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ZEOLITES IN EOCENE ROCKS OF THE PENTICTON GROUP, OKANAGAN-BOUNDARY REGION SOUTH-CENTRAL BRITISH COLUMBIA (82E)

By Z. D. Hora and B. N. Church

INTRODUCTION

A survey of Early Tertiary rocks of the Okanagan and Boundary areas (Church, 1963, 1973) led to discovery of a large variety of zeolites in both volcanic and sedimentary formations of the Penticton Group. The most common of these are natrolite, laumontite, and heulandite (Plate 5-1). Subsequent re-examination of the original survey samples by Z. D. Hora indicated local abundance of clinoptilolite.

The importance of the clinoptilolite discovery stems from industrial use of this mineral. Clinoptilolite resembles heulandite and belongs to the same mineral-chemical series of hydrous calcium-sodium aluminum silicates. Unlike heulandite, however, clinoptilolite is stable at relatively high temperatures and displays remarkable base exchange and absorption properties. Clinoptilolite has the capacity to absorb ammonia and is well known as a cation sieve in removing cesium from solutions. The list of uses includes fillers and carriers, a component in some construction materials, waste water treatment, and petroleum refining.

The purpose of this report is to provide preliminary information on the occurrence of zeolites in Early Tertiary rocks, indicating their stratigraphic range and regional distribution.

GEOLOGICAL SETTING

The principal Early Tertiary rocks of the Okanagan-Boundary area are assigned to the Penticton Group which, in the type area near Penticton, consists of six formations having a total thickness of about 2 500 metres (Fig. 5-1). The age range for the group, according to K/Ar analyses, is 48.4 Ma (whole rock) to 53.1 Ma (biotite) ± 1.8 Ma. Structural control of these rocks appears to have been meridianally directed maximum stresses that produced rifting and many graben and half-graben structures.

ZEOLITE OCCURRENCES

Formations in the lower and middle part of the Penticton Group are locally enriched in zeolites. These include the basal Springbrook and coeval Kettle River sedimentary rocks as well as immediately overlying volcanic members of the Marron Formation. Clinoptilolite shows a preferential occurrence as a fine-grained matrix in volcaniclastic rocks such as commonly found in the White Lake Formation, which rests unconformably on the Marron rocks.

PENTICTON TERTIARY OUTLIER

The type section of the Marron Formation is displayed near the west margin of the Penticton Tertiary outlier (Fig. 5-1, section A-B), where the tiered lava units of this sequence overlook Yellow Lake. The Yellow Lake volcanics, lowest member of the Marron Formation, are visibly enriched in zeolites in fresh outcrops along Highway 3. These rocks are typically grey mafic phonolite lavas with dark pyroxene phenocrysts and light-coloured natrolite-filled amygdales. Calcite and analcite commonly accompany natrolite lining the gas cavities: thomsonite and mordenite are less common. Pink laumontite-leonhardite occurs with calcite in veinlets along the main and satellitic fractures.

The occurrence of primary analcite as phenocrysts and in the groundmass of the Yellow Lake lavas (Daly, 1912) is indicative of silica undersaturation (Church, 1978). This characteristic is believed to have been an important factor favouring the development of zeolites in these host rocks.

The trachytes of the Kitley Lake and Nimpit Lake members, near the middle of the Marron section, host several small zeolite localities. These consist of heulandite and, less commonly, brewsterite on small fissures. North of section A-B, a brownish tuffaceous grit and siltstone unit at the base of the Nimpit lava was found to contain clinoptilolite and analcite in the 10 to 20 per cent range (Table 5-1, Nos. 2 and 3).

Elsewhere in the Penticton Tertiary outlier, clinoptilolite was found interstitially in sedimentary rocks in the Springbrook Formation (Table 5-1, No. 1) and in tuffaceous sandstones at the base of the Kearns Creek member in the middle of the Marron Formation (Table 5-1, Nos. 4, 5, and 6).

