

Formation-scale, immobile trace element variations in felsic volcanic host rocks of the California Lake Group VMS deposits in the Bathurst Mining Camp, New Brunswick, Canada

Eric A. Garcelon¹, David R. Lentz¹, and James A. Walker²

1. Department of Earth Sciences, University of New Brunswick, Fredericton, New Brunswick E3B 5A3, Canada

<e.a.garcelon@gmail.com>

2. Geological Surveys Branch, New Brunswick Department of Energy and Resource Development, P.O. Box 50, Bathurst, New Brunswick E2A 3Z1, Canada

The Bathurst Mining Camp (BMC) is a world class Zn-Pb-Cu mining district, containing forty-six VMS deposits. These deposits are hosted by Cambrian-Ordovician bimodal volcanic and intercalated sedimentary rocks that were deposited in the Tetagouche-Exploits backarc basin. The host sequence was dismembered and subjected to polyphase deformation and mid- to upper-greenschist grade metamorphism during incorporation in the Brunswick subduction complex. This study focuses on the northernmost thrust-nappe (California Lake Group) which is divided into three coeval volcano-sedimentary formations (i.e., Mt. Brittain, Spruce Lake, and Canoe Landing Lake formations) that are all conformably overlain by Boucher Brook Formation. Traditionally, formation-scale exploration in felsic volcanic sequences relies on textural criteria to locate the proximal volcanic facies. However, due to pervasive alteration and subsequent deformation, textures can be destroyed or are highly cryptic. The purpose of this study is to determine if immobile trace element compositions of felsic volcanic host rocks within a single formation can be used to develop exploration targeting tools. Host rocks from the hanging wall and footwall of eleven VMS deposits were sampled from drill core and analyzed using fusion ICP-MS/ OES. Zr, Nb, Y, La, Yb, and Ti were considered immobile elements and normalized to Al to correct for mass change effects. Compared to the least-altered averages, deposit associated host rocks are enriched in Zr and La, and depleted in Y and Yb with the footwall units having larger degrees of enrichment and depletion. The Spruce Lake Formation deposit host rocks are enriched in Ti and depleted in Nb, whereas the Mt. Brittain Formation deposit host rocks have the opposite characteristics. The immobile trace element signatures of these host rocks are primarily due to magmatic fractionation processes in shallow level intrusions, and are well-documented among VMS districts globally, but have not been used within a single volcanic sequence. Multivariate statistical analysis of deposit host rocks in the Spruce Lake Formation found that overall grade and tonnage of deposits is positively correlated with Zr, Nb, and La, and negatively correlated with Y and Yb. Additionally, Cu grade correlates positively with Zr, La, and Ti, whereas Zn and Pb grades positively correlate with Y and Yb. The felsic volcanic rocks in these formations consist of a thick sequence of stacked rhyodacitic cryptodomes, and the geochemical analyses suggest that immobile trace element signatures can be used to locate the more prospective proximal volcanic facies without the need for detailed textural interpretation.