Geological Survey of Canada
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SEAFLOOR MAPPING IN A HYPERTIDAL ESTUARY: MINAS BASIN, NOVA SCOTIA, CANADA

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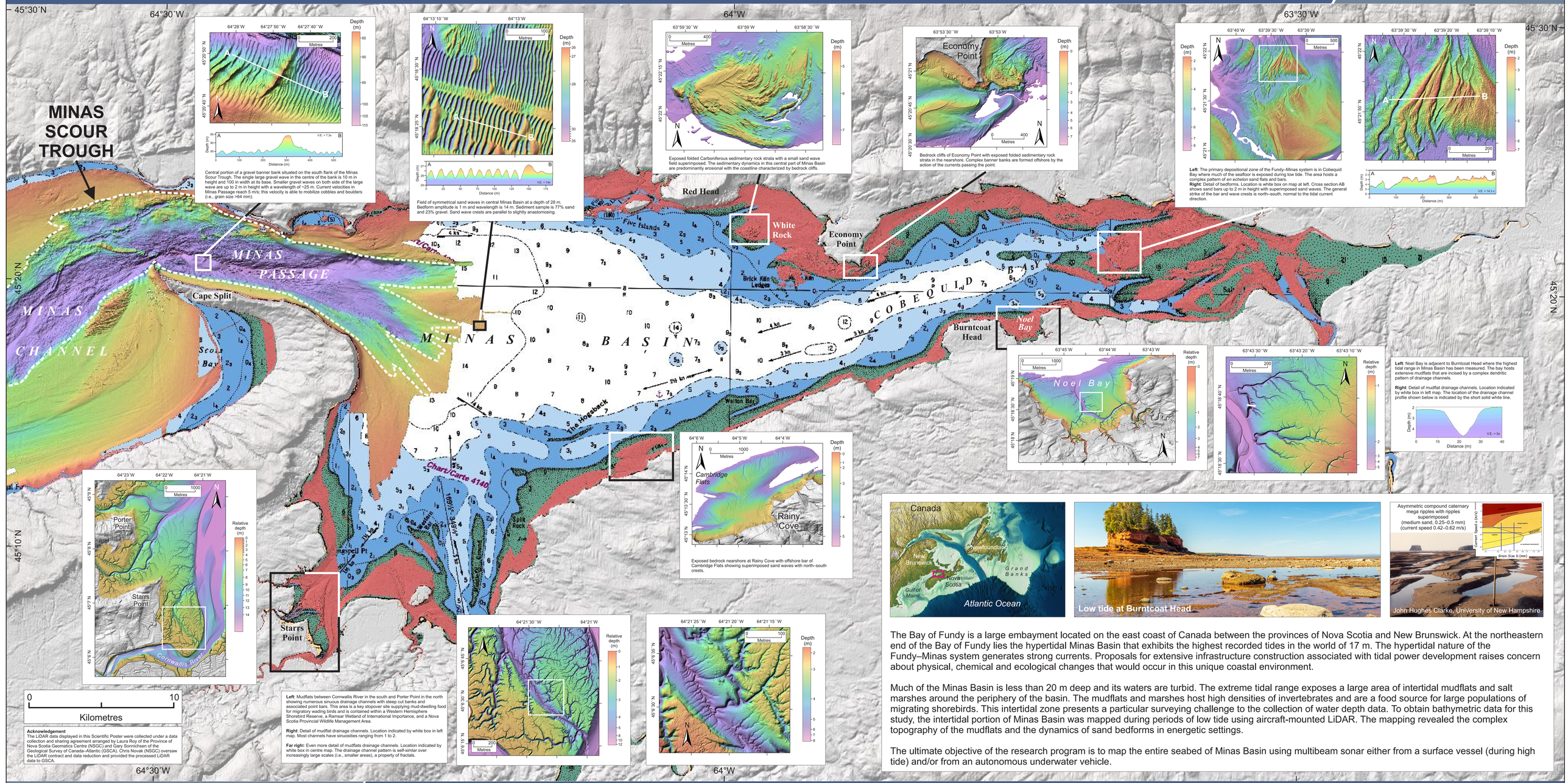

Central portion of a gravel banner bank situated on the south flank of the Minas Scour Trough. The single large gravel wave in the centre of the bank is 10 m in height and 100 m width at its base. Smaller gravel waves on both side of the large wave are up to 2 m in height with a wavelength of ~25 m. Current velocities in Minas Passage reach 5 m/s; this velocity is able to mobilize cobbles and boulders (i.e., grain size >64 mm).