SUMMERLAND TERTIARY OUTLIER

The Summerland Tertiary outlier is a remnant of a caldera structure with only a fragmentary representation of the middle sequence of the Penticton Group (Church, 1979). The single observed zeolite occurrence in the Nimpit trachyte lavas and ash flows, which underlie most of the basin, is a veinlet of heulandite found midway on the summit ridge of Mount Conkle, 3 kilometres southwest of Summerland. In contrast, a broad apron of sandstones and conglomerates assigned to the White Lake Formation, flanking Giant's Head dacite dome on the west and north, shows a wide distribution of clinoptilolite, laumontite, and stilbite (Table 5-1, Nos. 7 to 15).

KELOWNA TERTIARY OUTLIER

The Kelowna Tertiary outlier is a larger copy of the Summerland caldera (Church, 1980b). Again, the White Lake Formation, consisting of a mixture of volcanic breccias, tuff, sandstones, and conglomerates, hosts numerous occurrences of authigenic clinoptilolite and laumontite (Table 5-1, Nos. 16 to 23).

ROCK CREEK TERTIARY OUTLIER

The Rock Creek Tertiary outlier consists of a series of down-faulted panels of mainly Kettle River sedimentary rocks and Yellow Lake volcanics (Church, 1980c). The area includes two of six known localities of analcite-bearing shackanite lava (Fig. 5-2). Red shale from the Storm Hill member and tuffaceous arkose from the Ed James Lake member of the Kettle River Formation contain significant amounts of analcite (wairakite ?) and stilbite (Table 5-1, Nos. 24 and 25).

CONCLUSIONS

Zeolites in the Penticton Group appear to be most abundant in the lowest part of the section suggesting, at first, a low-grade regional metamorphic effect. However, the close association of natrolite and

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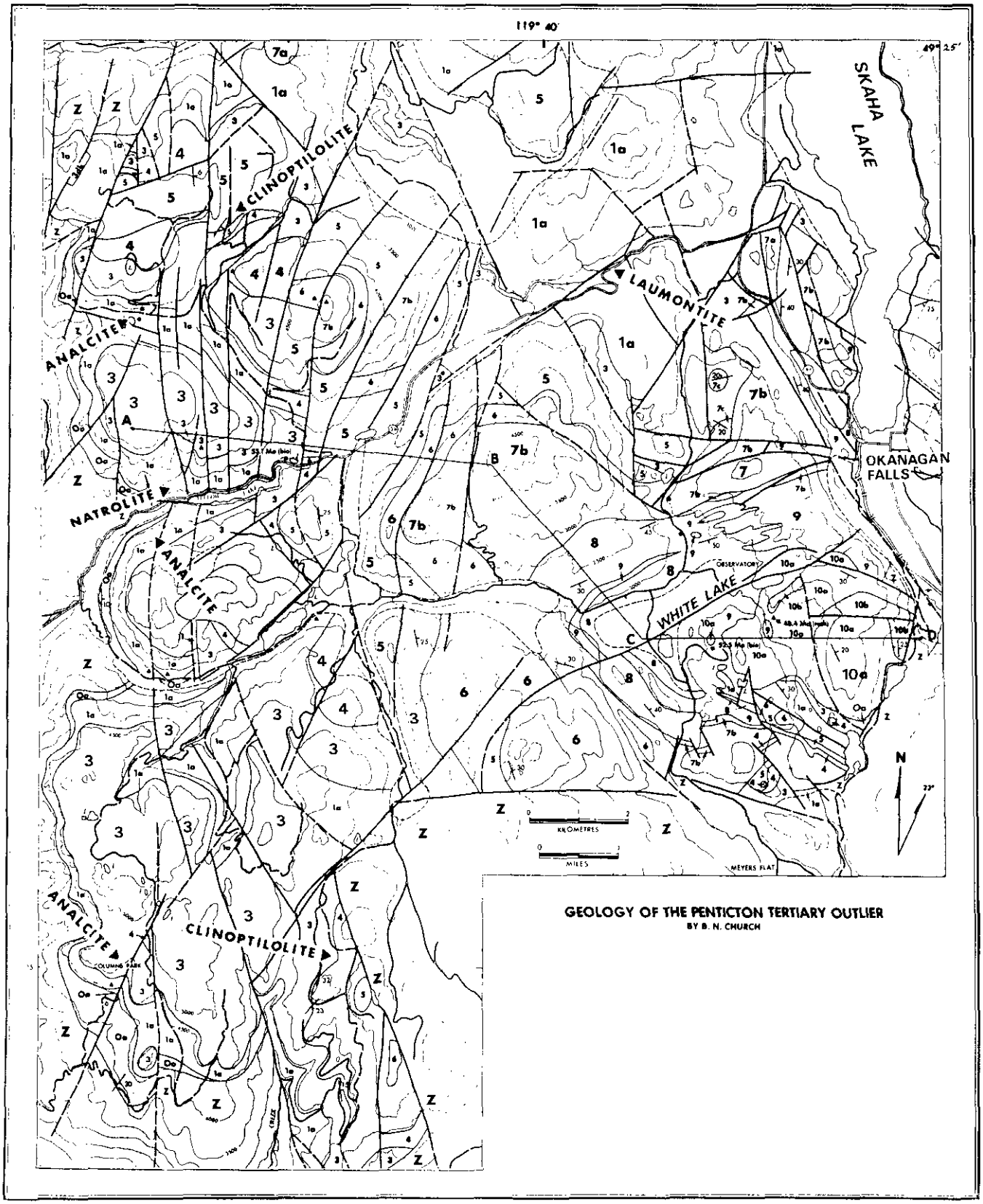

