FURTHER NOTES ON CARBONATITES IN CENTRAL BRITISH COLUMBIA (83D/6E, 7W)

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INTRODUCTION

Stratiform carbonatites, apparently with igneous strontium, carbon, and oxygen isotopes, and containing anomalous values of strontium and rare earths, occur from Revelstoke to north and east of Blue River (Fig. 25). Carbonatite crosscutting hosting schists is present on a small scale at Mount Copeland and south of Three Valley Gap. For the most part, however, these rocks are stratiform with fairly sharp to gradational, conformable contacts.

In the Blue River area there are a minimum of six carbonatite sites: Verity, Paradise Lake, Howard Creek, Gum Creek (with the Fir claims), Pyramid Creek, and Mud Lake. Several beds of carbonatite are usually found at each locality. The occurrences at Verity can be traced intermittently to Paradise Lake, 10 kilometres to the east. Carbonatite thicknesses of 30 metres have been recorded in drill sections from the Verity showing near Lempriere. Thinner but significant layers occur at most of the other Blue River sites.

Rocks that are referred to in this report as carbonatite contain anomalously high amounts of strontium and rare earths. They have variable mineralogical assemblages; the Mud Lake occurrence is typified by chondrodite, diopside, and garnet, while those at Verity, Paradise Lake, and Howard Creek have the mineralogy of marble, except for the presence of pyrochlore. Vertical mineral zoning is apparent in weathered outcrop at Mud Lake and Gum Creek, and in unweathered outcrop above timberline at Howard Creek. In unweathered outcrop, banding, possibly due to regional metamorphism, is in the form of concentrations of phlogopite or apatite; inexplicably, colour banding of 2 to 5-centimetre thickness, evident in weathered outcrops at Gum Creek, is not reflected in drill core.

Amphibolite to kyanite grade metamorphic rocks of the Shuswap Terrane host the carbonatites. At least three periods of structural deformation are evident at all the sites examined.

Attempts to correlate carbonatite bodies by pursuing daughter minerals in primary fluid inclusions in the ubiquitous accessory apatite, by studying the petrology of pyrochlore and other minerals, and by comparison of the quantity and type of rare earths present were not successful. Recent isotope studies by E. Ghent of the University of Calgary suggest that the carbonatites in the Verity area have an igneous origin (M. Mihalynuk, personal communication, 1984). Further studies are being carried out by

