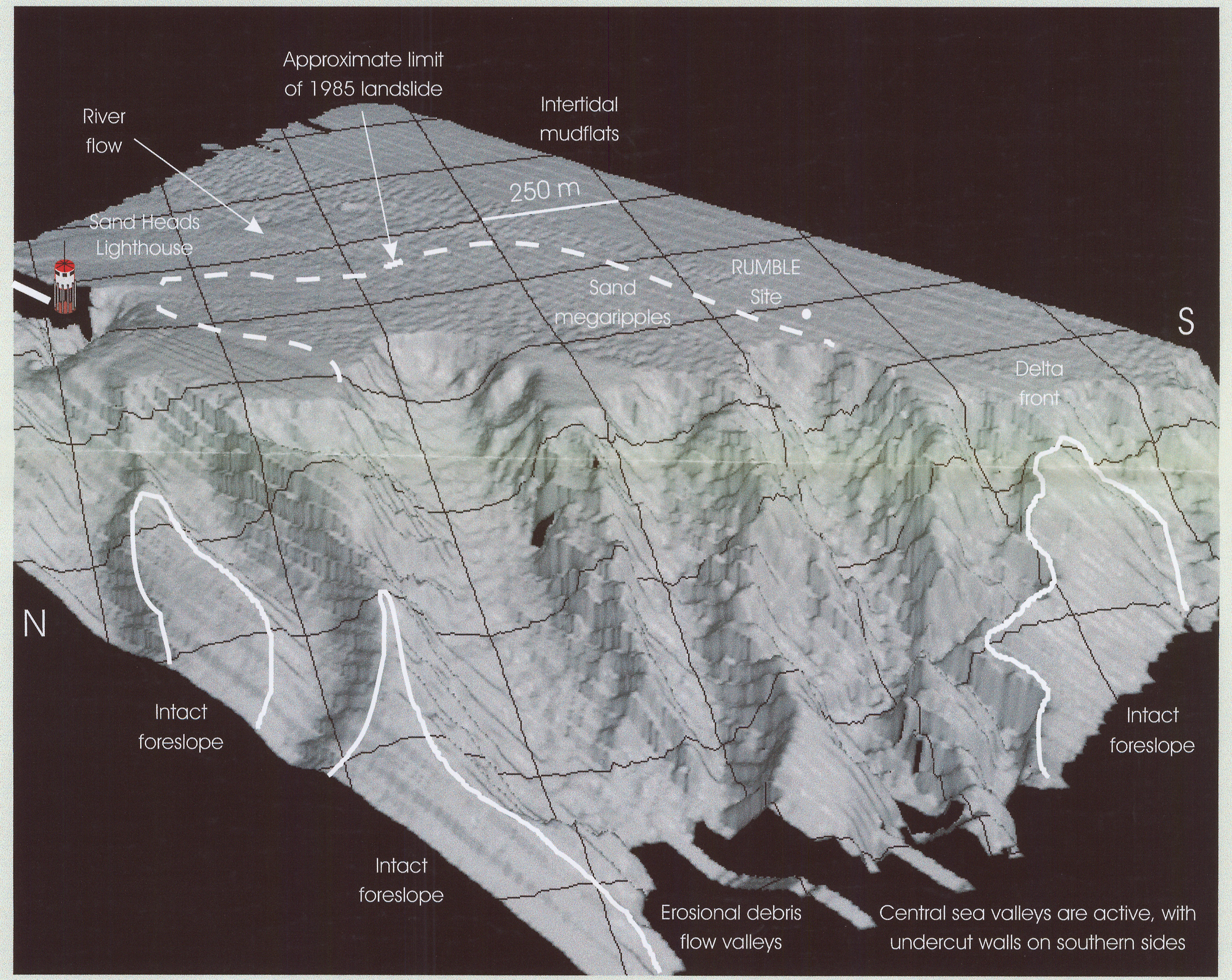
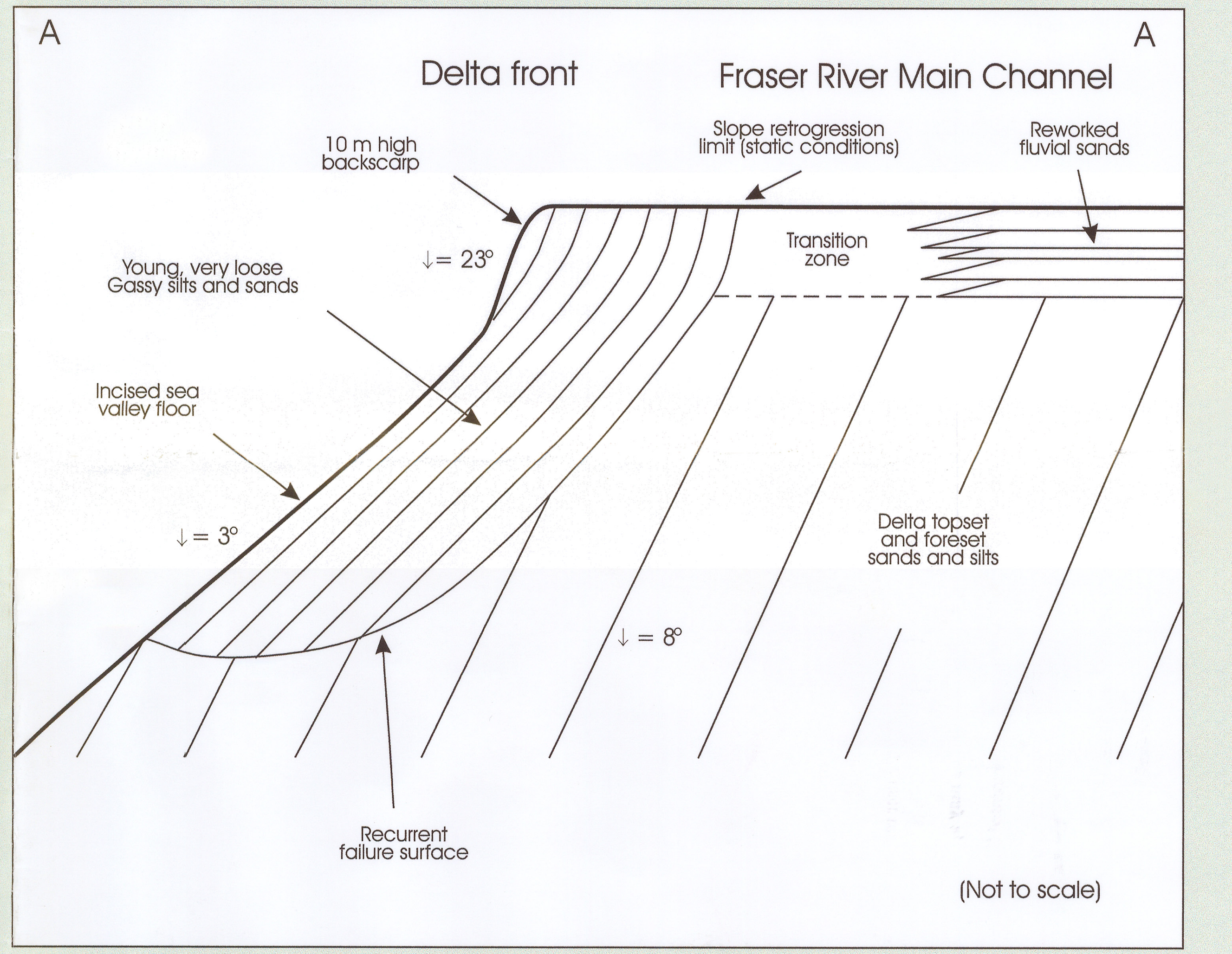


Oblique view illustrating seafloor mass wasting scars (sea valleys), along with adjacent intact areas of the delta slope. Delta foreslope sediments dip to seaward at angles of about 8 degrees. Sandy gravity flows bypass the delta foreslope by incising flat-bottomed debris channels, which extend to the base of the slope in 300 m of water. The sea valleys represent an area of recurrent infilling by rivermouth sedimentation and retrogressive liquefaction failure, developed along a well defined failure surface.



Idealized cross-section of the delta front along the transect A-A shown in the planview map (upper right corner of poster). The delta slope shown here consists of layered sands and silts. The delta front sea valley headscarp area is shown as the source area of submarine mass wasting. The base of the sea valley averages 3 to 5 degrees in slope. Gravity flows can travel to the base of the slope where they come to rest on slopes of less than 0.5 degree.

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