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Setting and Styles of Hydrothermal Mudstones near the Lemarchant Volcanogenic Massive Sulfide (VMS) Deposit, Central Mobile Belt, Canada - Newfoundland

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In some volcanogenic massive sulfide (VMS) deposits there is a close association of black shales and hydrothermal mudstones and massive sulfide mineralization, yet our understanding of the relationship of these muds to VMS genesis and exploration is incomplete. The Lemarchant VMS deposit in Central Newfoundland is an excellent location to study the relationship of black shales/hydrothermal muds to VMS mineralization because there is an intimate relationship between precious-metal bearing Zn-Pb-Cu sulfides and hydrothermal sedimentary rocks. The Lemarchant VMS deposit is hosted by the late Cambrian Tally Pond volcanic belt, Central Mobile Belt, Newfoundland and represents a bimodal felsic VMS deposit with a typical stratigraphic sequence consisting of rhyolite domes and/or breccias with a stockwork stringer zone, overlain by the massive sulfides, one or more barite bed(s), and are capped by hydrothermal sediments/mudstones. Mafic volcanic flows, predominantly pillowed basalts, are deposited on top of this sequence and represent a new cycle of volcanic activity. Metalliferous mudstones are deposited, where the precipitation of hydrothermal matter dominates over the abiogenic pelagic background sedimentation and represent a hiatus in the volcanic activity. In the drilled cores these mudstones/shales occur either stratigraphically on top of the massive sulfide deposits or as interflow muds within basaltic units. The sulfide-rich hydrothermal sediments comprise brown to black graphite-rich mudstones and finely laminated shales, which can be intercalated by siliciclastics and/or kidney-shaped chert layers as well as by fine layers of organic matter.

The sulfides occur parallel to the lamination, especially in the organic-rich layers indicating microbial activity, but also in later-stage veins, which are cross-cutting the original bedding. The dominant sulfide phases are pyrite and pyrrhotite plus minor amounts of chalcopyrite, sphalerite, arsenopyrite and galena. Pyrite mostly occurs as euhedral grains or as pyrite-framboids, whereas pyrrhotite forms fine granules or irregular shaped grains to massive vein infills. Ongoing research includes detailed mineralogical-petrographical studies of the sulfides, whole-rock lithogeochemical analyses, and sulfur isotope geochemistry. The aim of the research is to understand the role that basin redox conditions has on the genesis of the Lemarchant deposit, to discriminate the relative contributions of hydrothermal, detrital or hydrogenous (seawater-derived) materials in the genesis of the shales, to distinguish between hydrothermal, diagenetic and biological sulfur sources in the sediments, and to utilize the latter to create potential exploration vectors at Lemarchant and for other shale-associated VMS systems.