INTRODUCTION

In many areas of the world carbonatites are commercial sources of niobium, phosphates, rare earth elements, vermiculite, copper, and fluor spar. Carbonatites in British Columbia occur in a broad belt parallel to and encompassing the Rocky Mountain Trench. Those from the Mansoon Creek, Blue River, and Three Valley Gap areas were reported in 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 Hoy 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 Beach and the Peace 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 Red 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-greenstein 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.

GEOLGY OF THE ALEY CARBONATITE COMPLEX

RAUHAUGITE CORE ZONE

The core of the Aley Complex is approximately 2 kilometres in diameter. It comprises more than 5 per cent of the exposed complex and consists of dolomite (85 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 massive and homogeneous unit, weathering brown to brownish.

Pyrochlore [(Na,Ca,Ce),(Nb,Ta,Ti)]_xO_4(OH,Fl)] and/or columbite [(Fe,Mn,Nb,Ta)]_xO_4 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 ferrosilite [(Ca,Si,Na):Nb,Ta,Ti]_x(OH,Fl)] (Pride, personal communication, 1985).

AMPHIBOLITIC MARGIN

An amphibolitic margin approximately 1 kilometre in width encircles and complexly interfiners 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 silstone, chert, and sennite 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 gives 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 color 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 are typically 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,F], and other rare earth carbonate minerals (K. Pride and U. Maden, 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 lanthanide enrichment ratio than the sample from the amphibolitic margin.

* This project is a contribution to the Canada/British Columbia Mineral Development Agreement.

** 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

<table>
<thead>
<tr>
<th></th>
<th>1 Per Cent</th>
<th>2 Per Cent</th>
<th>3 Per Cent</th>
<th>4 Per Cent</th>
</tr>
</thead>
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<tr>
<td>Si</td>
<td>&lt;1.0</td>
<td>&lt;1.0</td>
<td>&lt;1.0</td>
<td>&gt;8.0</td>
</tr>
<tr>
<td>Al</td>
<td>&lt;0.5</td>
<td>&lt;0.5</td>
<td>&lt;0.5</td>
<td>3.0</td>
</tr>
<tr>
<td>Mg</td>
<td>&gt;5</td>
<td>&gt;5</td>
<td>&gt;5.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Cu</td>
<td>&gt;10</td>
<td>&gt;10</td>
<td>&gt;10</td>
<td>&gt;10</td>
</tr>
<tr>
<td>Na</td>
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<td>&lt;0.3</td>
<td>0.3</td>
<td>1.5</td>
</tr>
<tr>
<td>K</td>
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<td>&lt;0.3</td>
<td>&lt;0.3</td>
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</tr>
<tr>
<td>Mn</td>
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<td>Fe</td>
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<td>6.5</td>
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<tr>
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<td>ppm</td>
<td>ppm</td>
<td>ppm</td>
</tr>
<tr>
<td>Sr</td>
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<td>3000</td>
</tr>
<tr>
<td>Ba</td>
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<td>900</td>
<td>10000</td>
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<tr>
<td>Nb</td>
<td>200</td>
<td>100</td>
<td>—</td>
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<td>12-500</td>
<td>4000</td>
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<tr>
<td>Th</td>
<td>151.0</td>
<td>105.0</td>
<td>61.5</td>
<td>108.0</td>
</tr>
</tbody>
</table>

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

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

DISCUSSION

The Aley carbonate 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 poly-deformed 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 fennitized 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 (albite, syenite). Rauhugites and sovites were then emplaced, crosscutting and interfingered 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 carbonate and the nearby lamprophyres and diatreme breccia is unclear (see Pell, this volume).

ACKNOWLEDGMENTS

I would like to thank K. R. Pride and J. M. Hamilton of Cominco Exploration, Vancouver for making my visit to the Aley property possible and for their comments on this text. I would also like to acknowledge the Ministry for providing me with a capable field assistant (Olga Ljewli) and logistic support for this project, in part through the Canada/British Columbia Mineral Development Agreement.

REFERENCES


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