Field of symmetrical sand waves in central Minas Basin at a depth of 28 m. Bedform amplitude is 1 m and wavelength is 14 m. Sediment sample is 77% sand and 23% gravel. Sand wave crests are parallel to slightly anastomosing.

Exposed folded Carboniferous sedimentary rock strata with a small sand wave field superimposed. The sedimentary dynamics in this central part of Minas Basin are predominantly erosional with the coastline characterized by bedrock cliffs.

Bedrock cliffs of Economy Point with exposed folded sedimentary rock strata in the nearshore. Complex banner banks are formed offshore by the action of the currents passing the point.

Left: The primary depositional zone of the Fundy–Minas system is in Cobequid Bay where much of the seafloor is exposed during low tide. The area hosts a complex pattern of *en echelon* sand flats and bars.
Right: Detail of bedforms. Location is white box on map at left. Cross section AB shows sand bars up to 2 m in height with superimposed sand waves. The general strike of the bar and wave crests is north–south, normal to the tidal current direction.

Left: Noel Bay is adjacent to Burntcoat Head where the highest tidal range in Minas Basin has been measured. The bay hosts extensive mudflats that are incised by a complex dendritic pattern of drainage channels.

Right: Detail of mudflat drainage channels. Location indicated by white box in left map. The location of the drainage channel profile shown below is indicated by the short solid white line.

Exposed bedrock nearshore at Rainy Cove with offshore bar of Cambridge Flats showing superimposed sand waves with north–south creats.

Left: Mudflats between Cornwallis River in the south and Porter Point in the north showing numerous sinuous drainage channels with steep cut banks and associated point bars. This area is a key stopover site supplying mud-dwelling food for migratory wading birds and is contained within a Western Hemisphere Shorebird Reserve, a Ramsar Wetland of International Importance, and a Nova Scotia Provincial Wildlife Management Area.

Right: Detail of mudflat drainage channels. Location indicated by white box in left map. Most channels have sinuosities ranging from 1 to 2.

Far right: Even more detail of mudflats drainage channels. Location indicated by white box in centre map. The drainage channel pattern is self-similar over increasingly large scales (i.e., smaller areas), a property of fractals.

0 — 10
Kilometres

Acknowledgement
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The Bay of Fundy is a large embayment located on the east coast of Canada between the provinces of Nova Scotia and New Brunswick. At the northeastern end of the Bay of Fundy lies the hypertidal Minas Basin that exhibits the highest recorded tides in the world of 17 m. The hypertidal nature of the Fundy–Minas system generates strong currents. Proposals for extensive infrastructure construction associated with tidal power development raises concern about physical, chemical and ecological changes that would occur in this unique coastal environment.

Much of the Minas Basin is less than 20 m deep and its waters are turbid. The extreme tidal range exposes a large area of intertidal mudflats and salt marshes around the periphery of the basin. The mudflats and marshes host high densities of invertebrates and are a food source for large populations of migrating shorebirds. This intertidal zone presents a particular surveying challenge to the collection of water depth data. To obtain bathymetric data for this study, the intertidal portion of Minas Basin was mapped during periods of low tide using aircraft-mounted LiDAR. The mapping revealed the complex topography of the mudflats and the dynamics of sand bedforms in energetic settings.

The ultimate objective of the research program is to map the entire seabed of Minas Basin using multibeam sonar either from a surface vessel (during high tide) and/or from an autonomous underwater vehicle.

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