0700 hours Gently dipping flows with columnar joints from the shore of West Cracroft Island to starboard. Johnson Strait and its broader continuation, Queen Charlotte Strait, define approximately the highly irregular southwestern contact of the Coast Plutonic complex. Leaving Johnson Strait for Broughton Strait the small island to starboard, Hanson Island and a smaller island, Pierce, are both composed of undeformed Mesozoic volcanic rocks.

0800 hours Alert Bay to starboard. The small island on which it is situated is composed of interglacial sands. The small town is notable as an Indian mission centre and fishing centre. The small low island directly ahead which will be passed to port, known as Haddington Island, is of some local interest. Around the turn of the century quarries on this island provided andesite building stone which was used for construction of the Parliament buildings in Victoria and other public buildings in both Victoria and Vancouver. Passing Haddington Island, the large island to starboard, known as Malcolm Island, is composed entirely of interglacial sands and gravels. The low coast-line of Vancouver Island to port is composed of another local basin of upper Cretaceous coal-bearing sediments. From Dillon Point into Hardy Bay, the rocks are again Karmutsen volcanics. The town and harbour of Porty Hardy, however, are underlain by yet another Upper Cretaceous remnant. Here, again, these strata are almost flat-lying and completely undeformed. In contrast, rocks of an equivalent age far to the south on Vancouver Island are moderately to severely deformed by folding and faulting.

VISIT TO ISLAND COPPER MINE

1000 to 1630 Hours

D. G. Cargill

The Island Copper mine of Utah Construction and Mining is located on northern Vancouver Island on the north shore of Rupert Inlet approximately eight miles (13 km) south of the town of Port Hardy. The orebody consists of 280 million tons containing 0.522 percent copper and 0.028 percent molybdenum sulphide. The property is being developed as an open pit operation, with a mill capacity of 33,000 tons per day and is expected to begin operation in the autumn of 1971.

Regional Geology

The bedrock of Vancouver Island north of Rupert Inlet consists of volcanic and sedimentary rocks of Mesozoic and Tertiary age cut by Mesozoic and Tertiary intrusions. Table I outlines the stratigraphy.

The area is in an environment of block faulting with major faults trending WNW, NNE, and NNW. The faults form strong lineaments easily recognizable on air photos. Northcote (1968) reported that offsets of formations and shearing are recognizable along many of these features. Very little large-scale folding has been mapped in the region and the shallow dip of the formation is usually attributed to tilting of the fault blocks.

Mine Geology

Most of the mine area is covered by extremely thick glacial overburden (as much as 250 feet, 77 m). The ore zone does not outcrop. The geological picture was obtained from a few outcrops, diamond drilling, and rock exposed in the preliminary stripping operations. This picture will probably be considerably modified as more rock is exposed.

The pit area is underlain by a sequence of andesitic tuffs and flows which strike north 60° to 70° west and dip 35° to the south. This volcanic sequence is overlain by coarse volcanic breccias which are commonly cemented with chalky white laumontite. The volcanic rocks are believed a part of the Bonanza Volcanic sequence.

The volcanic rocks are overlain by Cretaceous sandstones and conglomerates on the southwest part of the property.

The volcanic sequence is intruded by a dyke of quartz monzonite porphyry which strikes north 70° west and dips 65° to the northeast. This dyke is approximately 450 feet (140 m) wide and has been traced for 6,000 feet (1,850 m) along strike. The porphyry dyke is considered consanguinous with a granitic intrusion on the east end of Rupert Inlet and both are regarded as Jurassic in age (Young and Rugg, 1971).

Mineralization

The mineralized zone, which is 6,000 feet (1,850 m) long and from 450 (138 m) to 1,700 feet (525 m) wide, is controlled by the quartz monzonite porphyry dyke. The copper and molybdenum mineralization usually lies within the volcanics on the hanging wall and foot wall of the dyke. However, the dyke itself contains some mineralization.

