Geochemical constraints on the origin of evolved magmas in the Northern Cascades

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The northern segment of the Cascade arc, the Garibaldi Volcanic Belt (GVB), is unique because it hosts among the youngest and 'hottest' subducting crust in the world [1,2] and the termination of the subducting slab (Nootka fault). We examine how these conditions may have affected the petrogenesis of GVB evolved lavas (andesites and dacites). Mafic GVB lavas transition from calc-alkaline basalts in the south to more unusual alkalic basalts in the north [3], whereas evolved lavas are consistently calc-alkaline. Evolved lavas have trace element 'arc signatures' of magnitudes that mirror those in mafic rocks from the same volcanic center. All lavas of Mt. Garibaldi show the strongest negative Nb-Ta anomaly, while it is reduced at Mt. Meager, reflecting a smaller slab input. There are significant differences in the geochemistry of evolved lavas in the GVB as compared to the southern Cascades (High Cascades). GVB evolved lavas have a lower range of $^{208}Pb^*/^{206}Pb^*$ (0.939-0.914) than evolved lavas of the High Cascades. Mt. Meager and Mt. Garibaldi evolved lavas have notably low Pb and high Hf isotope ratios ($^{206}Pb/^{204}Pb$: 18.66-18.74, $^{176}Hf/^{177}Hf$: 0.28308-0.28315), implying involvement of subducting oceanic crust melts. These values are comparable to the isotopic signatures of Glacier Peak basalts, which anchor the arrays formed by all High Cascade lavas [4]. While Mt. Garibaldi evolved lavas have among the highest Sr/Y ratios of the GVB, there is no other evidence for garnet fractionation, implying that their low Pb and high Hf isotope ratios are not due to the involvement of slab melts. Instead, GVB andesites and dacites form geochemical arrays extending towards local basement rocks with increasing SiO_2 in plots of Ba/La and Ce/Pb vs. $^{206}Pb/^{204}Pb$ and Zr/Nb vs. Ba/Nb, providing evidence for contamination by an isotopically depleted crustal contaminant. Previous work [5,6] has identified such signatures exist in local basement granitoids of the Coast Plutonic Complex.

[1] Harry & Green (1999) *Chem. Geol.* **160**, 309-333 [2] Syracuse *et al* (2010) *Phys. Earth Planet. Int.* **183**, 73-90 [3] Mullen & Weis (2013) *G3* **14**, 3126-3155 [4] Mullen & Weis (2014) *this meeting*. [5] Cui & Russell (1995) *GSA Bull.* **107**, 127–138 [6] Friedman *et al* (1995) *Can. J. Earth Sci.* **32**, 1681-1698