Using geochemistry to help answer stratigraphic and petrogenetic questions in the Wanapum Basalt, Columbia River Basalt Group

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The ~16 Ma Wanapum Basalt is the youngest of the 5 major Columbia River Basalt Group (CRBG) formations and consists of ~68 flows divided into 6 members and several unassigned units. Volumes of individual Wanapum units range from ~30 to >1,500 km^3. Basalts dominate the Wanapum basalts; however, several of the small volume flows (<50 km^3) are basaltic andesites.

The Shumaker Creek Member and Basalt of Powatka are two small volume (~30 to 35 km^3) largely aphyric high K_2O basaltic andesites occurring in approximately the same stratigraphic interval above Frenchman Springs Member flows in SE Washington and NE Oregon, USA. Both flows are notable for their higher P_2O_5 and Ba (P_2O_5: ~1.00 and ~1.23 wt%; Ba: ~1170 and ~1085 ppm, respectively) and lower TiO_2 and Mg# (TiO_2: ~2.45 and ~2.60 wt%, respectively; Mg# ~31 for both) relative to the voluminous main Wanapum units (i.e., Frenchman Springs, Roza, and Priest Rapids Members). Recent fieldwork in NE Oregon, integrated with internally consistent major and trace element chemistry, helped establish that the Basalt of Powatka is younger than the Shumaker Creek Member.

Abundances of most incompatible elements are greater in the Shumaker Creek Member and Basalt of Powatka than in the voluminous main Wanapum units, with significant enrichment of the large ion lithophile elements (Rb, Ba, K) in the small volume flows. Both the Shumaker Creek and Powatka flows and the main Wanapum flows show similar primitive mantle normalized trace element patterns, including prominent troughs at Nb and Sr, and comparable incompatible element ratios (i.e., Zr/Nb, Zr/Y). Taken together, the geochemistry suggests that all of these flows were derived from similar mantle sources and include contributions from both assimilated continental lithosphere and subducted material. The higher Ba abundances at essentially constant Zr/Y ratios (all mantle normalized) in the Shumaker Creek and Powatka lavas also suggests that they represent melts formed by lower degrees of partial melting of the mantle source rock compared to the more voluminous main Wanapum units.