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CARBONATITES IN BRITISH COLUMBIA: THE ALEY PROPERTY* (94B/5)

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INTRODUCTION

In many areas of the world carbonatites are commercial sources of niobium, phosphates, rare earth elements, vermiculite, copper, and fluorspar. Carbonatites in British Columbia occur in a broad belt parallel to and encompassing the Rocky Mountain Trench. Those from the Manson Creek, Blue River, and Three Valley Gap areas were reported on last year (Pell, 1985; White, 1985). Additional localities were visited during the 1985 field season in the Frenchman Cap area, where both intrusive and extrusive carbonatites are preserved (*see* Höy and Pell, this volume) and near Williston Lake where a previous unreported carbonatite exists. This paper discusses this newly discovered carbonatite complex.

The Aley property was staked by Cominco Ltd. in 1982. It is located approximately 140 kilometres north-northwest of Mackenzie on the east side of Williston Lake between Peace Reach and the Ospika River. The area has excellent exposure and is generally above tree line (1 450 to 2 200 metres). It is fairly remote; access is by helicopter from Mackenzie.

GENERAL GEOLOGY

The Aley Creek area is underlain by Cambro-Ordovician to Middle Devonian carbonate and clastic rocks of the Kechika, Skoki, and Road River Groups (Pride, 1983; Thompson, 1978). This miogeoclinal succession was intruded by the Aley carbonatite complex prior to the main Late Jurassic-Early Cretaceous orogenic event.

The carbonatite complex and surrounding sedimentary rocks were subjected to sub-greenschist facies regional metamorphism. The Aley complex is, however, essentially undeformed; it appears to have behaved as a rigid body during deformation and was rotated and/or transported eastward in a thrust slice.

GEOLOGY OF THE ALEY CARBONATITE COMPLEX

RAUHAUGITE CORE ZONE

The core of the Aley Complex is approximately 2 kilometres in diameter. It comprises more than 50 per cent of the exposed complex and consists of dolomite (80 to 95 per cent) and apatite (5 to 15 per cent) with minor amounts of phlogopite, pyrite, magnetite, and zircon (Pride, 1983). It is generally a massive and homogeneous unit, weathering buff to brownish.

Pyrochlore [$(Na,Ca,Ce)_2(Nb,Ta,Ti)_2O_6(OH,F)$] and/or columbite [$(Fe,Mn(Nb,Ta)_2O_6$] may be developed near the margin of this zone.

SOVITE ZONES

Sovite zones (dykes ?) occur locally near the margin of the rauhaugite core zone and in the surrounding amphibolite zone. The sovites exhibit a more varied mineralogy than the rauhaugites. Calcite with or without dolomite dominates and there are accessory amounts of apatite, sodic pyroxenes and amphiboles, magnetite, pyrochlore (Pride, 1983), and fersmite [$(Ca,Ce,Na)(Nb,Ta,Ti)_2(O,OH,F)_6$] (Pride, personal communication, 1985).

AMPHIBOLITIC MARGIN

An amphibolitic margin approximately 1 kilometre in width encircles and complexly interfingers with the rauhaugite core of the Aley complex. The marginal zone includes massive and breccia phases. No distinct pattern to the spatial distribution of the two phases is evident. Carbonatite dykes cut both members.

The massive phase is a medium to coarse-grained, dark green rock consisting primarily of sodic amphibole, quartz, and pyroxene (Pride, 1983). It is more extensively developed than the breccia phase and resembles fenites associated with some of the other carbonatite complexes in British Columbia (*see* Pell, 1985). The breccia phase contains subrounded clasts of dominantly orthoquartzite, with some siltstone, albitite, and syenite fragments in a matrix that is similar to the massive member. The clast to matrix ratio is highly variable and locally clast-supported breccias develop. The subrounded nature of the clasts give this unit the appearance of a conglomerate (Plate 42-1). The massive and breccia phases locally grade into one another.

ALTERATION HALO

Sedimentary rocks adjacent to the Aley complex have been altered for a distance of approximately 500 metres beyond the amphibolite margin. This alteration halo is characterized by a colour change from grey to buff which is indicative of a limestone to dolomite transition. The altered rocks can look superficially similar to material from the rauhaugite core zone. Apatite, pyrite, and magnetite are developed in the alteration zone. The degree of alteration decreases outward from the complex.

RARE EARTH-BEARING DYKES

Rare earth element-enriched dykes or 'sweats' occur throughout the complex but are most commonly developed in the outer alteration halo. The dykes weather dark reddish brown, are generally intruded parallel to bedding, and average 0.5 to 1.5 metres in thickness. Their primary component is dolomite. Accessory minerals include purple fluorite, pyrite, barite, bastnaesite [$(Ce,La)CO_3F$], and other rare earth carbonate minerals (K. Pride and U. Mader, personal communication).

