ANOMALOUS RARE EARTH ELEMENTS (REE) IN THE DEEP PURPLE AND CANDY CLAIMS (82J/3E)

By Z. D. Hora and Y. T. J. Kwong

In late August, 1985, one of the authors (Z. D. Hora) made a reconnaissance visit to the fluorite property (Deep Purple and Candy claims, MI 082J/SW-018) along Rock Canyon Creek in the East Kootenays (Fig. 37-1). On this property, fluorspar is abundant in float boulders and a few scattered outcrops over an area of some 2 000 by 3 000 metres. The boulders are of two main types: (1) large fluorspar fragments, and (2) brown, crystalline carbonate rocks with disseminations, patches, or veinlets of fluorspar. In this area the outcrop is sparse and soils have a characteristic gossan-like red colour. Previous trenching revealed heavy overburden in several localities. In the adjacent sedimentary carbonate rocks of Ordovician and Devonian age, fluorite occurs as replacement impregnations and local breccia-type veins and zones. The fluorite associated with the brown carbonate is mostly dark blue to dark purple, while in the surrounding sedimentary rocks it is either colourless or bright purplish and pink.

Because of a close resemblance of the brown carbonate to rauhaugite — a ferroan dolomite which occurs in some carbonatite localities (Mountain Pass, St. Honore) — several float samples collected this summer were semi-quantitatively analysed by an emission spectrographic method and the corresponding mineralogy ascertained by powder diffractometry. The results are summarized in Table 37-1.

Four of seven samples analysed show an anomalous total rare earth element (REE) content in excess of 0.5 per cent. Bastnaesite [Ce^*CO_3F] and gorceixite [$(Ba, Ca, Ce^*)Al_3(PO_4)_2(OH)_5 \cdot H_2O$] have been identified as the primary hosts of the REE's. Bastnaesite shows a positive correlation with crystalline dolomite, which could be iron-rich, whereas gorceixite can occur independently of the carbonate minerals; it is associated with massive fluorite in sample No. RC-85-D1. Although the abundance of fluorite in these rocks is itself intriguing, it is possible that the fluorspar mineralization is an integral part of a major intrusive carbonatite that carries a significant amount of REE's. Further laboratory and field studies are being planned to assess the plausibility of this hypothesis.

ACKNOWLEDGMENTS

We thank Mr. M. A. Chaudhry of the Analytical Laboratory for his prompt effort to produce the emission spectrographic data for us to finish this note before the publication deadline. We also thank Mr. C. Graf for the introduction to the property geology.

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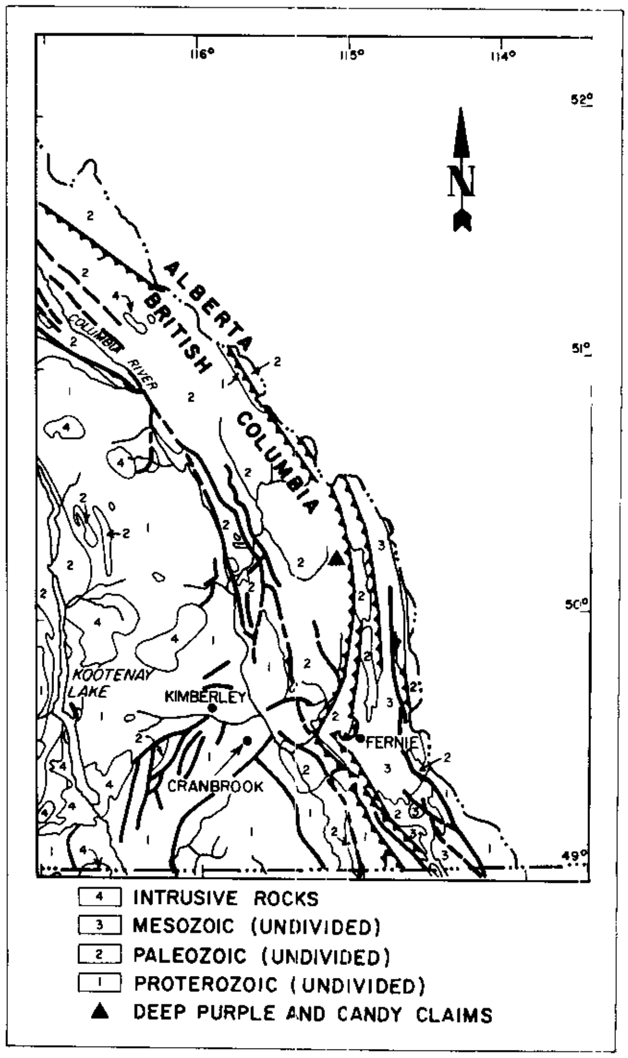

Figure 37-1. Location map for the Deep Purple and Candy claims (82J/3E).

* Usually accompanied by other lanthanide group elements.

