An Immature Back-Arc Setting for the Teutonic Bore Volcanic Complex Stratigraphy, Host to the Neoarchean Jaguar VHMS Deposit

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Jaguar, a Neoarchean Cu-Zn-rich VHMS deposit, is hosted in a succession dominated by coherent facies, associated volcaniclastic facies, and minor nonvolcanic facies. Unlike many of the areas of VHMS mineralization in the Yilgarn Craton, the host rocks are andesites rather than a bimodal suite. In detail the footwall lavas are uniform, consistent with a constant source. They display near-identical trends and slopes in BABB-normalized multielement and chondrite-normalized REE spidergrams. The range of [La/Sm]cn and [La/Yb]cn values reflect the sub-parallel slopes of the trend lines with a weak negative slope. All have similar Zr/Nb values, similar enrichment and depletion anomalies in other elements, except Eu.

Deposition during a short hiatus in volcanism was dominated by volcaniclastic and volcanosedimentary deposits and orebody formation. A positive Eu anomaly at the top of the footwall basalt may be evidence of an emptying magma chamber. Once volcanism resumed, the hanging-wall andesites were more highly fractionated. The trends, slopes, and ratios of these lavas do not match footwall trends. Ranges in [La/Sm]cn and [La/Yb]cn values indicate REE patterns with negative, much steeper slopes than the footwall. Andesite lavas become successively more mafic with time, and affinity changes from calc-alkaline to transitional. Zr/Nb values decrease, having a lower ratio than the footwall, although Zr remains relatively constant.

A sustained outpouring of chemically monotonous basalts followed, distinctly different from the footwall magmas. These have the highest Zr/Nb values of all units, reflecting low Nb rather than an increase in Zr. Flat REE trends [La/Yb]cn (1.3–1.9) and [La/Sm]cn (1.0–1.3), unlike all other units, show virtually no slope on the BABB-normalized spidergram. Dolerite sills have the same chemical composition as the basalt and thus likely have the same source. A short hiatus was followed by emplacement of andesite, chemically related to the first andesite erupted after ore formation, succeeded by rhyolite.

If the data are compared with modern BABBs (Manus, Lau, East Scotia, Mariana Trough), there is an obvious coincidence among the data, particularly for the Mariana Trough. The multi-element and REE patterns suggest that the coherent rocks have an enriched component, with anomalies indicative of a subduction-related arc signature. An ensimatic rift environment scenario is possible for Jaguar as multi-element and REE trends are similar to the BABB trends, and the Jaguar data also has a subduction signature in the form of strong negative Nb and Ta anomalies. Discrimination diagrams suggest a complex, early back-arc setting for Jaguar. Geological constraints of the sequence include domination by coherent volcanic rocks and associated facies, local reworking, and minor input from pelagic sources with no terrigenous input, apparently ruling out an environment such as an emergent arc or nascent submarine topography. The likely tectonic setting for Jaguar is an extensional environment, behind a subduction zone close enough to an arc to be capturing enriched arc melts at depth (a feature typical of incipient back-arc spreading), but not close to an emergent arc.