

Lithogeochemical and Nd isotopic provenance studies of metalliferous mudstones associated with the Lemarchant volcanogenic massive sulphide deposit, central Newfoundland, Canada

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Neodymium isotopic and geochemical data from metalliferous mudstones and tuffs associated with the Cambrian Lemarchant Zn-Pb-Cu-Ba-(Au-Ag) volcanogenic massive sulphide VMS deposit provide insights into the tectonic environment and metallogenic evolution of the Tally Pond volcanic belt, northern Appalachians. The Tally Pond belt represents the oldest (~513–509 Ma) magmatism associated with the construction of the Cambrian to Ordovician Penobscot Arc, and is built upon crustal basement of the Ediacaran Crippleback Intrusive Suite and coeval Sandy Brook Group. The Lemarchant metalliferous mudstones and tuffs yield ϵNd_{513} between -6.0 and -1.8, whereas the associated Tally Pond belt felsic and mafic volcanic rocks have more juvenile ϵNd_{513} of +0.4 and +1.4, respectively. The latter are similar to previously reported values for volcanic rocks of the Tally Pond belt. The more evolved values of the exhalative sediments have not been reported previously in this belt; however, they overlap the documented range of ϵNd for the underlying Neoproterozoic Sandy Brook Group rhyolite ($\epsilon\text{Nd}_t = -6.5$ to -1.9), and the Crippleback Intrusive Suite ($\epsilon\text{Nd}_t = -5.9$ to -5.2). Accordingly, it is suggested that the exhalative metalliferous mudstones that precipitated from hydrothermal fluids, represent mixed Nd sources with Nd inherited from the Tally Pond volcanic rocks as well as from the evolved crustal basement sources. Erosion of the Neoproterozoic crustal basement and the Cambrian Tally Pond volcanic rocks, together with coeval eruption that results in direct emanation of material into the water column, releases Nd into the seawater, which is subsequently scavenged onto hydrothermally Fe-oxyhydroxides and thus, archived in the metalliferous mudstones. Combined with lithogeochemical provenance data it is proposed that the Lemarchant sedimentary rocks were deposited in a volcanic basin/caldera setting in a peri-continental rifted arc environment, with evolved continental and juvenile volcanic arc rock sources, which is consistent with the previously reported tectonic environment of formation for the Tally Pond volcanic belt.