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PRELIMINARY GEOTECHNICAL AND GEOPHYSICAL LOGS FROM
DRILL HOLE 2C-80 IN THE CAPPS COAL FIELD,
COOK INLET REGION, ALASKA

By

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This report is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards and stratigraphic nomenclature. Any use of trade names is for descriptive purposes only and does not imply endorsement by the USGS.

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CONTENTS

	Page
Introduction.....	1
Acknowledgments.....	1
Drilling operation.....	5
Field geotechnical-logging operation.....	5
Summary of geotechnical properties.....	5
Description of geologic materials.....	5
Discontinuities and weathering.....	6
Strength properties.....	6
Geophysical logging.....	6
References.....	9

ILLUSTRATIONS

	Page
PLATE 1. Generalized geotechnical log.....In pocket	
2. Compilation of geophysical, lithographic, and casing logs.....In pocket	
FIGURE 1. Index map showing location of drill site 2C-80.....	2
2. Location of drill site 1C-79 and drill site 2C-80 in relation to the geology and proposed mine areas.....	3
3. Generalized lithologic log for drill hole 2C-80.....	4
4. Relationship between hardness and unconfined compressive strength.....	7

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INTRODUCTION

The drilling and logging information provided in this report was collected during September 1980 as part of the Energy Lands program of the U.S. Geological Survey.

Drill hole 2C-80 is located in the Capps Coal Field, approximately 100 km (62 mi) west of Anchorage, Alaska (fig. 1). The drilling was undertaken to obtain information on the geotechnical characteristics of a part of the coal-bearing Tyonek Formation and overlying surficial deposits. The preliminary results of a previous drill hole (1C-79), located 1.3 km (0.8 mi) northeast of drill hole 2C-80, were reported by Chleborad and others (1980).

The Tyonek Formation is early Oligocene to middle Miocene in age (Wolfe and Tanai, 1980). At the drill site it is overlain by a thin colluvial deposit of Quaternary age.

The drilling and continuous core sampling penetrated 19.5 m (63.9 ft) of overburden, a major coal bed (Waterfall bed), and approximately 29 m (95.1 ft) of underlying material, to a total depth of 61 m (200 ft). Drill hole 2C-80 stratigraphically overlaps drill hole 1C-79 and continues down section approximately 33 m (108 ft).

A proposed open pit coal-mining plan (Placer Amex, Inc., 1977, status report of December 1977) outlines a sequential mining and reclamation scheme for five areas in the Capps Coal Field. Figure 2 shows the location of drill holes 2C-80 and 1C-79 with respect to the proposed mining areas as well as selected surface features. A general description of the geology and natural hazards of the region are given by Schmoll and others (1981).

The generalized lithology interpreted from core obtained from drilling and supplemented by outcrop mapping accomplished during the 1979 and 1980 field seasons is presented in figure 3. A more detailed lithologic log is presented as part of the geotechnical log.

The geotechnical and geophysical logs presented herein (pls. 1 and 2) provide basic physical-property and engineering data useful in predicting the response of geologic materials to proposed large-scale coal mining and related development, and in identifying and assessing potential geologic hazards.