The most abundant sulphide minerals are pyrite, chalcopyrite, and molybdenite with galena and sphalerite occurring very locally. Pyrite, chalcopyrite and molybdenite occur both as fracture fillings and disseminations in both the vol-

canics and the dyke. The average pyrite content of the ore body is 3% but there are local concentrations of up to 15%. The molybdenite, which contains some rhenium, is apparently associated with quartz veining. Studies are in progress to determine the possible economic significance of rhenium.

The galena and sphalerite occur in erratically distributed carbonate veinlets which appear later than the ore minerals.

A natural bitumen also occurs locally throughout the orebody, particularly in the more brecciated and faulted portions of the volcanic rocks. It is a bright, black, soft material which resembles frozen tar. It has apparently migrated into the volcanics along fractures possibly from the Bonanza Sedimentary sequence.

Alteration

A zone of altered volcanic rocks surround the porphyry dyke, which is pervasively altered. Silicic, argillic and propylitic alterations are the most prominent. Potassium feldspar only occurs very locally.

Silicic alteration occurs both as pervasive replacement of the matrix (flooding) and as quartz veining. It is most intense within brecciated volcanic rocks adjacent to the dyke but also extends into the dyke and unbrecciated volcanics. Much of the quartz veining appears later than the other alterations and at least three ages of quartz veining have been recognized.

Argillic alteration occurs both as pervasive replacement of the matrix of the rock and as selective replacement of the feldspars. It is well developed both in the dyke and in the brecciated volcanic rocks. The argillic alteration can be divided into the intermediate argillic and advanced argillic facies (Henley, 1967) by the absence or presence of pyrophyllite, a soft, light brown mineral commonly intimately intergrown with blue dumortierite.

Propylitic alteration (as defined by Hemley, 1967) is pervasive through most of the volcanic rocks on the property. It is difficult to distinguish between hydrothermal and deuteric effects so that the extent of this type of alteration has not been clearly established.

Potassium feldspar occurs as a pervasive alteration, both in the dyke and the volcanics. It has the characteristic pink colour and is usually associated with silicification.

TABLE I

STRATIGRAPHY OF NORTHERN VANCOUVER ISLAND

I. Volcanic and Sedimentary Rocks

Formation	*Estimated Thickness*	*Age*	*Lithology*
Lower Cretaceous Rocks			Greywacke, siltstone, sandstone, conglomerate, minor coal seams.
Bonanza Subgroup	8,500 feet (2590 m)	Upper Triassic and Jurassic	
Bonanza Volcanic Sequence			Andesitic flows, pillow breccias, agglomerates, tuffs; minor amounts of rhyolites and dacites
Bonanza Sedimentary Sequence			Black calcareous siltstone, greywacke, breccias, silty limestone.
Quatsino Formation	760-2590 feet (230-790 m)	Upper Triassic	Thick bedded to massive grey limestone.
Karmutsen Formation	10,000-20,000 feet (3050-6100 m)	Upper Triassic	Submarine basic lavas, related clastics, dykes and sills, occasional limestone lenses.

END.

II. Intrusive Rocks

Intrusions range from dykes to stocks in size and from diorite to quartz diorite in composition. Many of the intrusions are considered of Jurassic age. Northcote (per. comm., 1970) considers many of the intrusions closely related to Bonanza volcanism.

SHIP'S LOG, continued

1630 hours Departure from Port Hardy. As the ship leaves Hardy Bay, Goletas Channel will be visible to port. This long remarkably straight channel is not used by the larger ships because at its seaward end is a shallow bar. However, it seems to mark an important geological boundary. Its south-southwest Vancouver Island shore is composed of Vancouver Group volcanic rocks which are unmetamorphosed and only slightly deformed. Its north-northeast shore, defined by Hope and Nigel Islands, and a number of smaller islands, consists of strongly metamorphosed volcanic rocks, hornfels, and migmatite cut by large and small, highly irregular intrusions of quartz diorite. Goletas Channel is therefore considered to mark the south-southwest boundary (probably a major fault) of the Coast Plutonic complex. As the ship turns into Gordon Channel, dark hornfelsic rock laced with lighter coloured granitic rock can be seen on the bluffs behind Doll Island Light to port. The dark coloured rock on the small islands to port is mainly either horn-