Figure 5-1. Geology of the Penticton Tertiary outlier.

LEGEND

MIOCENE

(OLALLA RHYOLITE)

11 MOSTLY RHYOLITE BRECCIA, SOME MASSIVE OBSIDIAN, AND ASSOCIATED DYKES

EOCENE

PENTICTON GROUP

SKAHA FORMATION

10a MOSTLY CHERT AND GREENSTONE SLIDE BRECCIA AND SOME TEPHRITE LAVA OVERLAIN BY POLYMICTIC FANGLOMERATE

10b CHANNEL DEPOSIT OF GRANITE BOULDER CONGLOMERATE AND BRECCIA AND ARKOSIC SANDSTONES

WHITE LAKE FORMATION

9 MOSTLY VOLCANIC BRECCIAS INCLUDING PYROCLASTIC ROCKS AND LAHARS, MINOR TRACHYTIC AND ANDESITIC LAVAS

8 VOLCANIC CONGLOMERATE, SANDSTONES, AND SHALES

MARAMA FORMATION

7a AENEAS BUTTE FELDSPATHIC DACITE

7b MASSIVE APHANITIC DACITE LAVA AND SOME BRECCIA FORMING MOSTLY REMNANTS OF VOLCANIC DOMES

7c VOLCANIC CONGLOMERATE WITH CLASTS FROM THE MARRON FORMATION

MARRON FORMATION

6 PARK HILL MEMBER: MEROCRYSTALLINE ANDESITE LAVA AND MINOR BRECCIA

5 NIMPIT LAKE MEMBER: TAN TRACHYTE AND TRACHYANDESITE LAVA AND MINOR BRECCIA

4 KEARNS CREEK MEMBER: VESICULAR PYROXENE-RICH BASALTIC ANDESITE LAVA

EOCENE *(CONTINUED)*

MARRON FORMATION *(CONTINUED)*

3 KITLEY LAKE MEMBER: TRACHYANDESITE LAVA WITH CONSPICUOUS GLOMEROPHENOCRYSTIC CLOTS OF FELDSPAR

2 SHATFORD CREEK MEMBER: LOCAL DEPOSIT OF BROWN ANDESITE LAVA AND BRECCIA WITH SOME QUARTZ-FILLED AMYGDALES

YELLOW LAKE MEMBER

1a MOSTLY PYROXENE-RICH MAFIC PHONOLITE LAVA WITH LOCAL WELL-DEVELOPED PHENOCRYSTS OF RHOMBANORTHOCLASE AND SOME PRIMARY ANALCITE, ABUNDANT ZEOLITE FILLINGS IN CRACKS AND AMYGDALES

