Searching for alluvial gold deposits off Nova Scotia

Ore values ranging to over $4 per cubic yard are concentrated in just two offshore locations. "Pay dirt" amounts to 42 million cubic yards.

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Prospecting for gold has come down from the hills and into the oceans. One of the most recent such projects not only made a "strike" that promises to be of significant value, but incidental finds included a large clam bed and a "fairly large" bed of huge scallops. Also significant is the fact that the prospectors plan a rather rapid jump toward dredging their offshore gold mine in the spring of 1969.

It all started last summer when Ocean Science & Engineering Inc. began an offshore mineral exploration program off Nova Scotia's southeast coast under contract to Matachewan Canadian Gold Ltd., Montreal. The primary goal was to locate and drill sample marine gold placers in nine lease areas. Some 268 miles of seismic acoustic profiling was done, and 187 holes were drilled in the alluvium. The whole program took three months to complete.

Initial studies of the onshore geology of gold ore deposits indicated the likelihood of similar deposits existing in offshore areas. Geologic trends, together with past sea current and beach wave action phenomen-
GOLD SAMPLES from drill holes in Lunenburg Bay were assayed at yields ranging up to $4/cubic yard of ore. Of the 80 holes drilled in some 10 days, none were “dry.” Most promising sources were submerged stream beds.

Exploration targets. Typical exploration targets were seaward extensions of ancient and recent stream channels that could contain gold-placer accumulations, seaward projections of onshore gold-bearing geologic structures that have been reduced to alluvial deposits by sea erosive forces; and scour channels and basins in gold-bearing areas that could contain gold-placer concentrations.

Marine bathymetric charts were contoured so that one could view the sea bottom configuration as if it were a land surface. Sea bottom features and configurations were interpreted geologically and correlated with the regional onshore geology. Known gold-bearing geologic structures were projected seaward by their onshore trends and exploration targets pinpointed.

Nine priority target areas, averaging about 30 square miles each in size and spread out along 190 miles of the Nova Scotia coastline, were selected for investigation. Several smaller areas and single points were also selected as alternative targets.

Drilling equipment. Drilling equipment consisted of a 3-in. jet-lift system with which a hole was jetted into the bottom alluvium with a small diameter, high pressure water jet stream. Dislodged material was sucked up and conveyed to the ship by a 3-in. airlift pipe and hoses. The bottom working end of the jet-lift was a 25-ft-long thatch of pipes welded together and collectively called the stinger. This was connected to the ship by a winch-controlled steel cable for support, with the appropriate size plastic hoses for water and air supply, and a large diameter hose to deliver the water-sediment mixture to the mineral processing system.

Hole cuttings were delivered at the head end of a 4-ft-wide sluice box where they were broken up, screened, passed over riffle sections, and the “cleaned” tailings discharged into alternate storage-measuring bins.

There was no set procedure for operating at sea because of the near infinite number of variable situations encountered in each area under investigation. A number of specific drill targets were selected after brief inspection of most areas. In general, tentative targets were selected from the known geology and bathymetry prior to entering an area. Seismic tracking was done either while approaching these targets or on a reconnaissance basis, and if a favorable bottom feature was revealed by the seismics, it was considered as a possible drill site. The less that was known of an area geologically, the more seismic work was required preliminary to selecting drill sites.

Encouraging first finds. The first operational drill hole near Lunenburg Bay was accomplished on the third cruise day on a target revealed by seismic records to be an ancient drowned and buried stream channel. A telltale quantity of gold was found in these first processed drill cuttings. Encouraged by the first findings, the ship was moved to a new, more promising area nearby where the second drill hole cuttings showed a much greater amount of gold, again located in a suspected drowned stream channel. This second channel was not a continuation of the first. It was apparent at this point that a sufficient quantity of gold existed in
this area to warrant an intensive search and drill schedule.

Systematic drill patterns were set so that the most likely looking portions of the area would be grid sampled. Sample values varied from hole to hole being mostly dependent on how close they were to the nucleus of the deposit. Drill site gold values for the area varied from a few cents to over $4 per cubic yard. A single drill hole near the nucleus of the deposit yielded values of over $4 per cubic yard.

There were no "dry" holes in this area, with all holes yielding some gold. Ten days and 50 holes later, the exploration ship was moved to another priority target area with plans to return if cruise time permitted. Of the areas investigated, one other in particular yielded abnormally high values of gold. This particular target area is a classic example of an ideal geologic situation. The selected drill zone lay at the intersection of a major fault and an anticlinal crest (a situation typical of nearby onshore gold deposits), and about 3 miles offshore. Bathymetric contours showed it to be semicircular and dome-shaped in outline. Seismic traverses indicated steep dipping beds beneath a fairly thick layer of alluvium. Somewhat insurmountable problems did exist at this site in the form of deep water (150 to 125 ft.), strong sea currents and difficult anchoring conditions.