PRELIMINARY GEOCHEMISTRY

Preliminary results of geochemical analyses are presented in Table 42-1 and on Figure 42-1. Only four samples have been analysed to date; three lanthanide-enriched dykes and one sample from the amphibolitic margin. All have high rare earth concentrations typical of carbonatites. The three samples of dyke rocks have a much greater light/heavy lanthanide enrichment ratio than does the sample from the amphibolitic margin.

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** Presently at the University of Windsor, Ontario.

Plate 42-1A. Breccia member of the amphibolite zone. Note the subrounded white quartzite clasts.

Plate 42-1B. Breccia member of the amphibolite zone. Here the matrix has weathered away, leaving quartzite clasts standing in relief.

TABLE 42-1. Preliminary Geochemistry

	1 Per Cent	2 Per Cent	3 Per Cent	4 Per Cent
Si	<1.0	<1.0	<1.0	>8.0
Al	<0.5	<0.5	<0.5	3.0
Mg	>5	>5	>5.0	3.0
Cu	>10	>10	>10	>10
Na	<0.3	<0.3	0.3	1.5
K	<0.3	<0.3	<0.3	0.6
Mn	0.7	1.0	2.0	1.0
Fe	4.0	6.0	6.5	2.5
Ti	tr	tr	tr	0.15
	ppm	ppm	ppm	ppm
Sr	1 000	800	5 000	3 000
Ba	300	900	10 000	1 500
Nb	500	100	—	800
Ce	12 100	12 500	4 000	2 070
Th	151.0	105.0	61.5	108.0

Analyses 1-3 are from REE dykes (3 contains fluorite); 4 is a locally developed basic phase of the amphibolitic margin.

The emission spectrographic analyses were performed by the Ministry laboratory. Ce and Th were analysed using induced neutron activation by Bondar-Clegg. *See* also Fig. 42-1.

DISCUSSION

The Aley carbonatite complex lies within the Rocky Mountains in a structural setting similar to that of the Ice River Alkaline Complex. Its setting contrasts with most other British Columbia carbonatites (Pell, 1985) which most frequently occur in high-grade polydeformed metamorphic core complex rocks, west of the Rocky Mountain Trench. Due largely to the lack of intense deformation the Aley deposit is an excellent locality in which to study and attempt to understand the emplacement of these bodies.

Field relationships suggest that amphibolites at Aley were the first to be emplaced, probably as a volatile-rich explosive mix of fenitizing solutions and igneous material. Intrusion must have been violent, ripping up country rock fragments (quartzites, mudstones) and abrading them as well as transporting fragments which may have originated from the initial magma chamber (albitite, syenite). Rauhaugites and sovites were then emplaced, crosscutting and interfingering with the amphibolites. The end of the igneous cycle was marked by intrusion of late stage, volatile-enriched rare earth dykes. The time relationship between the carbonatite complex and the nearby lamprophyres and diatreme breccias is unclear (*see* Pell, this volume).

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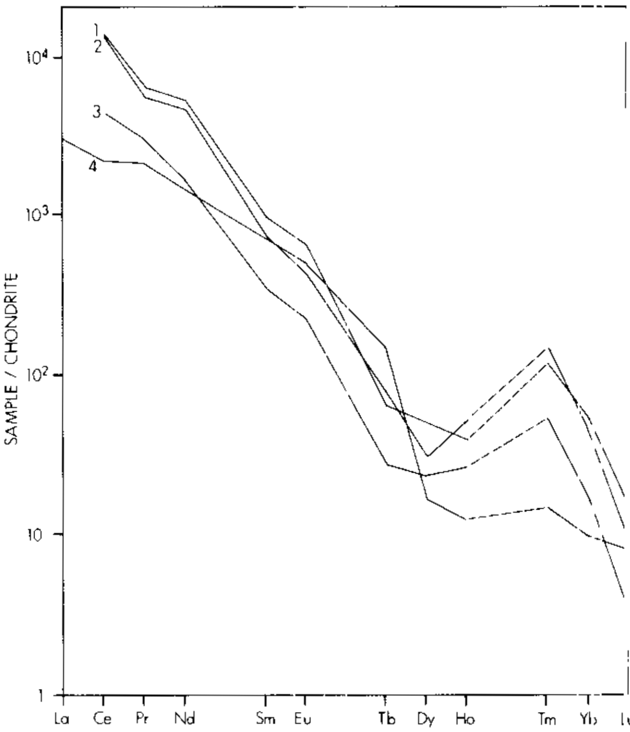

Figure 42-1. Chondrite normalized REE plot, *see* Table 42-1 for sample descriptions (chondrite REE values from Henderson, 1984).

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