1b PURPLE AND GREY VOLCANIC WACKE FROM EROSION OF 1a AND PINK RADIOACTIVE FELDSPATHIC TRACHYTIC ASH FLOW, SANDSTONE, AND CONGLOMERATE

1c CLARK CREEK PORPHYRY: A SILL-LIKE BODY RELATED TO 1a WITH LARGE FELDSPAR PHENOCRYSTS

SPRINGBROOK FORMATION

Oa POLYMICTIC CONGLOMERATE AND BRECCIA WITH CLASTS DERIVED MAINLY FROM PRE-TERTIARY BEDDED ROCKS

KETTLE RIVER FORMATION

Ob MAINLY GRANITE BOULDER CONGLOMERATES, ARKOSE, VOLCANIC WACKE, AND RHYOLITE BRECCIA

Oc SHINGLE CREEK PORPHYRY: A COARSE SANIDINE QUARTZ PORPHYRY INTRUSION FEEDER TO THE RHYOLITE VOLCANIC ROCKS OF Ob

PRE-TERTIARY ROCKS

Y MAINLY GRANITIC INTRUSIONS

Z MAINLY CHERTS, GREENSTONES, SCHISTOSE ROCKS, AND MINOR INTRUSIONS

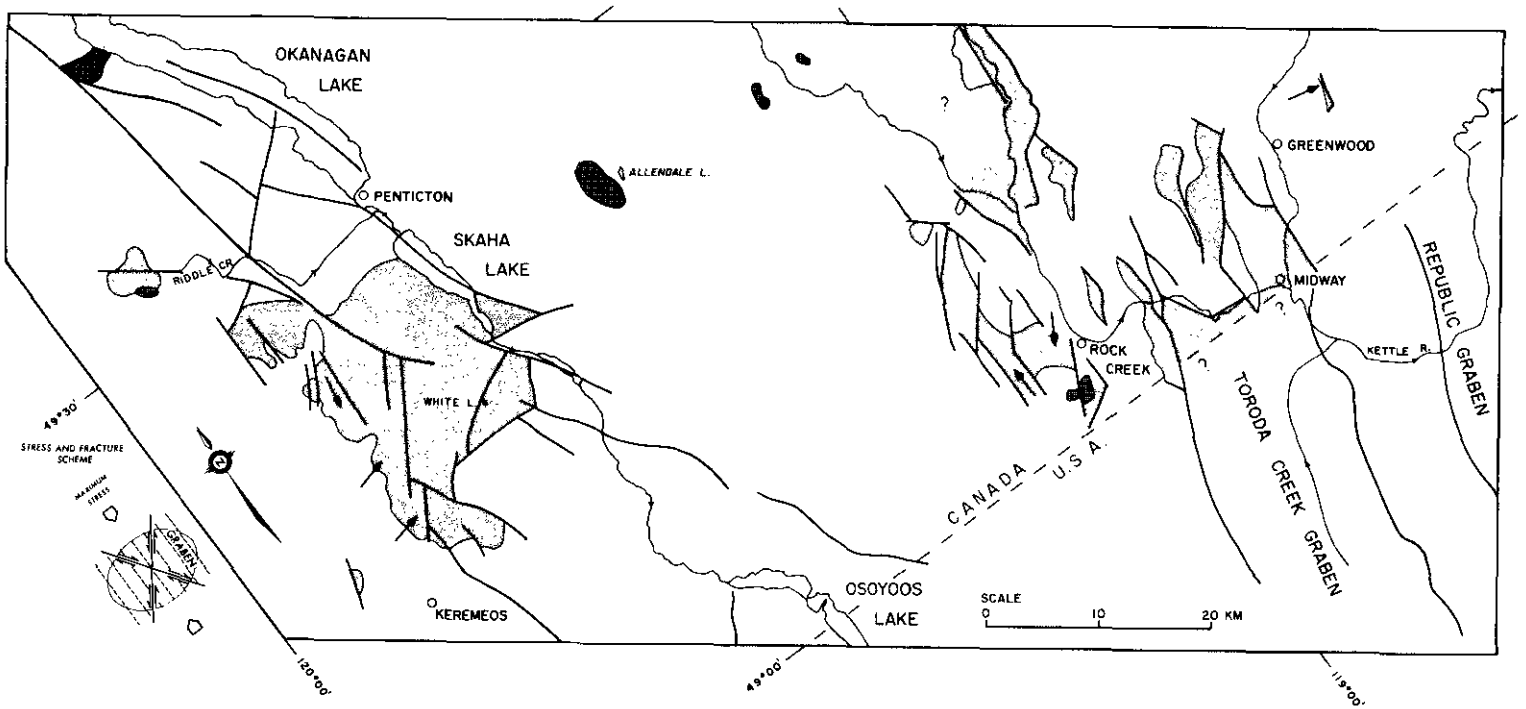

Figure 5-2. Distribution of analcite-bearing lavas in area of downfaulted Yellow Lake phonolite and mafic phonolite and Coryell source intrusions.

TABLE 5-1

ZEOLITES IN TERTIARY SEDIMENTARY ROCKS

No.	Coordinates (UTM) Easting	Northing	Description (X-ray Determinations)*
1	2967	54722	trace clinoptilolite
2	2998	54738	30% analcite, 10% clinoptilolite
3	2994	54748	20% clinoptilolite, trace analcite
4	3012	54579	20% clinoptilolite
5	3013	54571	5% clinoptilolite
6	3012	54585	8% clinoptilolite
7	3071	54950	10% clinoptilolite
8	3064	54946	5% sodium stilbite
9	3057	54958	5% sodium stilbite
10	3056	54945	8% clinoptilolite
11	3062	54957	8% clinoptilolite