Acknowledgments

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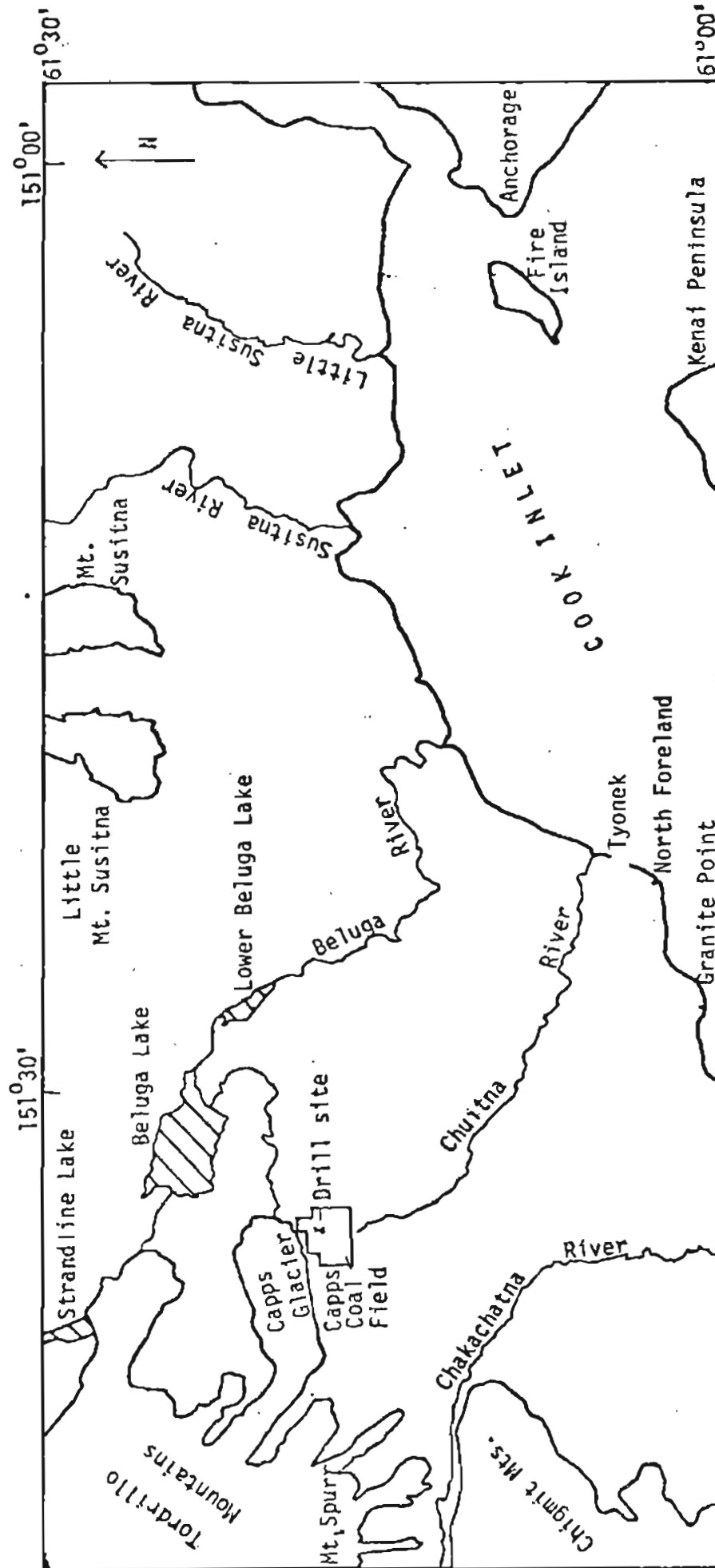
