Geochemistry of the Rock Canyon Creek REE-F-Ba deposit, British Columbia

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Introduction

The Rock Canyon Creek carbonate-hosted REE-fluorite deposit is approximately 90 km northeast of Cranbrook (Fig. 1; Pell, 1994). It is of uncertain origin (likely carbohydrothermal or hydrothermal). Work is in progress to elucidate timing of mineralization, ore-forming fluid origin, and tectonic, stratigraphic, and structural relationships to Mississippi Valley-type and sparry magnesite deposits along the eastern flank of the Canadian Cordillera (Fig. 1).

Mineralization occurs as breccias and fracture fillings in fluorite-bearing dolostone (Fig. 2). Fluorite concentrations vary from less than 1% to 13.5% by weight, and REE+Y concentrations vary from trace to 2%. Mineralization consists of dolomite [$CaMg(CO_3)_2$], fluorite [CaF_2], barite [$BaSO_4$], pyrite [FeS_2], quartz [SiO_2], K-feldspar [$KAlSi_3O_8$], calcite [$CaCO_3$], porous apatite [$Ca_5(PO_4)_3(OH,F,Cl)$], REE-fluorocarbonates, and REE-phosphates. The main fluorocarbonates are bastnaesite [(Ce, La, Nd)CO_3F], parisite [$Ca(Ce, La)_2(CO_3)_3F_2$], and synchysite [$Ca(La,Ce,Nd)(CO_3)_2F$]. Monazite [(Ce,La,Nd,Th)(PO_4,SiO_4)] and crandallite group minerals consisting mainly of Al, Ca, Sr, and lesser proportions of La, Ce, Nd, S, and F are the main phosphates (Hoshino et al., 2017).

Based on drilling by Spectrum Mining Corporation in 2009 (Fig. 3; Pighin, 2010), the main REE-fluorite zone is a steeply dipping tabular body or set of lenses extending more than 1100 metres along strike, reaching at least 50 metres in width and at least 100 metres in depth. In this study, geochemical data from drill-core samples for La, Nd, Nb, Ba, F, Mg, Fe, and S are used as the basis of 3-D models of the Rock Canyon Creek deposit showing variations of the selected elements (Fig. 4). Fluorite mineral chemistry and discrimination diagrams (Figs. 5, 6, 7) suggest that fluorite in prosopite boulders and in situ fluorite 850 m from mineralization may differ in origin.

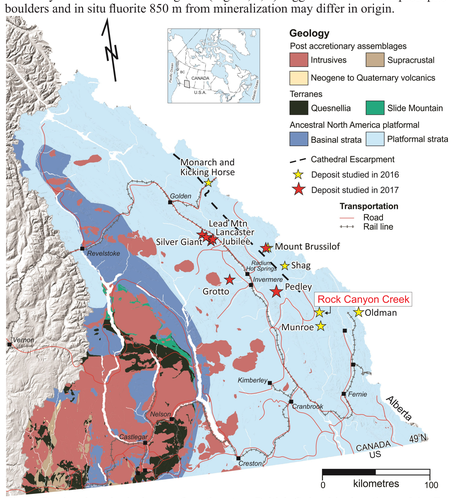


Fig. 1. Regional geological map of southeastern British Columbia, locations of the Zn-Pb deposits, Rock Canyon Creek REE-fluorite deposit, and Mount Brussilof magnesite mine. Modified from Katay (2017).

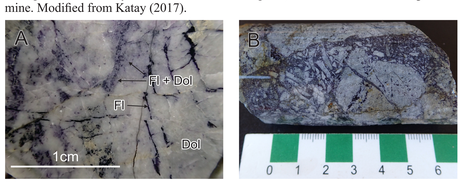


Fig. 2. A) Dolomite crackle breccia cemented by fluorite; open spaces filled by fluorite and dolomite (Fl+Dol); **B**) Dolostone breccia; larger fragments cut by purple fluorite; purple matrix consists of fluorite, dolomite, barite, and pyrite. From Green et al. (2017).

Deposit morphology

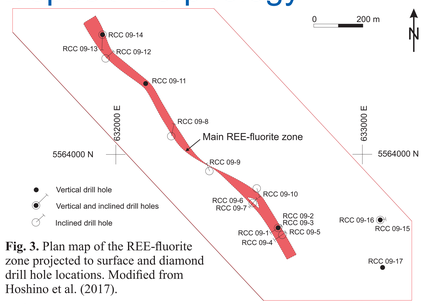
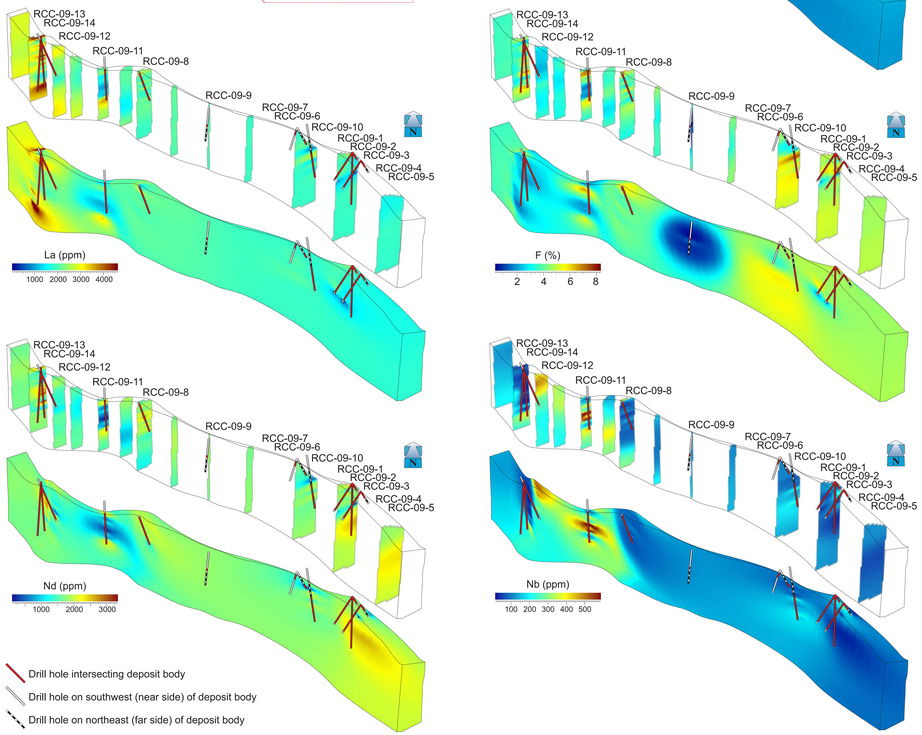


