

# Geochemical Mass-Transfer Patterns as Indicators of the Architecture of a Complete Volcanic-Hosted Massive Sulfide Hydrothermal Alteration System, Panorama District, Pilbara, Western Australia

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## Abstract

Outstanding exposure across the Panorama district, in the Archean Pilbara block of Western Australia, reveals a cross section through a complete volcanic-hosted massive sulfide (VHMS) hydrothermal alteration system in an area of low metamorphic grade and very low strain. Geochemical maps, in combination with alteration maps, document mass transfer across this alteration system. Feldspar-bearing rocks at the top of the volcanic pile are enriched in K and Si, but depleted in Na, in contrast to those at the bottom of the volcanic pile that are enriched in Na and depleted in K. Sericite-quartz altered rocks are typically enriched in Si and depleted in Ca, Na, and Fe, whereas chlorite-quartz altered rocks, which dominate transgressive feldspar-destructive alteration zones, are marked by K-Ca-Na depletion and Mg-Fe enrichment.

Copper and Zn are strongly depleted in rocks at the base of the volcanic pile and, to a lesser extent, in transgressive feldspar-destructive alteration zones. The amount of metal leached from the volcanic pile is far greater than that contained in known deposits, and thus a magmatic metal source is not necessary to explain the formation of the Panorama VHMS deposits.

Mass-transfer patterns at Panorama have similarities to existing models for regional VHMS hydrothermal alteration systems, including the distribution of alkali elements in feldspar-bearing semiconformable alteration zones and the presence of a base metal-depleted zone at the base of the volcanic pile. However, there are significant differences, both in the architecture of the hydrothermal alteration system and in mass-transfer patterns. These include Si enrichment rather than depletion at the top of the volcanic pile, widespread Mg enrichment outside of the upper semiconformable alteration zones, the absence of a silica cap rock above the base metal depleted zone, more hydrous alteration assemblages in the zones of base metal depletion, and extensive zones of transgressive feldspar-destructive alteration.