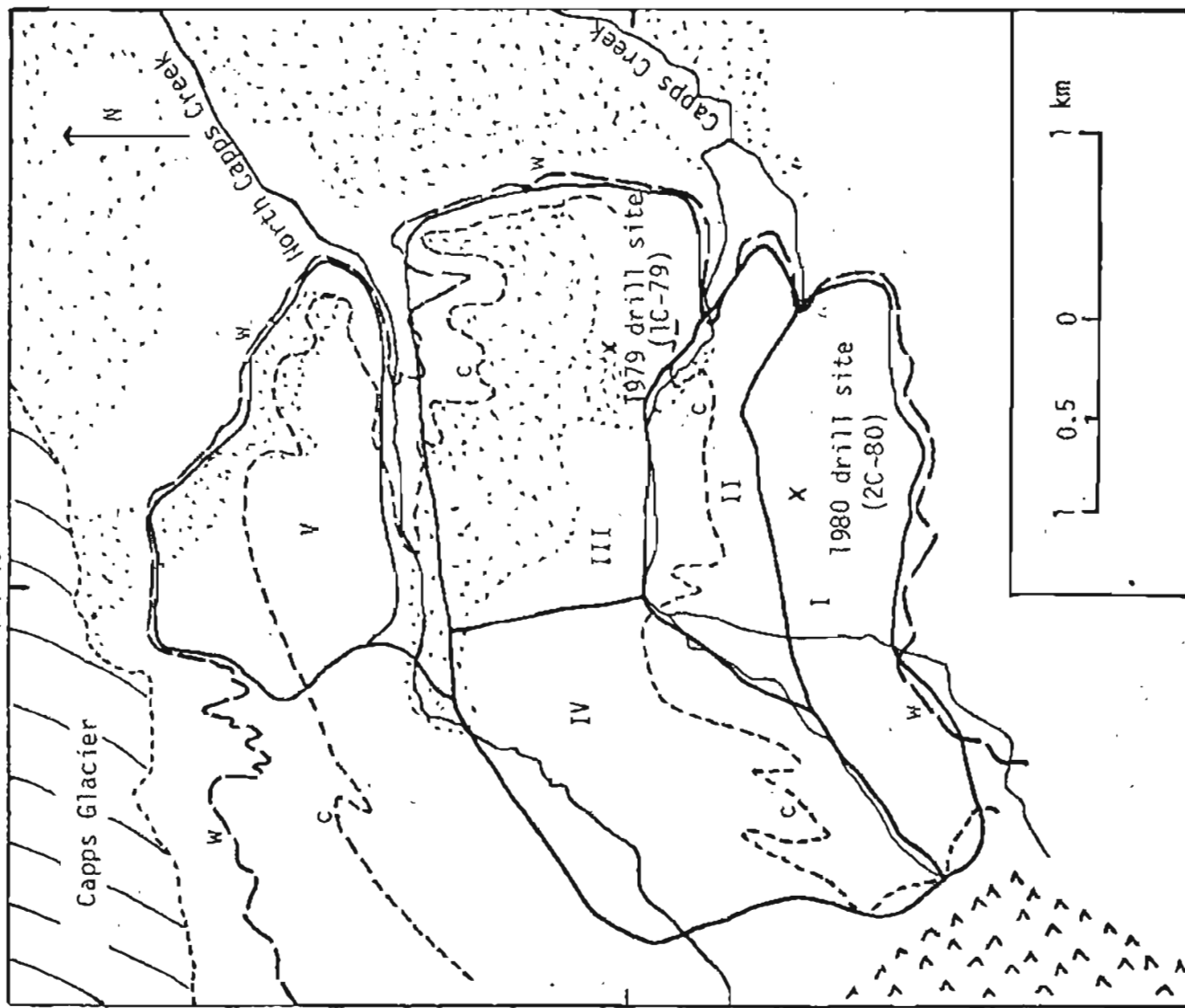
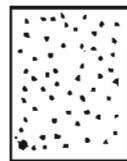


