THE PETROLOGY OF PRE-OROGENIC ALKALINE AND ULTRAMAFIC LAMPROPHYRE DIATREMES IN THE CORDILLERA NEAR GOLDEN, SOUTHEASTERN BRITISH COLUMBIA

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Diatreme breccias and dykes (the Golden cluster) occur in five localities along the Alberta/British Columbia border between 50 and 90 kilometres north of the town of Golden, BC; the Bush River, Mons Creek, Valenciennes River, Lens Mountain and Campbell Icefield areas (Figure 1). They are hosted by a Cambro-Ordovician carbonate rock-dominated sequence exposed in the Mons Thrust sheet, Eastern Main Ranges of the Rocky Mountains (Foreland Belt). All of the Golden intrusions have been subjected to orogenesis. They have been metamorphosed, deformed and transported eastward, along with their host strata, during the late Mesozoic Columbian Orogeny. The obvious effects of deformation vary according to lithology and orientation. Some breccias are massive while others are strongly foliated parallel to the regional trend. Some dykes are boudinaged. The HP pipe, near the Campbell Icefield, and some of the Bush River dykes are relatively unaltered compared to the other three sites. Biotite from the HP pipe yielded K-Ar dates of 391 +/-12 and 396 +/- 10 Ma and an Rb-Sr age of 391 +/- 5 Ma. Mica from Bush River dykes gave a Rb-Sr age of 409 +/- 6 Ma (Pell, 1994). These data suggest emplacement during Late Silurian to Early Devonian.

At least four types of breccias are present in the Bush River, Mons Creek, Valenciennes River and Lens Mountain areas: buff, sandy breccias; brown to rusty-weathering sandy megabreccias; rusty to green-weathering tuffisitic breccias with cognate and armoured xenoliths; and light green, fine-grained tuffisitic breccias and massive rocks. They generally form small, irregularly shaped diatremes that rarely exceed 6 hectares in area, associated dykes are commonly less than 2 metres in width. Not all lithologies are present at each site and mineralogy is variable. Pseudomorphs of olivine and mica occur with fresh spinel +/- apatite, iron oxides, sphene, plagioclase and titanamphibole. Groundmass and/or alteration minerals include serpentine, carbonate, talc, chlorite and quartz. The sandy breccias can contain up to 40 per cent rounded quartz xenocrysts. Trace amounts of microdiamonds have been recovered from the Lens Mountain and Valenciennes River sites. Dykes are also mineralogically varied and often altered; however, they generally contain olivine (commonly pseudomorphed), mica (biotite/phlogopite) and spinel +/- clinopyroxene, amphibole and plagioclase. Calcite, serpentine, chlorite and talc are common alteration minerals; quartz was also noted. The average composition of nine analyzed dykes is 39.09% SiO_2, 11.27% Al_2O_3, 8.47% Fe_2O_3(t), 8.36% MgO, 13.52% CaO, 0.80% Na_2O, 1.77% K_2O, 210 ppm Ni and 500 ppm Cr. Although alteration makes classification difficult, the petrographic and geochemical evidence (Figure 2) suggests that these rocks may best be classed as alkaline lamprophyres, although other workers (Fipke, 1989; McCallum, 1994) have suggested that they have a lamproitic affinity.

The HP pipe, south of the Campbell Icefied is unique in the Golden cluster and can be classified as an ultramafic lamprophyre. It is a composite diatreme, comprising five breccia phases and numerous dykes. The breccias differ in clast-to-matrix ratios, megacryst abundances (black salitic pyroxene/green chrome diopside/biotite) and the presence or absence of phases such as spinel and spherical structures. The breccia matrix has magmatic texture and is composed of calcite, biotite, colourless or slightly bluish clinoamphibole, chlorite, serpentine, talc and pyrite. Fine-grained titanium-bearing magnetite and euhedral, gold-brown, zoned melanite garnet are disseminated throughout. Euhedral brown-white melanites commonly form rims on spherical structures. Larger

garnets occur with calcite segregations in clast- and autolith-supported breccias. The dykes are generally fine grained, massive and mineralogically similar to the breccias. The average composition of three dykes is 35.45% SiO_2, 8.37% Al_2O_3, 8.02% Fe_2O_3(t), 11.22% MgO, 19.24% CaO, 0.74% Na_2O, 4.26% K_2O, 190 ppm Ni and 670 ppm Cr (Pell, 1994).