12	3058	54964	8% clinoptilolite
13	3061	54964	10% clinoptilolite
14	3064	54996	10% laumontite, trace ferrierite
15	3065	54995	10% clinoptilolite
16	3044	55240	8% clinoptilolite
17	3048	55240	15% clinoptilolite
18	3078	55243	10% clinoptilolite
19	3071	55193	trace laumontite
20	3094	55219	10% laumontite
21	3093	55217	30% laumontite
22	3096	55256	10% clinoptilolite
23	3126	55254	8% laumontite
24	3635	54290	20% analcite (wairakite)
25	3485	54549	35% sodium stilbite

* Approximate values by XRD.

secondary analcite with undersaturated sodic volcanics of the Yellow Lake member may indicate that these minerals formed from deuteric solutions at the time of cooling of the lavas. Also, the occurrence of some laumontite and heulandite in fissures throughout wide sections of the Penticton Group indicates open hydrothermal plumbing systems. Indeed, the frequent association of clinoptilolite with tuffaceous sedimentary rocks high in the White Lake section suggests at least some is of authigenic or early diagenetic origin.

The discovery of clinoptilolite in Tertiary outliers of the Okanagan-Boundary region is of economic interest, however, none of the occurrences listed (Table 5-1) attains the present minimum commercial grade of 80 per cent. Nevertheless the wide distribution of clinoptilolite indicated by this preliminary work warrants additional study and careful prospecting.