Figure 1. Index map showing the location of drill site 2C-80.



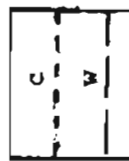
Explanation



Landslide areas



Volcanic plateau



Tyonek Formation (modified from Magoon and others, 1976), outcrop of Capps coal bed, (c), outcrop of Waterfall coal bed, (w), (modified from Placer Amex Inc. status report, Dec. 1977)



Proposed mine area boundary. Roman numerals indicate sequential order of areas to be mined (modified from Placer Amex Inc. status report, Dec. 1977)

Figure 2. Location of drill site IC-79 (Chleborad and others, 1980) and drill site 2C-80 in relation to the geology and proposed mine areas.

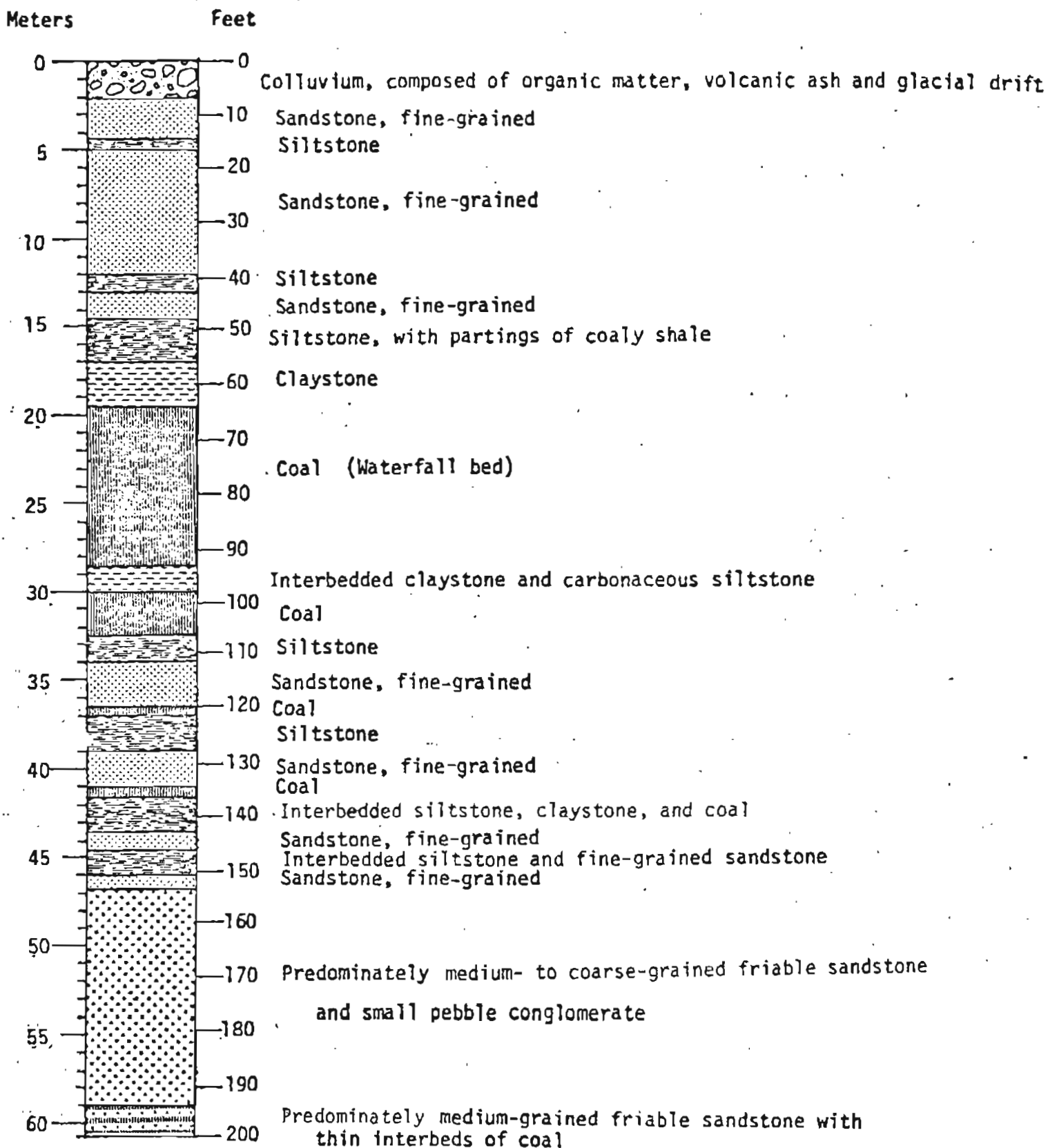


Figure 3. Generalized lithologic log for drill hole 2C-80.

DRILLING OPERATION

A Gardner-Denver Model 2000 drill rig equipped with a rotary HQ wire line core system (6.4-cm- (2.5-in.-) diameter core size) was used to obtain continuous core suitable for logging and physical-property testing. Diamond core bits were used on a 1.5-m- (5.0-ft-) long HQ core barrel with split-tube inner barrel. Drilling mud additives were used starting at a depth of approximately 50 m (164 ft) to stop a loss of drilling fluid. Drilling of the 60.6-m- (200-ft-) deep, near-vertical drill hole was completed in approximately 6 days.

FIELD GEOTECHNICAL-LOGGING OPERATION

The procedure for retrieving, logging, testing, and packaging the core was similar to that described for drill hole 1C-79 (Chleborad and others, 1980). The core was washed, photographed, and described using an abbreviated field-logging scheme (Rankilor, 1974). Field tests included the pocket penetrometer (Soiltest, Inc., 1978), and point-load (Broch and Franklin, 1972) strength-index tests, moisture-content determination tests, and a carbonate-detection test. The core (except for the coal) was wrapped in cheesecloth and waxed for transport and storage. Coal samples were sealed in plastic sleeves and further sampling and strength-indices tests were performed in Denver. Test results and descriptions of the core are presented in generalized form on plate 1.

SUMMARY OF GEOTECHNICAL PROPERTIES

Description of Geologic Materials

Sandstone, siltstone, coal, and claystone are the principal lithologies sampled at the site.

The sandstones above 49 m (160 ft) in depth range in color from pale yellowish brown (weathered) to medium gray and contain mostly fine to very fine subrounded to subangular grains. The bedding ranges from massive to obscurely bedded to laminated, and generally exhibits gradational contacts. Below 49 m (160.8 ft) the sandstone is medium light gray to medium gray, medium to coarse grained, and very friable.

Siltstone is medium dark gray, grayish brown (where weathered), massive to obscurely bedded or laminated, commonly clayey or sandy, and occasionally carbonaceous.

Claystones are medium gray to medium dark gray, massive to obscurely bedded or laminated, silty, and often carbonaceous.

