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APPLICATION OF HIGH FIELD STRENGTH ELEMENTS TO DISCRIMINATE TECTONIC SETTINGS IN VMS ENVIRONMENTS

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Abstract

High field strength element ratios in felsic volcanic rocks reflect the tectonomagmatic evolution of a region. Th/Ta, Th/Hf, Ta/Hf, Th/Yb, and Ta/Yb ratios collectively help to define the tectonic environment of volcanism, separating oceanic arcs, active continental margins, and within-plate volcanic zones. On the basis of the above empirical observations, the tectonic environments of selected Archean and post-Archean volcanogenic massive sulfide deposits were reexamined. Published data sets plotted on discriminant diagrams represent twelve volcanogenic massive sulfide (VMS) deposits from two distinct tectonic environments. The volcanic rocks of the kuroko deposits (Japan), San Nicolas (Mexico), and Bathurst (New Brunswick, Canada) plot within the active continental margin field on all diagrams, whereas volcanic rocks from Archean deposits of the Superior province, Canada (Kidd Creek, Kamiskotia, Geco, Winston Lake, Mattabi, Lyon Lake, Noranda, Selbaie, and South Bay) plot in the within-plate volcanic zone field.

The discriminant diagrams demonstrate that although the chemical character of rhyolites has not changed significantly since the Archean, the range of geotectonic setting of VMS deposits probably has. It is suggested that Archean deposits most likely formed in an ensimatic rift environment, whereas post-Archean deposits formed in subduction-related rift zones of arc environments. Subduction-related rhyolites of VMS deposits are variably enriched in Th and the light rare earth elements with respect to Ta, Nb, and the heavy rare earth elements.