Crustal recycling vs. arc maturity, Mesozoic Quesnel terrane intrusive rocks, Canadian Cordillera

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The Quesnel terrane of the Canadian Cordilleran province is characterized by an assemblage of Mesozoic arc rocks. We provide a high-precision geochemical and isotopic framework for a regional, time-transgressive sampling of intrusive rocks from a series of magmatic centers representing a 350-km long segment of the southern Quesnel arc. The samples are grouped into suites on the basis of distinct compositional trends reflective of changes in magma source at various stages of arc maturity.

The 214-207 Ma Guichon Suite (calc-alkaline Cu±Mo±Au-bearing porphyry intrusions) represents the early-arc stage with slightly radiogenic initial $^{207}Pb/^{204}Pb$ (15.576-15.799), Nd (εNd= +1.0 to +1.8) and Hf (εHf= +7.1 to +8.7), and is typically adakitic. The 205-200 Ma Copper Mountain Suite (alkaline Cu-Au±Ag-bearing monzodioritic sub-intrusive stocks) records a punctuated transition towards a more radiogenic source component, and is broadly correlative with metamorphic fabric marking regional tectonism. Voluminous granodioritic batholiths of the 197-193 Ma Wildhorse suite (i.e. the mature arc), are systematically more radiogenic than preceding magmatic phases (initial $^{207}Pb/^{204}Pb$=15.598-15.635, εNd= -2.9 to +0.6, εHf= +4.3 to +7.4). A single pluton from this suite (Bromley) has adakitic characteristics.

The foregoing secular trends in isotopic compositions, coupled with Nd T_{DM} model ages, are consistent with: 1) assimilation of attenuated, Precambrian lower crust in the early-arc stage (T_{DM}=0.4-0.6 Ga); 2) a sharp increase in assimilated component during imbrication and thickening of the crust during latest Triassic accretion (T_{DM}= 0.51-0.65 Ga), and 3) widespread crustal contamination of arc magmas in the mature stages of convergent margin tectonism (T_{DM}= 0.60-0.95 Ga). The presence of adakites in two of the suites suggests contributions to the melt from either slab melting or anatexis of previously underplated basalt at ca. 210 and 193 Ma. Subducted sediment from the Cache Creek basin (initial εNd= -13 to -10, εHf= -9 to -7) was a likely contributor of radiogenic material throughout, but is unlikely to account for the observed differences in sources and contamination components of the entire Quesnel arc intrusive suite.

Solubility of Os, Ir and Au in molten silicate at high P-T, low fO_2 conditions

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The solubility of Au, Os and Ir in molten silicate at conditions approaching those relevant to core formation is being investigated. Given uncertainties of metal valence state at low fO_2, and the possible importance of superheating, our focus is the effect of fO_2 and T on metal solution behaviour. Samples of Fe-bearing synthetic basalt are encapsulated with an Os- or Ir-bearing Au bead in graphite that is subject to 2273 to 2588 K and 2 GPa in a piston-cylinder apparatus, at fO_2 ranging from ΔIW + 1.5 to –1.3. Solution of Au, Ir and Os in the glass is demonstrated by homogeneous time-resolved LA-ICPMS spectra. The exception to this is Au in glass produced at 2588 K, which shows some variability, reflecting quench precipitation due to high solute load, and retrograde solubility. This behaviour is similar to that for Pt reported by Cottrell & Walker (GCA vol 70, pp 1565-1580), although our results show systematic T-fO_2 trends not evident in their work. Au, Os and Ir solubility all increase with temperature, and at 2588 K are ~300-fold (Os) to 1000-fold (Au, Ir) higher than values measured at 0.1 MPa and similar relative fO_2. Os and Ir solubility decrease with decreasing fO_2, whereas values for Au increase slightly. The fO_2-dependence of Au solubility may reflect complexing with other melt components, like carbon or silicon. Assuming ideal mixing behaviour in the core-forming Fe liquid, results at 2273 K show relative metal/silicate D_{Os}/D_{Au} increasing from ~200 (ΔIW+1.5) to >10^4 (ΔIW-1). Values of D_{Ir}/D_{Au} for similar fO_2 conditions increase from ~200 to 2000. These results suggest that the chondritic relative abundances of Os, Ir and Au in Earth's mantle cannot be reconciled by high temperature metal-silicate equilibrium.