CAVENDISH TEST RANGE DRILLING PROGRAM, 1973

by

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PART 1

Operational Report of Drilling Program

PART II

Geology of Cavendish Test Range

GEOLOGY OF CAVENDISH GEOPHYSICAL TEST RANGE

1. INTRODUCTION

A diamond drilling program was undertaken by the Geological Survey of Canada to establish the subsurface geology at the Cavendish test range and subsequently obtain a correlation between geophysical instrument findings and the actual rock formations at depth. The test range is located approximately six miles south of Gooderham, Ontario, and one and a half miles west of Highway 507 on Salmon Lake Road. The area is easily accessible by snowmobile in winter, four wheel drive vehicles in spring and automobile during summer and fall. Permission from the land owners was necessary before the work began. The cut lines, as shown on the accompanying map, overlap six different private properties. The vegetation varies from hay fields to hardwood forest and cedar swamps. Glaciation has left its mark on this area in the form of extensive drift cover averaging five to fifteen feet thick.

Thirty-three holes were drilled: four on line 4S, eighteen on line 8S, and eleven on line 12S.

1.1 Diamond Drilling:

1.1.1 Equipment

Two G.K. Smit & Sons G-W-15 "Winkie Drills" mounted on Unipress hand-feed frames were employed on this project. These drills, according to the supplier, have a depth capability of 425 to 475 feet under ideal drilling conditions. Average depths of one hundred feet were reached without too much difficulty. Ten-foot IEX core barrels with standard diamond bits produced one inch diameter core and a hole diameter of one and one half inches. Light weight "Mag-Zirc" drill rods made it possible to pull the rods by hand avoiding the use of a tripod. The total weight of one drill is about 185 lbs. enabling it to be moved by hand with relative ease.

Water was used as the drilling fluid. Both a pressure pump (PRA4-22 Moyno Progressing Cavity Pump; 5 HP gasoline powered, rated at 350 psi and 6 gpm) and a supply pump (F.S.22c, R & M Pump; 3 HP gasoline powered, rated at 125 psi and 6 gpm) were required to supply water to the drill bit. A propane-fired water line heater was also included in the equipment so that drilling could continue in sub-zero temperatures.

Survey tents with Coleman flameless space heaters provided shelter and warmth for the drilling crew when weather conditions were extreme.

1.1.2 Procedure

The diamond drill holes were about one hundred feet in length and spaced at regular one hundred foot intervals except in interesting zones where a closer spacing was required. A drill hole plunge of approximately 45 degrees was chosen to obtain a good coverage of the geological section.

A supply pump was used to fill a reservoir 45 gallon drum if the water supply was more than one hundred feet away. During freezing weather a water line heater was hooked up at the source. Draining the water lines and pumps was essential during such weather.

Two twin track Alpine Skidoos provided the transportation for the men, equipment, and core to and from the drill site as well as relocating the drills.

In order to maintain a certain amount of secrecy, the core sleeves were brought to the geologist for boxing and splitting. During the latter part of the project it was found to be more convenient to have one man for boxing and splitting core.

1.1.3 Performance

The "Winkie" drills proved adequate for the drilling program. A maximum depth of about 120 feet on 45^0 plunging holes was reached with relative ease in competent ground. In blocky ground such as at 8S, 15W, the rods had to be pulled every two to three feet since the core would easily jam in the core barrel. In competent ground a drilling speed of approximately ten feet per hour was possible. It is estimated that the average weekly footage drilled by two winkies (including breakdowns and delays due to bad weather) was 250 feet in a forty-hour week. It was time-consuming to drain water lines daily and to move the machines.

Some of the breakdowns and malfunctions in the drills encountered were:

- burnt clutches; clutches broke free of their mounting shaft;
- broken recoil starters in cold weather; required frequent change of diaphragms to ensure sufficient gasoline supply to motor.

In the pumps the problems were:

- gas line freezing
- worn universal joints
- scored stator due to sand intake
- improper draining and subsequent freezing cracked pump housing.

The skidoos were subject to occasional breakdowns due to:

- broken recoil starters
- cracked clutch pulley
- gas line freeze up

1.1.4 Recommendations for Future Projects to Improve Performance

a/ Winkie Drill:

For a more efficient project it is essential to stock the following spare parts for the drill in addition to the regular repair kit:

i. carburetor kits
ii. clutches and matching keys
iii. recoil starters
iv. hydraulic oil for gearbox
v. exhaust gaskets

The gas tanks should be hung above the motor to prevent fuel starvation. The use of high test gasoline improved running performance. The exhaust ports should be cleaned regularly. An experienced driller should be consulted before the project begins for any helpful hints or personal preference for equipment that he may have.

b/ Water Pumps:

In addition to standard spare parts included in the maintenance kit, the following should be kept in stock:

i. stator housing
ii. universal joints

c/ Transportation:

The skidoos should be run with gas line antifreeze in the fuel. Spare pull cords, gas caps and carb kits are also essential for reliable performance. It is suggested that if such projects span the spring breakup, ATV's should be used to provide transportation for the men and material in terrain where large four wheel drive trucks cannot be used.

d/ Specific Recommendations for Cavendish Test Range:

If another such project were to be run in the winter, all possible efforts should be made to keep the road plowed to the farm buildings where the laboratory trailer would be set up. This would reduce wear on the skidoos.

It is recommended that drill sites should be chosen on the frozen swamps and near available water during the winter. As the warmer weather approaches sites should be drilled where water would be scarce later in the season i.e. in the fields and other high ground.