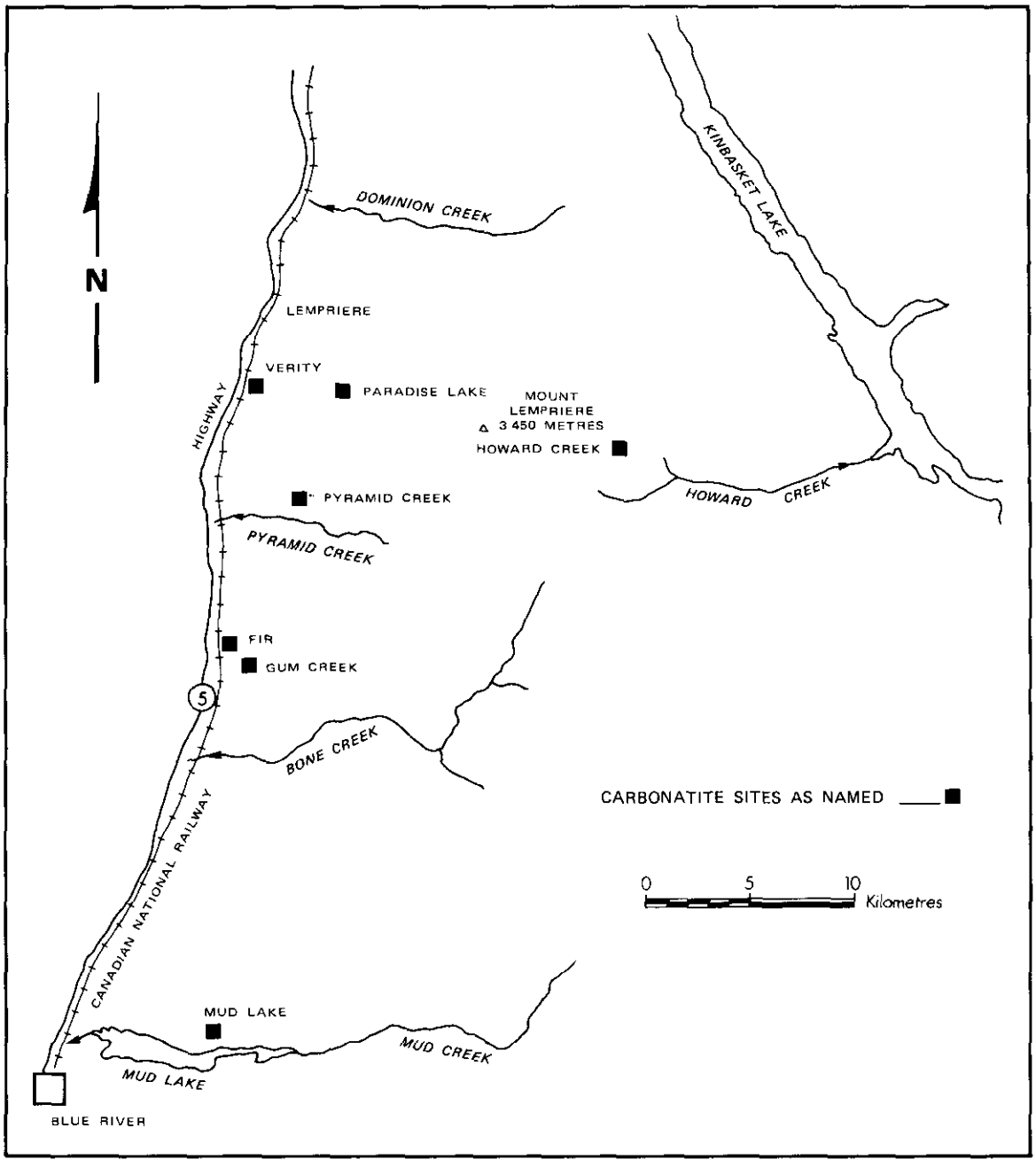

Figure 25. Blue River area. Map showing carbonatite localities.

J. Pell (*see* report, this volume) at the University of British Columbia; it is hoped that further studies of the strontium, oxygen, and carbon isotopes will answer some of the questions of origin. A study of correlative petrology is also required.

The volume, elemental content, and mineralogy of these carbonatites make them an important potential source of rare earths, niobium, phosphate, and vermiculite. The Verity and Gum Creek (Fir) carbonatites have been surveyed and drilled, while less extensive exploration has been carried out during the past two years in the Perry River (Revelstoke) area. Niobium was pursued at Verity while rare earths were sought at Perry River.

HOWARD CREEK (83D/7W)

The Howard Creek carbonatite occurrence is at the headwaters of Howard Creek, 13 kilometres west of Kinbasket Lake and 41 kilometres northeast of Blue River at an elevation of 2 360 metres in an alpine setting. The carbonatites are hosted in a series of schists of amphibolite to kyanite metamorphic grade, which are part of the Shuswap Terrane. At least two separate bodies conformable to the regional schistosity and lithological layering have been identified within 300 metres of stratigraphic thickness. The structurally higher body contains nepheline syenite.

The regional foliation in the area trends east-west and dips 40 degrees south (Fig. 26). Cross-folding and right-hand *en echelon* faulting has displaced all rock units. As at other Blue River occurrences, this area has been subjected to at least three periods of structural deformation. In the earliest event, lithologic layering and the carbonatites were transposed parallel to the regional foliation. Drag folds and tight crenulations are evident in the carbonatites, particularly near their contact with the host rock.

At Howard Creek the carbonatite bodies vary in thickness from 10 centimetres to 20 metres. An interbed of schist less than 1 metre thick occurs within the carbonatite at the most western outcrop (Fig. 26). Most contacts of carbonatites with the schists are sharp but gradational contacts are present as well. Coarse banding of 5 to 50 centimetres is due to increased phlogopite content in the thinner bands. No crosscutting relations were noted.

