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Critical Mineral Distribution and Resource Potential in Tailings from the Abandoned Stirling Zn-Pb-Cu Mine, Nova Scotia

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*A collaborative project between the GSC, CanmetMINING, and
Nova Scotia Department of Natural Resources and Renewables*

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Legacy Mine Wastes: Opportunities and Challenges



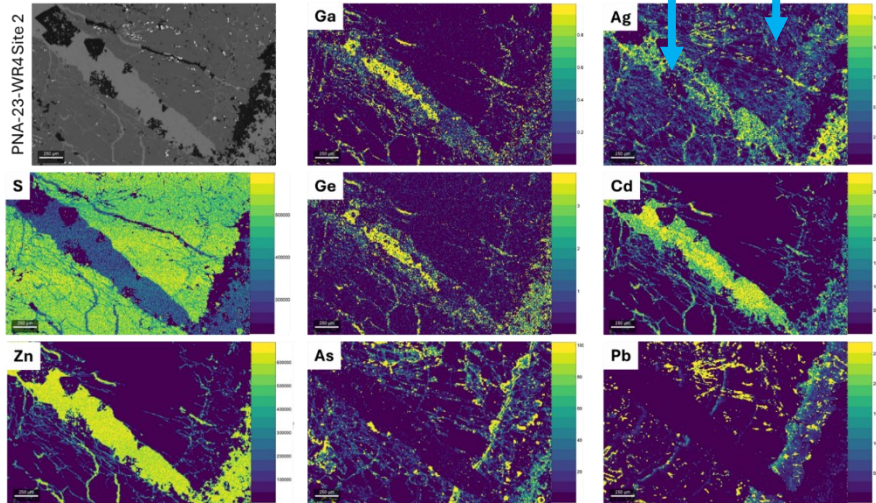
Weathered, sulphide-rich tailings at the abandoned Stirling Zn-Pb-Cu-Au-Ag Mine, Cape Breton, NS (October 2023)

- There are more than 10,000 orphaned or abandoned mines in Canada, many of which include acidic and/or metal(loid)-rich tailings in aging impoundments or as unconfined deposits released directly to the environment.
- Reprocessing of legacy tailings for their critical mineral content could help to reduce their environmental impact, but significant challenges remain concerning economics, technical feasibility, and regulatory barriers.
- This NRCan project focuses on the **effects of weathering** on the distribution and mineral hosts of critical minerals in historical tailings and the **most effective methods of reprocessing** for critical mineral recovery.



Weathering of Historical Mine Tailings

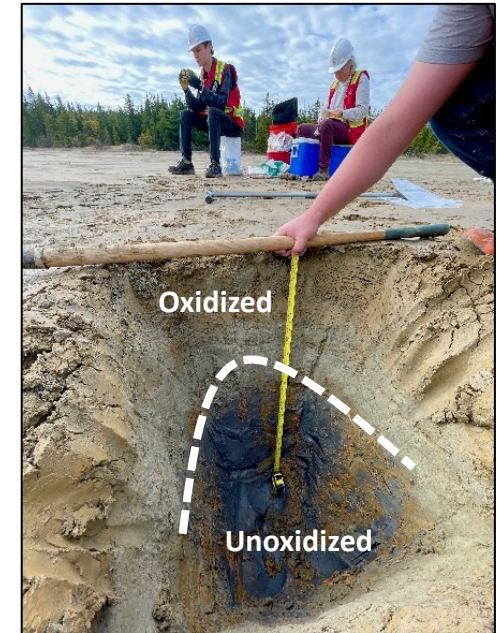
ORE COLLECTED IN 1929



LA-ICP-MS analyses of archived Stirling ore samples show that most critical metals of interest (Ga, Ge, In, Zn) are hosted by sphalerite (ZnS), but the relative proportions of these elements varies widely between samples.

TAILINGS

Leaching & reprecipitation of metals at depth?



Oxidation of sulphides (e.g. sphalerite, galena, chalcopyrite) in the near-surface (top 40 cm) tailings has redistributed metals into a wide range of secondary phases such as smithsonite (ZnCO_3), aurichalcite ($(\text{Zn,Cu})_5(\text{CO}_3)_2(\text{OH})_6$), and hydrohetaerolite ($\text{ZnMn}_2\text{O}_4 \cdot \text{H}_2\text{O}$) (Clever et al. 2021, 2022).



Drilling of Stirling Tailings Impoundment



Top



Bottom

- In June 2024, CanmetMINING (Project Lead: Julie Deriaz) drilled 33 boreholes in the Stirling Mine tailings to help develop a standardized protocol for sampling mine tailings and estimating critical mineral resources for tailings across Canada.
- GSC collected samples of the deeper tailings (max depth 5 m) as well as bulk samples of oxidized and unoxidized tailings for metallurgical testing (led by Dr. Terry Cheng at CanmetMINING).
- Characterization of critical mineral deportment in primary and secondary phases in tailings using automated mineralogy methods is ongoing.





*Base metal tailings
Stirling Zn-Pb-Cu-Au-Ag Mine
Cape Breton, NS*