TABLE 37-1
CHEMISTRY* AND MINERALOGY OF SELECTED FLOAT SAMPLES FROM THE DEEP PURPLE AND CANDY CLAIMS

SAMPLE No.	BRIEF DESCRIPTION	CHEMISTRY (ABUNDANCE IN PER CENT)	MINERALOGY
RC-85-A1	Dark brown carbonate with patches and veinlets of fluorite	Si <1.0, Al <1.0, Ti 0.03, Na <0.3, K <0.3, Mg 5.0, Ca 10.0, Fe 4.5, Mn 1.0, La 0.5, Ce 0.5, Nd 0.1, Nb 0.02, Y 0.05, Sr 0.1, Ba 0.5, Mo 0.02 trace Pb, Cu, V, Zr, Be, Pr, Sm, Gd, Dy, Yb, Th	Dolomite >> fluorite >> minor bastnaesite > calcite > limonite ± trace pyrite ± gorceixite
RC-85-A2	Light brown carbonate with streaks and veinlets of fluorite	Si <1.0, Al 2.5, Ti 0.02, Na <0.3, K <0.3, Mg >5.0, Ca >10.0, Fe 3.0, Mn 0.8, La >0.5, Ce >0.5, Nd 0.1, Nb 0.01, Y 0.03, Sr >0.5, Ba >1.0, Mo 0.01, P 0.5 trace Pb, Cu, V, Zr, Be, Pr, Sm, Gd, Dy, Yb, Th	Dolomite >> fluorite >> minor barite, gorceixite, calcite, talc(?) ± trace bastnaesite
RC-85-B1	Medium brown carbonate with streaks of fluorite	Si 5.0, Al 1.2, Ti 0.01, Na 0.4, K 1.2, Mg 5.0, Ca 4.0, Fe 5.0, Mn 0.5, La 0.25, Ce 0.25, Nd 0.07, Nb 0.02, Y 0.01, Sr 0.1, Ba >1.0, P >0.5 trace Pb, Cu, V, Ni, Mo, Ga, Zr, Be, Pr, Sm, Gd, Dy, Yb, Th	Dolomite >> fluorite > K-feldspar > barite > minor gorceixite, calcite, illite, talc(?), pyrite ± bastnaesite
RC-85-B2	Light-coloured carbonate with purple fluorite	Si 4.0, Al 1.5, Ti 0.03, Na 0.3, K 0.5, Mg 3.0, Ca >10.0, Fe 1.2, Nb 0.01, Ba 0.06 trace Mn, Cu, V, Ni, Sr, Y, Be	Calcite — dolomite > fluorite > quartz > K-feldspar >> trace illite ± gorceixite
RC-85-C1	Light grey, laminated carbonate with brown clots of limonite	Si 3.0, Al <1.0, Ti 0.01, Na <0.3, K <0.3, Mg 1.2, Ca >10.0, Fe 0.7 trace Mn, Cu, Ni, Sr	Bulk sample: calcite >> dolomite >> minor fluorite, quartz and K-feldspar Brown clots: dolomite >> calcite > minor quartz, K-feldspar, pyrite, and limonite
RC-85-D1	Fine-grained purplish grey massive fluorite with abundant pyrite	Si <1.0, Al 3.0, Ti 0.5, Na <0.3, K <0.3, Mg <0.1, Ca >10.0, Fe 4.0, Be 0.03, V 0.12, La 0.25, Ce 0.3, Nd 0.1, Nb 0.14, Sr >1.0, Ba >1.0, P >1.0, Mo 0.01 trace Mn, Pb, Cu, Ni, Co, Sn, Zr, W, Cr, B, Pr, Sm, Gd, Dy, Th	Fluorite >> gorceixite > pyrite > minor barite, calcite, rutile ± trace K-feldspar
RC-85-D2	Coarse purple fluorite	Si 1.0, Al 5.0, Na 0.3, K <0.3, Mg <0.1, Ca >10.0, Fe 0.4, Ba >0.5 trace Ti, Mn, Cu, Sr, Be	Fluorite > prosopite [$CaAl_2(F,OH)_8$] >> minor kaolinite

* Semi-quantitative emission spectrographic analyses performed by M. A. Chaudhry of the Analytical Laboratory.

DIATREME BRECCIAS IN BRITISH COLUMBIA* (82G, J, N; 83C; 94B)

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INTRODUCTION

Over the last decade considerable interest has been expressed in diatreme breccias of possible kimberlitic affinity in British Columbia (Fipke, 1983; Fipke and Capell, 1983; Grieve, 1981 and 1982; Roberts, *et al.*, 1980; Woodcock, 1978; etc.). This interest has been heightened by the reported recent discovery of diamonds in pipes north of Golden (Dummet, *et al.*, 1985; Northcote, 1983a and 1983b).