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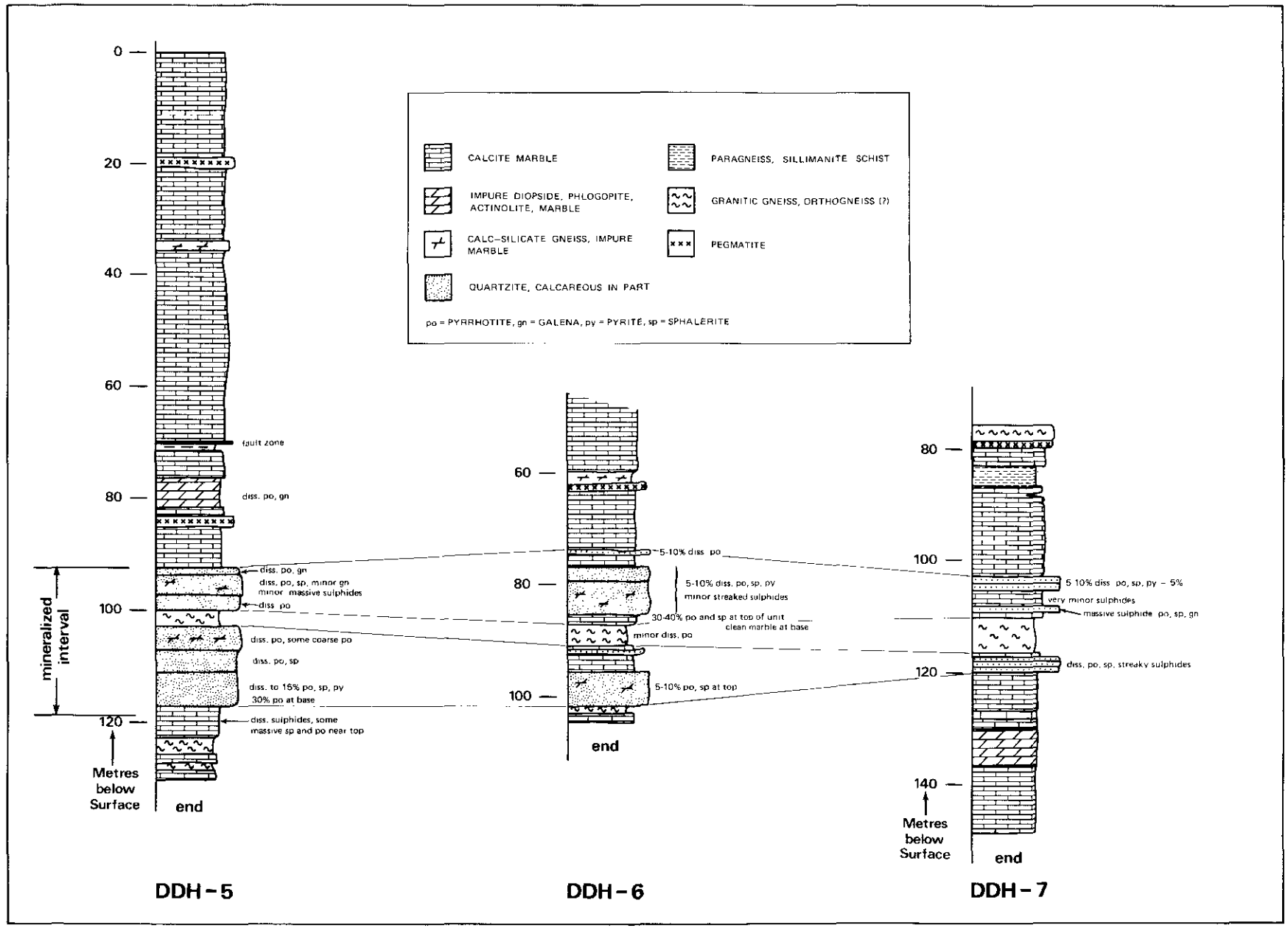

Figure 6-1. Diamond drill-hole sections through the mineralized interval of the Sherpa lead-zinc occurrence.