Coal beds are brownish black to black, and are massive with partings or interbeds of siltstone or claystone.

Unconsolidated silty sand and clayey silt of probable colluvial origin extend from the surface to a depth of nearly 2 m (6.6 ft); however a few pebbles were also present. The colluvium probably was derived from siltstone, sandstone, and glacial drift. The colluvium also includes a mantle of volcanic ash and some organic matter totaling about 1 m (3.3 ft) in thickness.

All materials sampled were noncalcareous.

Discontinuities and weathering

Discontinuities in bedrock include joints, bedding break separations, and broken rock zones. The discontinuities shown on plate 1 include both natural and drilling induced fractures; often it was difficult to distinguish between the two. Those discontinuities indicated as joints are believed to be natural fractures.

Weathering is believed to extend to a depth of approximately 11 m (36.1 ft) on the basis of: (1) discoloring related to iron-oxide stain, (2) the apparent oxidation (depletion) of carbonaceous materials, and (3) low strength values (pl. 1). Many of the joints above 11 m (36.1 ft) are marked by iron-oxide stain indicating that they are avenues for the infiltration of surface waters (pl. 1).

Strength Properties

Unconfined compressive strength values were calculated from point-load tests (Franklin and others, 1972). The materials excluding coal, range in strength from 0.24 to 7.44 MPa (megapascal) and can be classified as ranging from soft soil to soft rock (fig. 4). Calculated compressive strengths of coal samples varied greatly with values as high as 21.6 MPa (pl. 1).

The preponderance of relatively low strengths indicate that much of the material can be easily excavated. Such material, however, may be easily eroded and may contribute to slope-stability problems if not adequately evaluated and designed for in the mining plan.

GEOPHYSICAL LOGGING

Natural gamma radiation, gamma-gamma radiation, neutron radiation, caliper, spontaneous potential, single-point resistance, and temperature measurements were run in the hole soon after completion of coring. A Well Reconnaissance, single-conductor cable, suitcase-sized logger was used following techniques described by Keys and MacCary (1971). A compilation of the geophysical logs with lithologic and casing logs are shown on plate 2.

The geophysical-log responses document almost all lithologic contacts. In general, interpretation of the suite of logs reinforces the subtle descriptive differences noted on the lithologic log. The more important interpretative features are briefly discussed below.

Washouts or hole diameter enlargements, due to caving of loose or friable beds along the drill hole, occur fairly commonly above the water level. Radiation logs, run inside the drill stem before it was removed, reflect major washed-out intervals. The largest deflection on each log occurred between 10.7 m (35 ft) and 13.7 m (45 ft), and these large deflections are mainly the result of an unintentional "window" in the surface casing. Apparently, the lower 3 m (10 ft) of casing became unscrewed and slipped down 2.1 m (7 ft). The most direct measurement of hole-size variations is the caliper log, which was run after the drill stem was removed.