There are three main areas in which diatreme breccias are known to occur: the Cranbrook-Invermere area, the Columbia Icefield area north of Golden, and the Williston Lake area north of Mackenzie (Fig. 38-1). In all but one case (the Cross diatreme) these breccia pipes occur in a zone within the Western and Main Ranges of the Rocky Mountains which is between 20 and 50 kilometres east of the Rocky Mountain Trench. The diatremes in British Columbia intruded the miogeoclinal sequence of platformal carbonate and clastic rocks prior to deformation. With one notable exception (the Cross diatreme) all are hosted in Cambrian to Devonian sedimentary rocks which are unconformably capped by Middle to Upper Devonian strata (Grieve, 1981; Leech, 1979; Roberts, *et al.*, 1980). The Cross diatreme is located approximately 60 kilometres east of the Rocky Mountain Trench and is hosted by Pennsylvanian sedimentary rocks.

CRANBROOK-INVERMERE AREA (82G and 82J)

Forty or more breccia pipes and related dyke rocks are known to occur within the Bull, White and Palliser River drainages, east of Cranbrook and Invermere (Pighin, Fipke, personal communication). A number were visited for this study; four were mapped in detail and will be described here.

THE SUMMER 1 DIATREME (82G/11)

The Summer 1 diatreme is one of two small intrusive bodies found at the intersection of Galbraith and Summer Creeks, approximately 40 kilometres northeast of Cranbrook. It has previously been reported on by Grieve (1981). The Summer diatreme forms a rusty weathering, 50-metre-high resistant knoll hosted in rocks mapped by Leech (1960) as Late Cambrian McKay Group. In the vicinity of the diatreme the McKay Group consists of thin-bedded grey micritic limestone, argillaceous limestone, and intraformational limestone conglomerate. In only one place is the contact between the limestones and the diatreme exposed (Fig. 38-2) and there the contact is subparallel to bedding in the limestones. This is *most likely a locally developed phenomenon, as the overall outcrop* pattern (Fig. 38-2) indicates that the body must be discordant. The limestones within 0.5 metre of the exposed contact are highly brecciated and material similar to the diatreme matrix forms veinlets in the limestone breccia. No thermal metamorphic effects are evident.

The diatreme itself is a breccia throughout. It consists of angular to subrounded clasts in a medium green to grey matrix which is locally calcareous. The matrix is foliated, with the foliation striking southerly to southwesterly and/or west to northwesterly. The matrix is predominantly chlorite and serpentine (Grieve, 1981) with or without carbonate. Rare chrome diopside xenocrysts were noted. The clast:matrix ratio is in the order of 50:50, with clasts ranging from granule to cobble size. The largest and most numerous are angular limestone, limestone conglomerate, and shale fragments up to 70 centimetres in size; these comprise 90 per cent of all the clasts. The remaining 10 per cent are buff dolostones, crinoidal limestones, red-weathering thinly laminated dolostones, granites, granitic gneisses, phlogopite-chrome diopside-marbles, fine-grained intermediate to felsic volcanic rocks, and autobreccia fragments. Resistant (silicified ?) reaction rims were noted around many clasts.

Adjacent to the main diatreme (Fig. 38-2) are possibly related dykes (and sills ?). These dykes have a very fine-grained light to medium green matrix with dark green serpentine-filled ocelli. Subrounded quartzitic and granitic clasts, up to 2 centimetres in size, are locally present.

The majority of the clasts present in the main diatreme are limestones similar to, and likely derived from, the host McKay Group. Crinoidal limestone clasts are also present. Crinoidal limestones are not characteristic of the Cambrian McKay limestones and are most likely derived from younger formations. The Summer diatreme is itself deformed (foliated) and is therefore likely to have intruded the original miogeoclinal succession prior to deformation.

If this is the case, the Summer diatreme must have intruded crinoidal limestone-bearing formations which overlay the McKay Group, and blocks of these younger rocks collapsed into the breccia pipe. This suggests that the diatreme is considerably younger than its host rocks.

THE BLACKFOOT DIATREME (82G/14)

The Blackfoot diatreme crops out at 2 650 metres elevation on ridges east of the headwaters of Blackfoot Creek, approximately 65 kilometres northeast of Cranbrook. It is a recessive, green-weathering body discordant with rocks mapped by Leech (1960) as Ordovician to Silurian Beaverfoot-Brisco Formation. Folds are evident in the host rocks in the vicinity of the diatreme, where there is a deviation from the regional steep westerly dips (Fig. 38-3). The Beaverfoot-Brisco Formation in the hangingwall is characterized by thick-bedded, massive, medium grey limestones containing rugosan corals and light grey limestones in which chain corals (favosites and halosites type) are present. Thin-bedded to laminated, non-fossiliferous, purplish weathering limestones and shaly *limestones are present in the footwall. The contacts between the* diatreme and the limestones are well exposed (Fig. 38-3). As with the Summer diatreme, no thermal metamorphic effects are evident

The Blackfoot diatreme is a composite or branching pipe-like body consisting of pale green breccia with generally small (up to 10 centimetres) subrounded to subangular clasts. The largest xenoliths present are purple-grey to buff-weathering limestones likely derived from the Beaverfoot-Brisco Formation. The clasts generally comprise up to 50 per cent of the diatreme and are predominantly

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

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