Spinels are the primary igneous phase found in four of the Golden cluster lamprophyres (excluding Lens Mountain possibly due to incomplete sampling). Their chemical compositions and trends can be used to elucidate the igneous processes occurring during lamprophyre formation and emplacement. The spinels are reddish-brown in thin section and occur both as phenocrysts and groundmass phases. A few spinels occur within olivine pseudomorphs at Valenciennes River. They plot within the magnesiochromite quadrant on the base of the spinel prism (Cr# vs Fe^{2+}#); however, each site exhibits a characteristic trend (Figure 3). Using the interpretation of Dick and Bullen (1984), the HP spinel compositional trend with increasing Cr#, could be indicative of increased mantle melting. Positive correlations between Cr# and Ti# (0.69); Cr# and Fe^{3+} (0.42) suggest that fractionation also occurred. The bimodal Mons Creek spinel population has a lower Cr# group with increasing Cr# and Fe^{2+}# that is consistent with olivine+plagioclase fractionation and a higher Cr# group with decreasing Cr# and increasing Fe^{2+}# that is consistent with olivine fractionation alone. This could be the result of two melting and fractionation episodes. The Bush River spinel trend is indicative of olivine+plagioclase fractionation while the Valenciennes River spinels show very little compositional variation (Ijewliw, 1991). Spinel compositions are useful tools for understanding lamprophyre processes.

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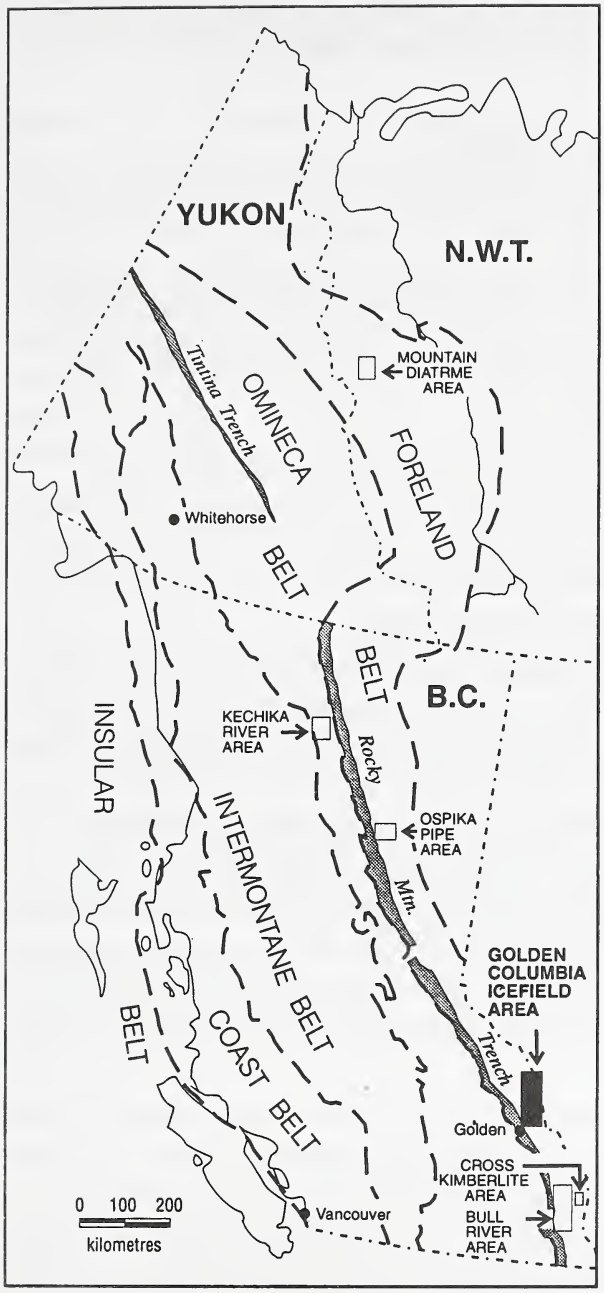

Figure 1: Location of alkaline and ultramafic lamprophyres near Golden.

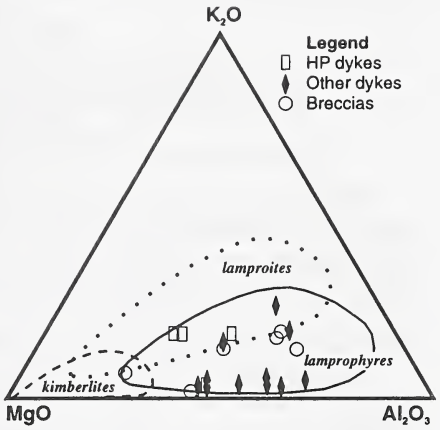

Figure 2: Whole rock chemical composition of Golden cluster compared to lithology fields of Bergman, (1987).

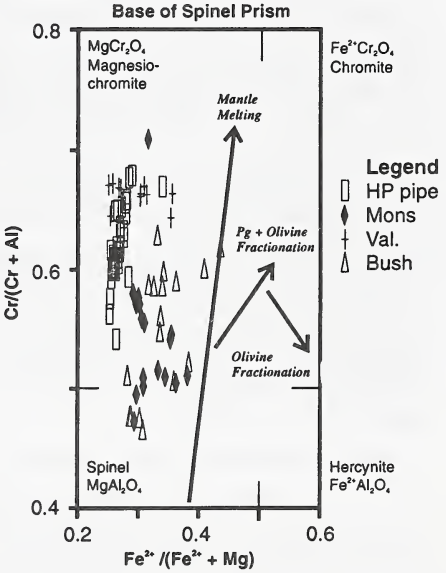

Figure 3: Spinel trends compared to Dick & Bullen (1984) interpretation.