Diverse invasive melts in Cascadia mantle xenoliths: No subduction connection

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Mantle xenoliths (spinel lherzolite, dunite, harzburgite, websterite, rare phlogopite-bearing orthopyroxenite) in basaltic lavas of the Simcoe volcanic field, southern Washington Cascades arc are invaded by diverse alkali- and silica-rich glasses. The following melt variants are identified: (1) volatile-rich melts - fresh glass veins with vesiculation bubbles (up to ~57% SiO_2, ~19% Al_2O_3); (2) potassic melts - glass pools or veins in contact with phlogopite (up to ~62% SiO_2, ~12% total alkalies); and (3) *in situ* melts - blebs of glass in contact with exsolution lamellae of orthopyroxene and spinel in clinopyroxene (~52–55% SiO_2, ~6% total alkalies, ~10% CaO) (Fig. 1). Glass/quench olivine (Fo_{88-91}) assemblages in veins (1) and pockets (2) indicate high equilibrium temperatures ~1000°C. Especially pyroxene-rich varieties contain pure CO_2 fluid inclusions with high densities (~1.07) entrapped at minimum depths of = 35 km (Ertan and Leeman, 1996, 1998). These melts differ significantly from the host lavas (Fig. 1) (Leeman *et al.*, 1990) with phenocrysts [olivine (Fo_{65-80}); plagioclase (An_{45-58})] and they must have been emplaced after the deformation of mantle, but before entrainment of the xenoliths. The invasive melts resulted from decompressional melting of hydrous phases, magmatic corrosion along mineral grain boundaries, and *in situ* melting.

The rare xenolith occurrences from island arc settings potentially provide important information about the subduction processes. For example, melts and CO_2-rich fluids from a subducting sediment-rich oceanic plate may cause the metasomatism of the overlying lithospheric mantle wedge (Peacock, 1993). Trace element analyses of selected glasses were made to evaluate possible relations between metasomatism and subduction processes. Ba, Rb, K,

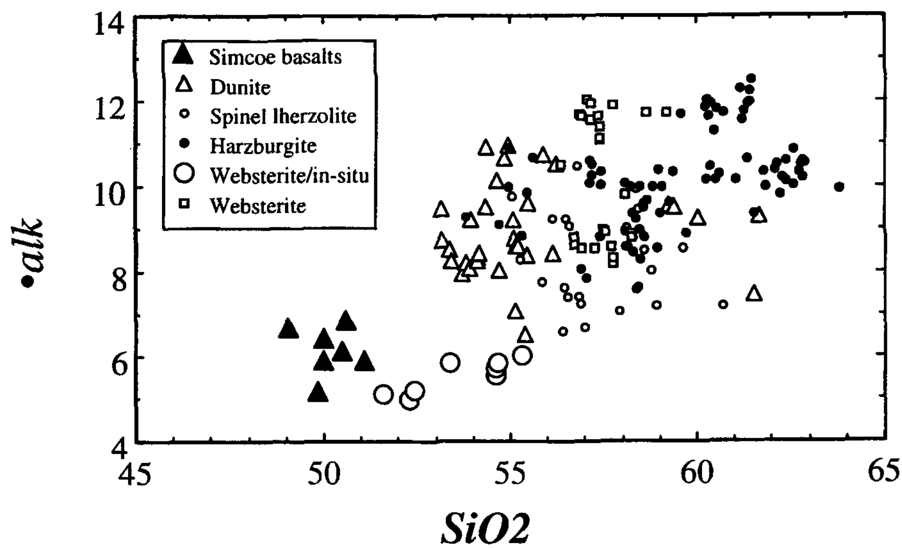

FIG. 1. Total alkali/SiO_2 variations in xenolith lithologies and Simcoe host alkali basaltic lavas. Type (1) and (2) glasses show a wide range of compositions within pools or veins; type (3) *in situ* melts in websterite on the other hand (larger open squares) have relatively low silica and alkali, and higher Ca- (~10) contents.

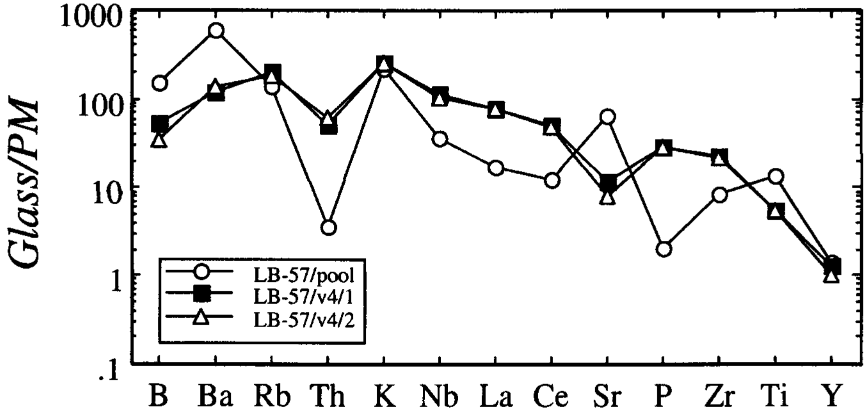

FIG. 2. Primitive-mantle normalized trace element analyses of selected glasses; note the absence of HFSE anomalies. Similar patterns are observed in other Simcoe xenoliths.

B, and Nb are similarly enriched (50–100 ×) above primitive mantle values and display no LILE/Nb anomalies (Fig. 2). Conspicuous depletions of Th and Sr may reflect residual accessory phases. These data indicate that sources of the invasive melts were not metasomatized by subduction zone melts or fluids, but more likely by within-plate (i.e. oceanic) type melts. Since these melts are distinct from the coeval host basaltic magmas, they must represent partial melts of a unique, relatively potassic source (i.e. previously metasomatized mantle) - possibly mantle wallrocks traversed and heated by the ascending Simcoe basaltic magmas. We propose that this mantle domain is part of a relic oceanic lithosphere plate that was attached to North America during accretion of the Coast Range province and initiation of the modern Cascadia subduction zone. Accordingly, Simcoe xenoliths provide constraints on the nature of part of the Cascadia mantle wedge, but not direct sources of Cascades arc magmas.

References

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