Many shallow drill holes were made in this target zone, but because of anchoring instability and the bouldery nature of the bottom, no truly representative samples of the alluvium could be obtained. Nearly all the holes drilled yielded some coarse gold. The highest values obtained were around 30 cents per cubic yard. Of the gold deposits located and sampled, this one is by far the largest.

From seismic and bathymetric records it is interpreted as having 36 million cubic yards of gold-bearing alluvium within its confines. Perhaps the most revealing single bit of information obtained from this target zone is the fact that it consistently yielded coarse-grained gold which, generally speaking, is indicative of a nearby source.

Clean medium to coarse gravels offer the best potential for yielding placer gold and were thus the most sought after. Clean gravels could be indicative of reworked beach deposits, stream channel deposits, or residual deposits formed by the scouring action of longshore and tidal currents.

Strong seafloor currents work away on sand and gravel deposits winnowing out the smaller and lighter materials, leaving behind coarse and heavy particles in a residual deposit enriched in heavy minerals such as gold. Narrows or constrictions between land masses often cause such currents, and if found in a potential gold bearing area, offer a good possibility for heavy mineral deposition.

Medium to coarse gravels of ancient stream channel origin show that the stream had a great deal of transporting energy and could therefore transport and concentrate heavy minerals, including gold. It is the middle reaches of a stream, having medium to coarse gravels, that offer the most favorable environment for the deposition of gold. Stream headwaters are characteristically steep graded with fast water which transports everything but large boulders and cobbles. As the stream approaches its midreaches, the transporting energy decreases as the bed slopes lessen. Medium coarse particles and their smaller hydraulic equivalents in heavy minerals, such as gold, are deposited in such areas. Some fine gold is transported for long distances in low energy streams, to eventually be deposited in fine grained delta deposits or even travel out to sea where it might enter a new flow regime.

Often, very fine gold particles or "colors" are found spread over an extremely large area at sea. These individual colors can be readily seen in gold pan concentrations but may amount to as little as 2,000 colors.
Coarse gravel best source. Several good prospect areas were located and some gold values were recovered. Many of the coarse gravel deposits found were drowned ancient stream channels buried beneath thick deposits of recent sediment, such as silt. Of the materials sampled, the notable gold yields were found mostly in coarse gravels, a few in medium to coarse sands, and a single occurrence of fine gold of low value in a thick estuarine silt.

Of the nine areas investigated, one yielded two significant gold deposits and another a single gold deposit. The combined volume of gold-bearing alluvium in these deposits is about 42 million cubic yards.

Several lesser areas yielded a “show” of gold, but not in quantities sufficient to justify further expenditures of time or money. Also discovered by drilling during the cruise was a possible commercial clambed, and a fairly large bed of huge scallops found by chance while scuba diving on a mineral target that lay in water too shallow to permit entry of the drillship.

Exploration activities were more or less confined to within the 20-fathom isobath as this is about the practical depth limit for present-day dredging operations.

During the two-month period, holes were drilled at about 200 sites; the total drilled footage amounted to 1,447 ft. Additionally 226 long tons of sands, gravels, silts, and clays were pumped onboard ship and processed for heavy mineral extraction.

Future plans for mining. It is tentatively planned to further sample two of the aforementioned gold deposits by using small-scale mining methods. A barge-mounted suction dredge will be put into operation this spring near Lunenburg, Nova Scotia. The suction dredge will have an initial mining capacity of about 150 cubic yards per hour with design capacity. The dredged gold-bearing alluvium will be processed onboard for the extraction of gold and tailings disposed of at suitable nearby sites.

The initial objective of the sample mining operation will be to trench across the deposits to accurately assess the lateral extent, depth and worth of each. After total ore reserves have been blocked out and their worth determined, an estimate of total mining requirements can be made and the most feasible mining method adopted. It is expected that the extent of the alluvial gold deposits as known today will be expanded by such a detailed investigation.

Further exploration of other nearby potential areas will also be carried on in conjunction with the gold dredging operation.

Gold and other minerals in the sea offer a vast new potential for a mineral-hungry world, and it is exploration activities such as this that will bring these deposits into closer economic focus. Thousands of important offshore mineral deposits exist in the sea that only await discovery and exploitation. As knowledge of the sea bottom and ocean technology increases, these deposits will certainly become economic.