1.2 Surveying

A level survey was run on lines 4S, 8S and 12S to provide a surface profile for plotting the diamond drill holes. A 'Wild' Model NA2 with stadia hair was employed for the survey (see surface profile).

1.3 Logging

1.3.1 Equipment

The basic equipment in the lab trailer consisted of an 1EX core splitter and a petrographic microscope. Other basic geologist's tools such as hand lenses, magnets, acid etc. proved essential to logging the core.

1.3.2 Procedure

The core was left in sleeves until it reached the geologist who boxed, measured and split the core. This procedure relieved the men of the responsibility of knowing the contents of the core. The core was split perpendicular to the strike of the foliation at two foot intervals or at distinctive changes in rock type. A visual examination of texture, structure and colour was made. Due to the fine grained nature of the rock, a microscope was necessary to determine the mineralogy. Hydrochloric acid aided in testing for calcite. Pyrrohotite and magnetite were detected by the use of a hand magnet. Scratch tests for hardness were not useful in most cases due to the microscopic size of the grains. All useful information was recorded on strip logs.

After logging, the core was shipped to Ottawa for further study.

1.3.3 Recommendations for further study and future logging in the field

In future the rocks should be slabbed and stained in the field. Stains for sodium and potassium rich feldspars and calcium and magnesium ion in crystalline marble would prove useful in giving the geologist a better feeling for the rock's mineralogy. Heavy metals tests and copper ion concentration test if available should also be used.

Further laboratory work should include a study of thin sections and polished sections. Assays are advisable on sulphide horizons.

Magnetic intensity and electrical conductivity tests would also provide essential information about the anomalous areas of the rock formations.

1.4 Surface Mapping

The study area was mapped in detail by L. J. Kornik and D. A. Williams.

PART II

GEOLOGY OF CAVENDISH TEST RANGE

2.1 General geology

The bedrock consists of Grenville mafic gneiss, crystalline limestone, and granitic gneiss. Foliation is well developed, and dips steeply east. Two types of mafic gneiss can be distinguished; hornblende gneiss (with minor biotite) and biotite gneiss with minor or no hornblende). The granitic gneiss is characterized by alternating mafic (hornblende-biotite) and felsic layers, a fraction of an inch to several inches thick, and by feldspar augens.

2.2. Mineralized alteration zones

The entire grid area forms part of a calcite-quartz-calc silicate (diopside-garnet)-sulphide (pyrrhotite-pyrite) alteration zone. Pyrrhotite is associated mainly with calcite, and pyrite with quartz. Sulphide content is generally approximately 0.1%. There are two areas of sulphide concentration, Zone A (in the western part of the grid area) and Zone B (in the central part); both are characterized by an outer zone containing approximately 2% sulphide, and a central massive sulphide zone. The sulphide distribution is best documented on lines 8S and 12S, where drilling was concentrated; the distribution on the other lines is based on surface mapping, extrapolation, and the limited amount of drilling on line 4S.

The sulphide minerals occur as disseminations and as stringers parallel to the foliation. Although the sulphide zones strike generally parallel to the foliation, the discordant nature of the mineralization is evident from local cross-cutting of lithologies and distortion of the foliation attitude. Zone A dips to the east, but Zone B apparently dips west. Structural control of emplacement is suggested by the occurence of slicke sided graphite within and adjacent to the sulphide zones in drill holes at 8S, 9+40W; 8S, 15+55W; and 12S, 16 W.

2.2.1 Zone A

On line 4S, the drillhole at 13 + 60W intersected a 4-foot section containing 2% pyrite in stringers parallel to the foliation. Pyrrhotite stringers were noted in an outcrop of biotite gneiss along the east bank of St. Croix Creek, at approximately 14 + 20W.

On line 8S, a 10-foot section of pyrrhotite-pyrite stringers in garnetiferous biotite gneiss, averaging about 10% sulphide was intersected in drillholes at 15 + 55 W and 15 + 80 W. The enveloping zone containing 2% sulphide is about 80 feet thick.

On line 12S, a 43-foot section containing 2% sulphide was intersected in the drillhole at 16W.

2.2.2 Zone B

On line 4S, the drillhole at 6 + 20W intersected 57 feet containing about 1% pyrrhotite; silicified layers up to 1 foot thick were noted. The drillhole at 7 + 10W intersected four sections (23, 5, 4 and 8 feet thick) of silicified hornblende gneiss containing 5% pyrite; the overall sulphide content of the entire zone is approximately 2%.

On line 8S, the drillhole at 8W intersected 30 feet of mineralization similar to that in the hole at 4S, 6 + 20W. The drillhole at 9W intersected 68 feet containing about 2% sulphide; close to the middle of the section, two intersections of 4 inches and ¼ inch of pyrrhotite-pyrite-calcite separated by about 3 feet were observed to contain about 80% sulphide. A westward dip of the zone is indicated by the lack of significant mineralization in the drillhole at 9 + 40W.

On line 12S, the drillhole at 8W intersected 90 feet containing 2% pyrrhotite, and the drillhole at 9W intersected 57 feet containing 1% pyrrhotite, The drillhole at 10W cut 68 feet containing about 2% pyrrhotite, with a 2-foot section in the central part of the zone averaging about 10% pyrrhotite-pyrite.

2.3 Economic geology

Nine samples with high sulphide content were analyzed for Zn, Cu, Pb and Ni. The highest values obtained were 170 ppm Zn, 600 ppm Cu, 17 ppm Pb and 230 ppm Ni.