Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.37418

Magmatism, Volcanism and Future Hazard Asessment at Nch'k̲a'/ Mt Garibaldi, British Columbia, Canada

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The Canadian west coast lies along an active subduction zone and has a geologically recent history of volcanism that remains an area under recognised for its natural hazards potential. The Garibaldi Volcanic Belt in southwestern British Columbia (BC) represents the northern segment of the Cascades Volcanic Arc and includes three major multi-vent Quaternary volcanic fields: Nch'k̲a' / Mt Garibaldi-Price, Sxel'tskwu'7 / Mt Cayley, and Qwelqwélústen / Mt Meager. Among these, Nch'k̲a' / Mt. Garibaldi, located 60 km north of Vancouver and active since 1.3 Ma, is ranked as Canada's most threatening volcano. This volcano has been significantly dissected by glaciation, deglaciation and other erosive processes that removed substantial portions of the tephra record, while also exposing well-preserved proximal stratigraphic exposures that facilitate reconstruction of the preserved eruptive history.

The Garibaldi-Price volcanic field is dominated by voluminous calc-alkaline andesite and dacite deposits produced by intermittent period of volcanism. Over the past 50 ka, at least 15 eruptions have been identified (15 km3 of materials), with the most recent eruption (10 ka ago) forming Opal Cone generating 2.8 km3 of andesite. Intermediate and felsic lavas generally contain abundant amphibole as the principal mafic phase indicating hydrous magmatic origins, and preliminary geochemical modelling suggests pre-eruptive pressures and temperatures consistent with mid-crustal magma storage (200-350 MPa, 900-950 °C). Mafic eruptions are comparatively rare and typically formed small-volume peripheral centres. Mineral textures in these centres indicate rapid crystallisation prior to eruption and short timescales between magmatic perturbation and eruption.

Ongoing petrological and geochemical investigations will inform on the Mt Garibaldi magma storage architecture, elucidate pre-eruptive magmatic processes, and provide data the effect of glacial loading and unloading on recurrence of volcanic eruptions. This will provide more robust constraints on past eruptive behavior and contribute to better understanding of volcanic hazards in southwestern BC. Clarifying these magmatic processes and timescales, will improve our interpretation of future unrest signals given that Mt Garibaldi is currently monitored by satellite within Canada's new volcano monitoring system. Ultimately, these results will improve our understanding of long-term eruptive potential, inform future monitoring efforts, and enhance our ability to forecast unrest outcomes.