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Geochemical Evidence of a Near Surface History for the Source Rocks of the Central Coast Mountains Batholith, British Columbia

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Major and trace elemental concentrations as well as Sr, Pb and O isotopic data, completed on 41 plutonic samples from the Coast Mountains Batholith (CMB) ranging in age from ∼108 Ma to ∼50 Ma indicate that the source regions for these rocks were relatively uniform and typical for island arcs around the Pacific. The studied rocks are mineralogically and chemically metaluminous to weakly peraluminous and are mainly calc-alkaline with a few samples (mostly from the eastern part of the Coastal Shear Zone (CSZ) and three samples from the western part) showing a high-K calc-alkaline feature. Trace elements, especially REE, suggest a mafic source, probably oceanic plateau or island arc in origin, buried to different depths in the crust and that underwent various degrees of partial melting. Initial whole-rock $^{87}Sr/^{86}Sr$ range from 0.7035 up to 0.7053, whereas lead isotopic data range from 18.586 to 19.078 for $^{206}Pb/^{204}Pb$, 15.545 to 15.634 for $^{207}Pb/^{204}Pb$, and 37.115 to 38.661 for $^{208}Pb/^{204}Pb$. In contrast to these fairly primitive isotopic data, $\delta^{18}O$ values for quartz separates determined for 19 of the samples range from 6.8 ‰ up to 10.0 ‰. Such $\delta^{18}O$ values exclude the possibility that these melts were solely generated from the Mesozoic mantle wedge of this continental arc, just as the Sr and Pb data preclude significant involvement of an old (Precambrian) crustal/mantle lithospheric source. We interpret the high $\delta^{18}O$ component to represent materials that had a multi-stage crustal evolution. They were originally mafic rocks derived from a circum-Pacific juvenile mantle wedge that experienced a period of near surface residence after initial crystallization. During this interval these primitive rocks interacted with meteoric waters at low temperatures, as indicated by the high $\delta^{18}O$ values. Subsequently, these materials were buried to lower crustal depths where they re-melted to form the high $\delta^{18}O$ component of the CMB. We estimate that, based on REE ratios and the presence of magmatic garnet in the samples from Eocene intrusives, that the source rocks for the samples on the east side of the CSZ were, at least partially, mafic rocks with a strong basaltic component buried to a depth of more than 30 km. This component makes up at least 45% (mass) of the Cretaceous through Eocene batholith in the studied area. The remainder of the source materials making up the CMB had to be new additions from the mantle wedge. A prolonged period of contractional deformation beginning with the Early Cretaceous collisional accretion of the Insular superterrane is inferred to have been responsible for underthrusting the high $\delta^{18}O$ into the lower crust. We suggest that rocks of the Insular superterrane (e.g. Alexander-Wrangellia) are of ideal composition, and were accreted to and overthrust by what would become the CMB just prior to initiation of magmatism in that region.