Fig. 3. Plan map of the REE-fluorite zone projected to surface and diamond drill hole locations. Modified from Hoshino et al. (2017).



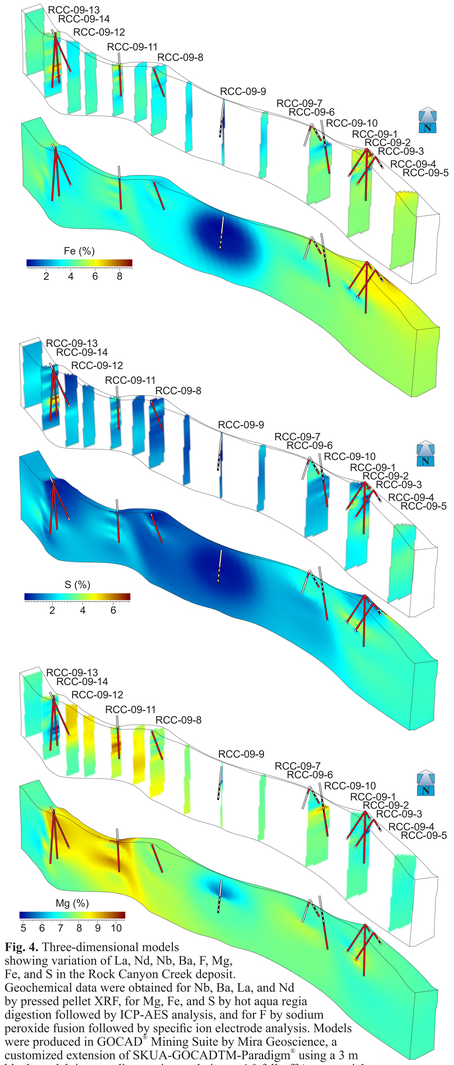


Fig. 4. Three-dimensional models showing variation of La, Nd, Nb, Ba, F, Mg, Fe, and S in the Rock Canyon Creek deposit. Geochemical data were obtained for Nb, Ba, La, and Nd by pressed pellet XRF, for Mg, Fe, and S by hot aqua regia digestion followed by ICP-AES analysis, and for F by sodium peroxide fusion followed by specific ion electrode analysis. Models were produced in GOCAD® Mining Suite by Mira Geoscience, a customized extension of SKUA-GOCADTM-Paradigm® using a 3 m block model, inverse distance interpolation, a 4.0 fall-off (exponential rate of weight decay), and ellipse parameters: R1 1000, dip direction 90; R2 500, dip 0; and R3 200, plunge 0.

Fluorite chemistry

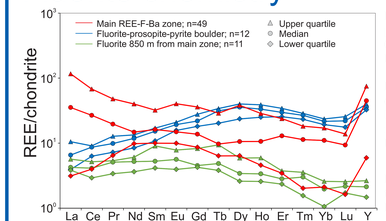


Fig. 5 (Left). Chondrite-normalized REE patterns of fluorite from the Rock Canyon Creek area. Main REE-F-Ba zone data from Mao et al. (2016).

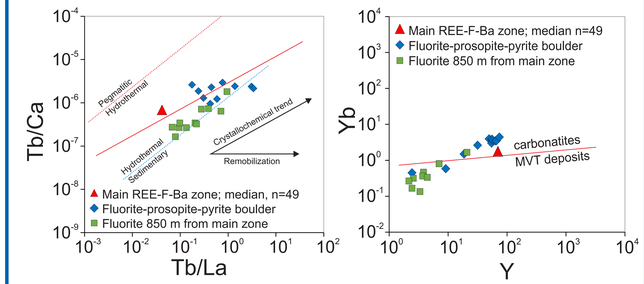


Fig. 6 (Bottom left). Tb/La-Tb/Ca discrimination diagram. Solid red line is the boundary between MVT- and carbonatite-related fluorite. From Moller et al. (1976) and Makin et al. (2014).

Fig. 7 (Below). Y-Yb discrimination diagram for fluorite from carbonatite and MVT deposits. Based on Makin et al. (2014).

Conclusions

- Rock Canyon Creek shares the same tectonic and stratigraphic setting with MVT Zn-Pb deposits.
- The deposit is steeply dipping and mineralization is largely controlled by crackle breccia.
- Quality of historic data is acceptable for qualitative 3-D modelling, but not reserves calculations. These models suggest possible co-variation between Ba, F and La and possible co-variation between La and Nd to the northwest of the deposit.
- Chondrite-normalized REE pattern of fluorite from mineralized zone shows highest LREE content and differs from patterns of fluorite associated with prosopite (boulder) and distal in situ fluorite (850 m from mineralization).
- Detailed studies of chemical and isotopic compositions of minerals are underway to determine the origin of Rock Canyon Creek deposit.

Acknowledgements:

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