CNAV Sackville Marine Geological Studies

CNAV Sackville was the primary research vessel for a number of marine geological studies undertaken, primarily in the Gulf of St Lawrence and its estuary, during the early and mid 1960's in conjunction with other oceanographic and biological studies
These studies were regional and of a reconnaissance nature in the sense that they were designed to obtain acoustical and sampling data on the morphology and basic properties of the sediments for the whole Gulf area. The results were used by those interested in earth science and especially by those engaged in economic activities. For fishermen and biologists the resulting morphological and sedimentary maps are used to find the relief and composition of the seafloor that are most suitable for particular fish, shellfish or bottom organisms. Marine and petroleum engineers could find information on the relief and texture of the seafloor at potential cable, pipe, and well sites as well some information on the subsurface structure. For earth scientists, these studies show the characteristics of glacial marine sediments and their response to the past and present physical and physico-chemical environment.

A characteristic marine geological program in the Gulf would follow along these lines: On land it would take a least a week to prepare for a cruise and would include planning, recruiting the personnel, as well as finding and loading sediment sampling gear such grabs and corers on the CNAV Sackville A bottom grab sampler is box shaped and consists of a set of hinged iron or steel jaws that close on the bottom sediment . It is lowered open and when it reaches the bottom it closes and rotates into the sediment to a depth of 6-10cm. Sediment corers are used to collect vertical sediment profiles. They consist of two parts: (1) an coring barrel that is the main housing that accomplishes the vertical penetration of the sediment and (2) an internal liner in which the sediment is collected

In addition, it would be necessary to ensure that the on board facilities such as the navigation and echo sounding equipment were in good working order. An echo sounder is the measuring instrument that sends out an acoustic pulse in water and measures distances (water depth) in terms of the time for the echo of the pulse to return.

On such a cruise the sounding lines and sample stations are selected initially on the basis of sea floor bathymetry shown on existing Canadian Hydrographic Service (CHS) and older British Admiralty charts, and later, at sea, in combination with a preliminary knowledge of the sea floor sediments.

At sea, when the scientific personnel, led by a Chief Scientist, and technical support staff and equipment were on board, CNAV Sackville would sail from the RCN dockyard en route to the chosen study area in the Gulf. Navigation for the chosen location of preliminary sounding and sampling stations was determined primarily by DECCA and LORAN; in areas without this coverage (pre-1963) celestial navigation and dead reckoning were used and radar was often used near land to establish positions. In the northeast Gulf, the only charts available for use were British Admiralty Charts prepared in 1760 by Captain James Cook whilst he was a Admiralty surveyor stationed in Newfoundland.

Geological operations at sea were carried out on a 24/7 basis for 10-15 days once the starting point for the survey was reached. With an 8 man team, this meant standing watch on 6 hour on and 6 hour off watches. Initially, an echosounding profile would be run along the track of the proposed sampling line, which might be as much as 400 km in length. The resulting echograms show very clearly the relief and general nature of the surface and near surface

(acoustically transparent) sediments. It soon became apparent that echo sounding signals reflected from denser coarse grained sediments like sand and gravel were recorded by a dense dark line whilst the finer grained sediments such as muds recorded a lighter trace and in many cases, the recorded signal trace was doubled as the echo sounder signal penetrated the sediments to display the thickness (up to 10m) of sediments that had been recently deposited. Based on this information, the sampling program began at various intervals along the sounding line. In practice this meant more samples (every 4-10km) were required from shallow water areas or shelves (water depths less than 100m) which had a more complicated sediment pattern than the deeper troughs with water depths up to 500m with their nearly consistent fine-grained (muds) sediment cover (sample intervals of 10-25km)). Once other scientific measurements such as temperature and salinity were taken and the geographical location determined, the sampling would begin by lowering on a steel cable a bottom grab known as modified Van Veen ($0.1m^2$) to collect a sample (0.1-3kg) of the sea floor sediment. Once the bottom grab was retrieved, the grab was opened and any water retained in the grab was slowly removed. Field observations of the fresh sediment included estimates of the colour made by reference to a international standard colour chart, gross lithology (sand and mud) together with measurements of the pH (acidity) and Eh (oxidation potentials). The samples were then stored in plastic bags and numbered consecutively along with the cruise number , for example sample number 10 would also have another number such a S-75, the S refers 75th cruise by CNAV Sackville. The samples were then refrigerated until returned to the laboratory. At selected sites, vertical sediment core samples up to 5m in length were also obtained using a standard piston corer with plastic liners ~4cm in diameter.

Back at the laboratory, the sounding records were studied, interpreted, and reduced manually for plotting and presentation. For the grab samples, the sediments were sorted and their water content determined. A representative sample for sediment analyses was prepared by separating particles > 2mmin diameter from the finer material. Material >2mm was set aside for petrological analyses. The particle size analyses of finer material were determined by a normal sieve-pipette method. The results were studied, interpreted, and then plotted for each sample on the chart to show, when completed, the distribution of the different types of sediments such as gravel, sands, and muds in the study area. Chemical analyses of the sediments were also done to show the distribution and concentration of the various major (Al, Si, Fe, Mg etc) and trace elements such as As, Ba, Cd, Cu, Hg, and Zinc so that the level and distribution of biologically toxic metals could be evaluated. Finally, a sedimentological map was produced that showed the distribution, texture, and chemistry of the sediments. The sediment map and detailed results on the sedimentary texture and chemical composition were then published in the scientific literature so that the results would be available to the public and those engaged in economic activities (as mentioned above).

For further information, the reader may consult the selected references noted below:

1962. Loring, D.H., A preliminary study of the soft sediment layer in the Gulf of St.Lawrence and parts of the Scotian and Newfoundland Shelves. Fish. Res. Bd. Canada, M.S. Rept. (Oceanogr. and Limnol.), No. 107.

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