Minerals identified in the Howard Creek carbonatites are calcite, dolomite, apatite, richterite, hornblende (possibly edenite), clinopyroxene (acmite-augite), sphene, biotite, phlogopite, nepheline (cancrinite), zircon, pyrochlore, baddeleyite, ilmenite, magnetite, pyrite, and plagioclase. The nepheline syenite body in the area of outcrop 35 (Fig. 26) is approximately 5 by 20 metres and appears to be concordant with the schist/carbonatite complex. Coarse-grained, biotite-rich bands up to 20 centimetres wide are in contact with the

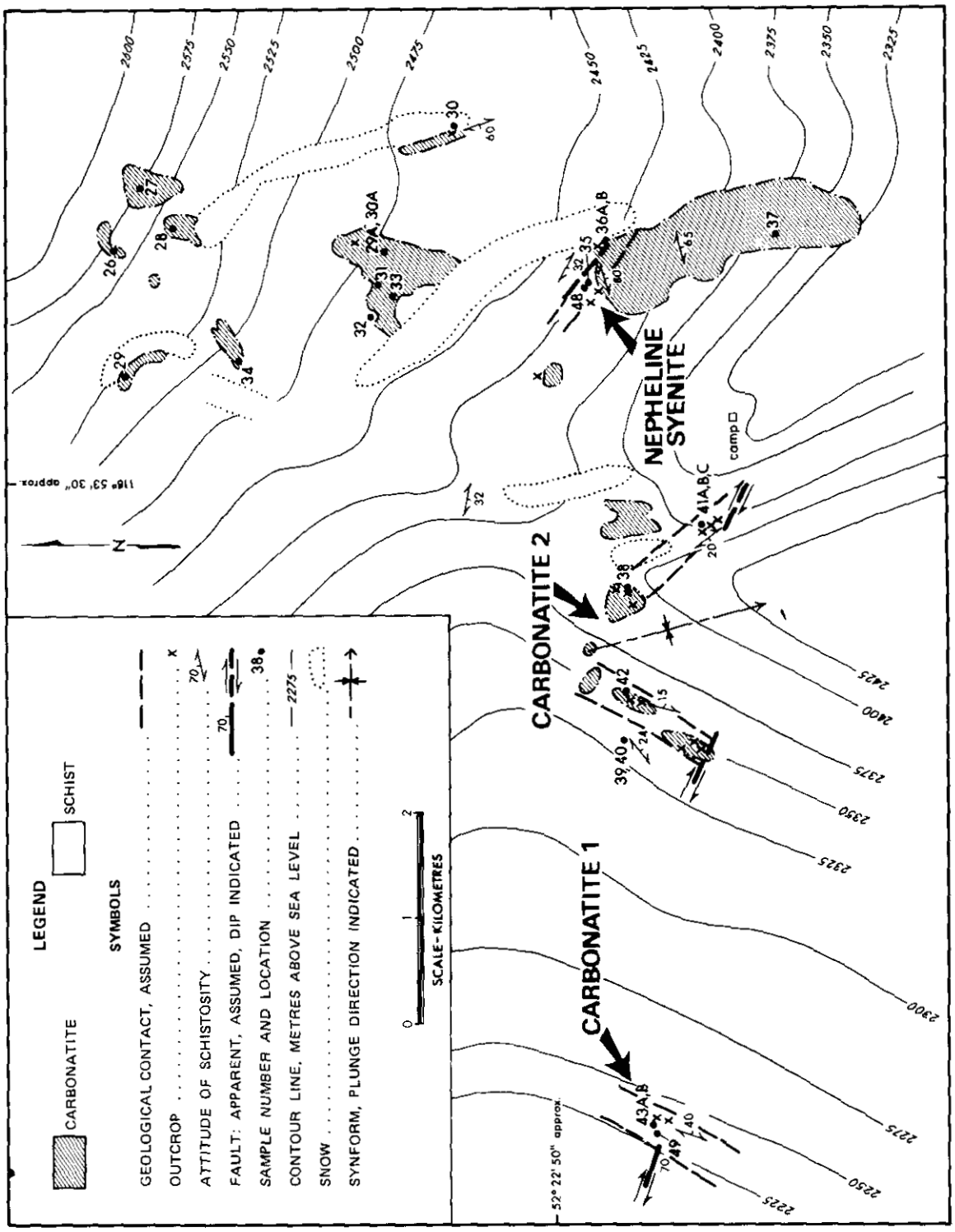

Figure 26. Preliminary geological plan, Howard Creek carbonatite.

