

Qualitative Assessment of the Transition and Noble Metal Enrichment in Hydrothermally Altered Volcanic Sequence Using a Portable X-ray Fluorescence Spectrometer

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IODP Expedition 369 recovered the first stratigraphically constrained volcanic sequence at Site U1513 on the Naturaliste Plateau, comprising basalt flows interlayered with volcanoclastic beds and intruded by dikes. Dike intrusions may be responsible for the widespread hydrothermal alteration. We used portable X-ray fluorescence (pXRF) to measure the elemental composition and assess any metal enrichment trends associated with hydrothermal alteration. Most major elements (Si, Ti, Fe, Mg, Ca, P) and some trace elements (Sr, Y, Cr, Zn, Cu, Ru, Pd, Ag) measured by pXRF have $\leq 10\%$ precision. Concentrations measured by both pXRF and XRF plotted with depth show a similar trend for most elements but with some discrepancies. The matches and differences can be explained by the type of material measured by pXRF (i.e., clast/vein/matrix/groundmass vs. whole rock). Concentration plots of transition metals with depth show a notable enrichment at ~688, ~695, and ~697 meters below seafloor (mbsf) for Hole U1513E and ~700, ~710, and ~750 mbsf for Hole U1513D. Enrichment of Fe concentration coincides with the presence of hematite, goethite, and dickite associated with the alteration of the glassy matrix, groundmass, and Fe-Ti oxides during hydrothermal alteration. Spikes in the concentration of Cu reflect the occurrence of native copper as vein or dissemination near the dike intrusions or within the volcanoclastic units. For the noble metals, apparent depletion of Ru and Pd is notable at ~700 and ~750 mbsf, and enrichment of Ag at ~700 and ~750 mbsf. Apparent depletion or enrichment of the elements may be associated with their mobility and immobility during hydrothermal alteration. The pXRF measurement can be used for qualitative assessment of the enrichment or depletion of elements during hydrothermal alteration and as a preliminary tool to identify sample points for further studies of alteration and mineralization associated with the volcanic sequence.

Keywords: X-ray Fluorescence, Hydrothermal Alteration, Naturaliste Plateau