SEABED CONDITIONS EAST OF THE AVALON PENINSULA TO THE VIRGIN ROCKS --

Their relationship to the feasibility of a pipeline from the Hibernia P-15 well site area to Newfoundland.

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Since the discovery of hydrocarbon at the Hibernia P-15 well site on the northeastern Grand Banks of Newfoundland, much discussion has transpired on the future movement of oil via pipeline to the Island of Newfoundland. The proposed routes tend to follow the most direct path to the Avalon Peninsula. No information has been published on seabed conditions and their relationship to pipeline construction across this area of the Grand Banks. It is well known that large icebergs, which originate from northern waters, transgress the Grand Banks and scour the seabed. This necessitates the burial of pipelines for protection from grounded icebergs. We are concerned about the feasibility of pipeline burial in relation to the geology of the seabed and subsurface, and this relationship forms the basis of the report.

Our discussion is based on geological data collected during 1975, 1977 and 1980 (Hudson cruises 75-009, 77-011, and 80-010) for purposes of studying the surficial and bedrock geology of the Grand Banks area. These data include airgun and Huntec deep tow high resolution (DTS) seismic profiles, sidescan profiles, and bedrock cores obtained with an electric rock core drill. Interpretation of these data has been compiled (Fig. 1) for the purpose of assessing the feasibility of burying a pipeline from the Hibernia area to the Avalon Peninsula, Newfoundland. Detailed information on the bedrock geology will be

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published in a paper in preparation.

Bedrock Geology

Within the study area, Figure 1, the bedrock geology can be divided into three units. These units have been established on the basis of their acoustic signature as they appear on the seismic reflection profiles together with lithologic and biostratigraphic information obtained from 21 drill cores. Unit 1 consists of a sequence of undifferentiated metamorphic rocks which are an offshore extension of the rocks on the Avalon Peninsula and are Late Precambrian in age. They occur in a narrow zone which parallels the east coast of the Avalon and extends offshore for a distance of approximately 5 km. They also are found in the Virgin Rocks and Eastern Shoals area as an isolated occurrence.

Unit 2 comprises a succession of well indurated sedimentary rocks ranging in age from Cambrian to Mid-Silurian. These rocks occur over a vast area between the Avalon Peninsula and the Virgin Rocks and also underlie much of Conception Bay, Newfoundland. To the east they are overlain by sedimentary rocks of Cretaceous and Tertiary age (Unit 3).

Unit 3, of Cretaceous and Tertiary age, extend across the eastern part of the Grand Banks to the edge of the shelf.

The Precambrian and the Cambro-Silurian rocks are both resistant from the engineering viewpoint, and in our opinion would require the use of explosives or equivalent techniques to excavate trenches for pipeline burial. The Cambro-Silurian succession consists of grey shale and red sandstone, and rocks of similar lithology occur on land on Bell Island of Conception Bay. The Cretaceous-Tertiary unit consists of a succession of semi-consolidated sedimentary rocks that probably would not present a trenching problem.