nepheline syenite. The nepheline syenite contains coarse-grained nepheline (40 per cent), hornblende (30 per cent), sphene (15 per cent), and biotite (15 per cent). The syenite minerals are relatively unaltered, suggesting possible recrystallization due to regional metamorphism. Infrequent boudins of coarse-grained amphibolite 5 to 50 centimetres long are found within the carbonatites and the nepheline syenite. The amphibolites are mainly hornblende, calcite, and sphene with lesser amounts of phlogopite.

Rock samples were collected from the carbonatite, the syenite, the adjacent schist, and from schist and amphibolite more than 1 kilometre away from the nearest carbonatite, and form a coarse-grained pegmatite approximately 3 kilometres to the northeast of the area mapped. These specimens were submitted for spectrographic analysis to determine whether content of strontium and rare earths varied from carbonatites to country rock, and, in particular, to see whether there was any similarity in the rare earth contents of the pegmatite and the carbonatites. Felsite and pegmatite are present away from the carbonatite but are of infrequent occurrence. A pegmatite body measuring 50 by 150 metres, that consists of quartz, albite, grey pearly muscovite, and secondary sericite, appears to crosscut a fine-grained garnetiferous, quartz-albite-hornblende schist.

Eighteen semi-quantitative analyses from the carbonatites and associated rocks, yielded 0.25 to 0.5 per cent strontium with an average content of 0.35 per cent; 0.20 per cent average strontium occurred in the carbonatite-hosted amphibolite; and 0.30 per cent average strontium in the adjacent schists. Strontium content of the amphibolite collected more than 1 kilometre away from the carbonatites registered only as trace. Strontium in the nepheline syenite is 0.07 per cent while that in the coarse-grained pegmatite is below detection limit.

Some elements from the carbonatites and their quantities as determined by spectrographic methods and expressed in per cent are: P >2.0, Sr 0.2, Ba 0.05, Zr 0.04, Cr 0.01, La 0.03, Ce 0.03, Nd 0.03; there are also trace amounts of Ga, Sn, Y, Yb, and Nb. The only significant difference in rare earth and trace element content, therefore, seems to be between the schists/carbonatite and the pegmatite. The mineralogy of the more distant amphibolite was similar to that of the amphibolites in the carbonatites, except for the presence of quartz.

The Verity carbonatite, 18 kilometres east of Howard Creek, is located 5 kilometres south of Lempriere, and 35 kilometres north of Blue River, approximately 100 metres above the North Thompson River on west-facing slopes. These carbonatites vary in composition from calcite to dolomite-rich and, with the exception of olivine, contain mostly the same minerals as those at Howard Creek. R. Parrish, while at the University of British Columbia, made two age determinations on zircons from the Verity site; both results are 325 Ma, indicating either a Chesterian age or deformation and recrystallization during Chesterian time.

CONCLUSIONS

A number of tentative conclusions may be drawn from the mineralogy and analyses. Due to their anomalously high strontium and rare earth contents, these rocks are probably true carbonatites despite their obvious stratigraphic conformity. High strontium in adjacent schists may indicate limited fenitization. The nepheline syenite may be a stock, or a centre of near surface igenous activity. The relatively distant pegmatite in the area does not appear to bear a genetic relationsip to the carbonatites.

As suggested, further work should be carried out on the comparative petrology of the carbonatites, as well as a study of the possible scavenger effects of rare earths by carbonatites during regional metamorphism.

ACKNOWLEDGMENTS

All analyses and mineral identities exclusive of thin section work were carried out at the British Columbia Ministry of Energy, Mines and Petroleum Resources' laboratory in Victoria. B. French of Blue River supplied some of the zircon crystals from Verity that were used for age dating. Dialogue was held in the field on several occasions with B. Aaquist, formerly of Anschutz Mining Corporation of Denver, Colorado, and Corporation geologists who visited the Howard Creek site on two occasions. Field assistance at Howard Creek was provided by S. Kennedy of Kamloops.