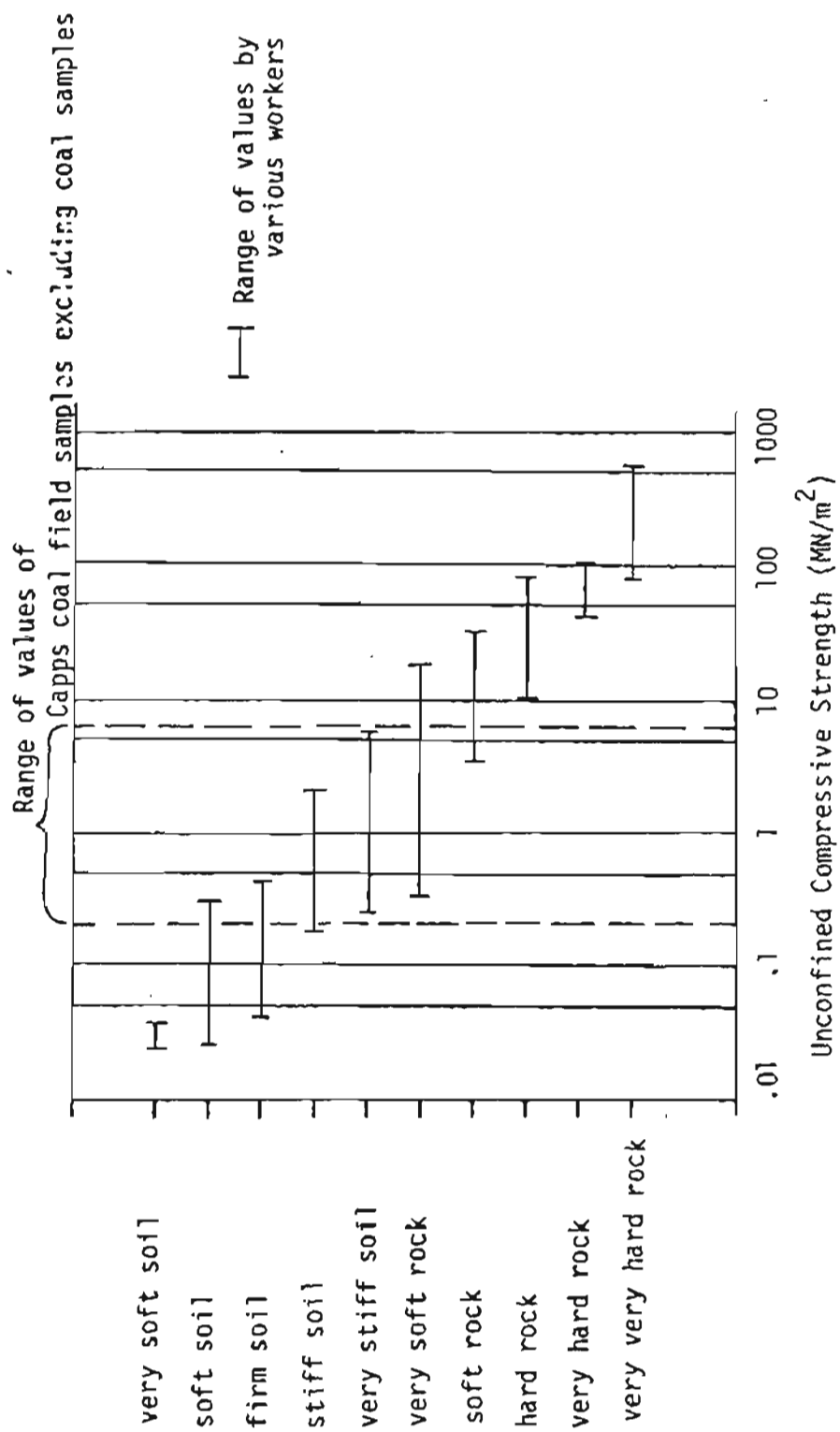


Figure 4. Relationship between hardness and unconfined compressive strength (modified from Jennings and Robertson, 1969).

All coal beds within the logged interval, except for a very thin bed at 40.2 m (132 ft), caused conspicuous deflections on the radiation logs. These responses are a result of a very low natural-gamma radiation level; a low backscatter level on the neutron log because of the abundance of hydrogen molecules; and relatively low density indicated by a marked increase in the gamma-gamma count rate.

Deflections characteristic of coal beds are also generally present on the spontaneous potential and resistance logs, which begin below water level 33.5 m (110 ft) because of instrument limitations. The thinness of coal beds below this depth caused much less deflection than would have been registered by the much thicker coal beds at shallower depth.

The suite of geophysical logs, especially the natural-gamma and electric logs, strongly indicate that beds below a depth of 47.2 m (155 ft) for which no core was retrieved, are probably composed of relatively clean granular material--most likely medium or coarse-grained sandstones. It is recognized in this interpretation that the abrupt and pronounced rightward shift on the gamma-gamma log at 56.1 m (184 ft) is due to the lower termination of the drill stem, and not to any recognizable decrease in bulk density. The other radiation logs also reflect the constructional change in the drill hole, but to a lesser degree.

The temperature log was run several hours after drilling ceased and presumably after temperature effects from drilling had largely dissipated. The only pronounced shift on the log, at 49.7 m (163 ft), may be due to downward flow of water within the drill hole. The highly sensitive and finely calibrated thermistor-type probe detected a rapid temperature increase of over 0.5°C (32.9°F) below this depth. A warmer, nearly constant temperature of 3.3°C (37.9°F) occurred below 50.3 m (165 ft). Water thought to be entering the hole above 32.9 m (108 ft) probably was moving downward and out into a permeable sandstone(?) lying between 46.3 m (152 ft) and 50.6 m (166 ft). Further evidence of permeability of this zone is found on the other geophysical logs as well-marked deflections.

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