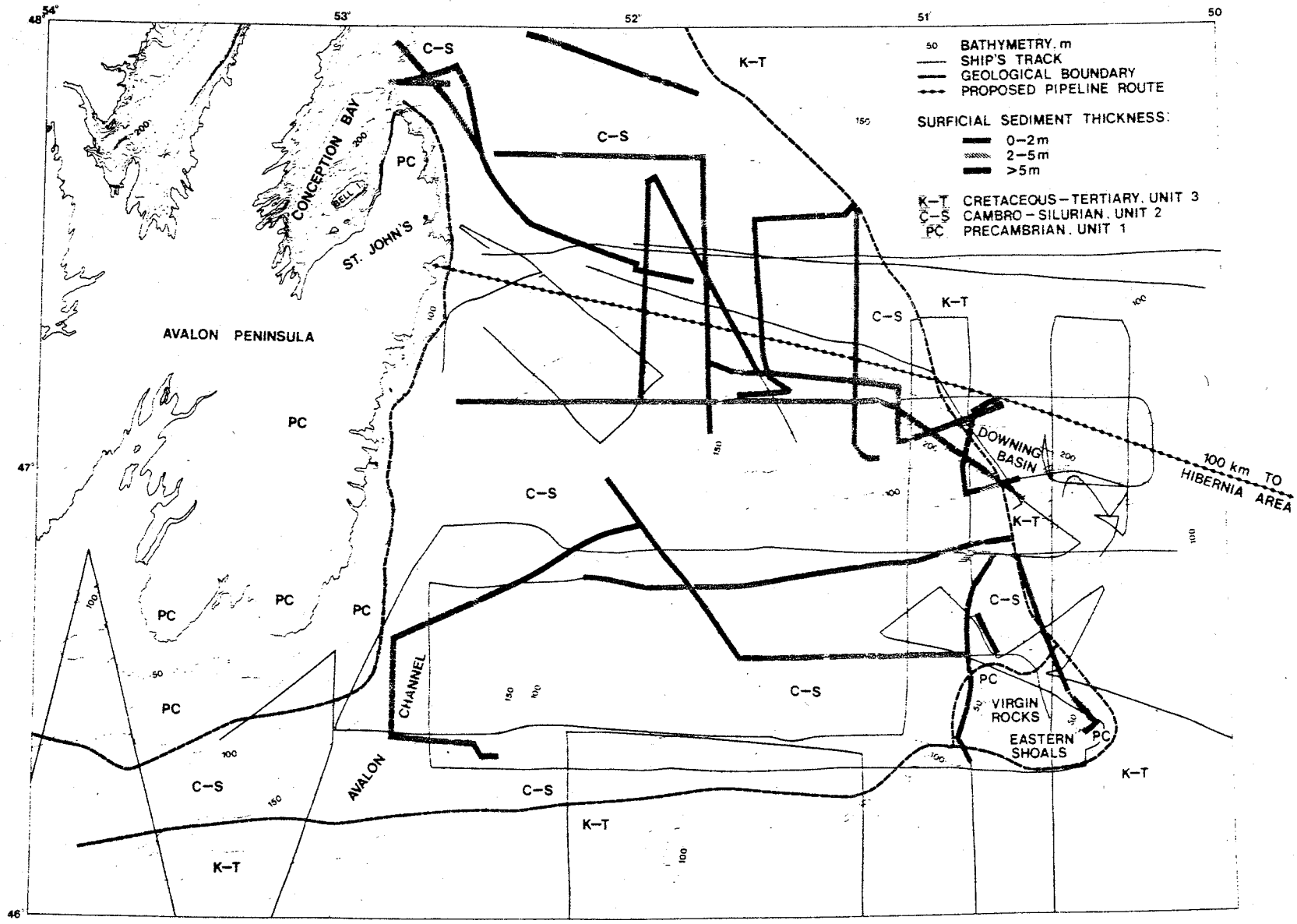
Surficial Geology

The surficial formations which occur in the area consist of glacial till, a glaciomarine silt, and a basal transgressive sand and gravel. The thickest surficial deposits occur in the southern area of the Avalon Channel, Downing Basin, and off the mouth of Conception Bay (Fig. 1). This information has been compiled from an interpretation of the Huntec (DTS) data. A preliminary framework for the formation of the surficial units has been proposed for the Grand Banks area (Fader and King, in press). During the Wisconsinan glaciation most of the shelf is believed to have been covered with glacial till and glaciomarine sediment. In the subsequent Holocene transgression, since 10,000 to 12,000 years BP, this material was eroded and redistributed resulting in the deposition of lag gravels and thin sand. Surficial sample data is not detailed enough, however, for mapping the distribution of textural variations. None of the surficial formations should present a trenching problem.

The total thickness of the surficial formations is shown in Figure 1 along the ship's tracks, and is classified into three thickness categories: 0-2 m, 2-5 m, and >5 m. In the 0-2 m range, icebergs generally scour to the bedrock surface and in areas where bedrock forms the seabed, the icebergs appear to remain stationary for extended periods and form isolated pits on the seabed.

Examination of Figure 1 indicates that the surficial sediment overlying the Cambro-Silurian bedrock between the Avalon Peninsula and the Cretaceous-Tertiary bedrock is generally between 0-2 m thickness. This represents a distance of approximately 120 km along a proposed pipeline route that would require trenching through well indurated bedrock to protect a pipeline from grounding icebergs. This could constitute a serious problem because of the possible

difficulties entailed in trenching hard bedrock; it may be that alternative means of transporting the oil should be considered. The trenching problem could be circumvented by choosing a route south of the Virgin Rocks across the Tertiary-Cretaceous bedrock and well-indurated rocks would then only be found at the landfall end in the Avalonian metamorphic rocks. This would, of course, increase the length of the route substantially and may introduce other pipeline transmission problems.


54°
53°
52°
51°
50
48°
47°
46°
50 BATHYMETRY, m
SHIP'S TRACK
GEOLOGICAL BOUNDARY
PROPOSED PIPELINE ROUTE
SURFICIAL SEDIMENT THICKNESS:
0–2m
2–5m
>5m
K–T CRETACEOUS–TERTIARY, UNIT 3
C–S CAMBRO–SILURIAN, UNIT 2
PC PRECAMBRIAN, UNIT 1
CONCEPTION BAY
BELL I.
ST. JOHN'S
AVALON PENINSULA
DOWNING BASIN
100 km TO HIBERNIA AREA
CHANNEL
AVALON
VIRGIN ROCKS
EASTERN SHOALS
C–S
K–T
PC