MINERALOGY OF HISTORICAL GOLD MINE TAILINGS FROM LOWER SEAL HARBOUR, NOVA SCOTIA

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Gold Mining Nova Scotia

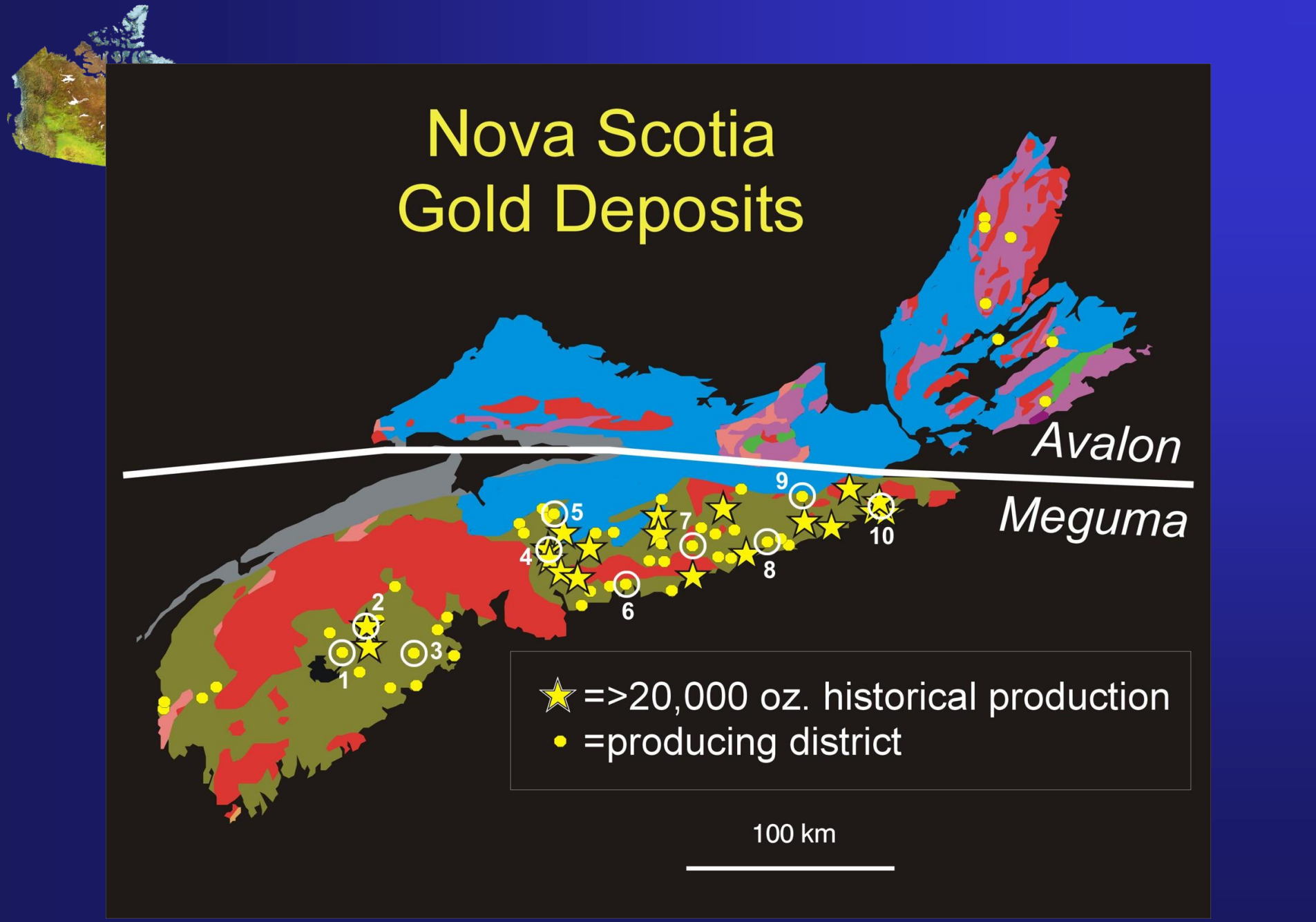
TH' DRAPPIN' OV TH' STAMPS

I've heard many a band ov music siftin' sweetness on th' air,
An' a fiddler drawin' ov his bow, that just sounded like a prayer,
I have heard Aeolian music when the wind was on the ramps,
But no music ever was so sweet as th' drappin ov the' stamps.

When I've laid awake and listened t' th' clink, clink, clink, clank, clank,
As they drapped upon and crushed th' ore t' put moneys in th' bank,
Then I'd fall asleep a-dreamn' ov th' happiness galore,
With my pockets full ov money t' divide among th' poor.

There is music and ther's music, but ther's nothing half so fine,
As th' runnin' ov a ten-stamp mill, on a regular payin' mine.
You may talk erbout your 'cinches' an' other kinds ov clamps,
But t' me ther' is no music like th' drappin ov th' stamps.

Unknown Nova Scotian author, as quoted in Henderson (1935)

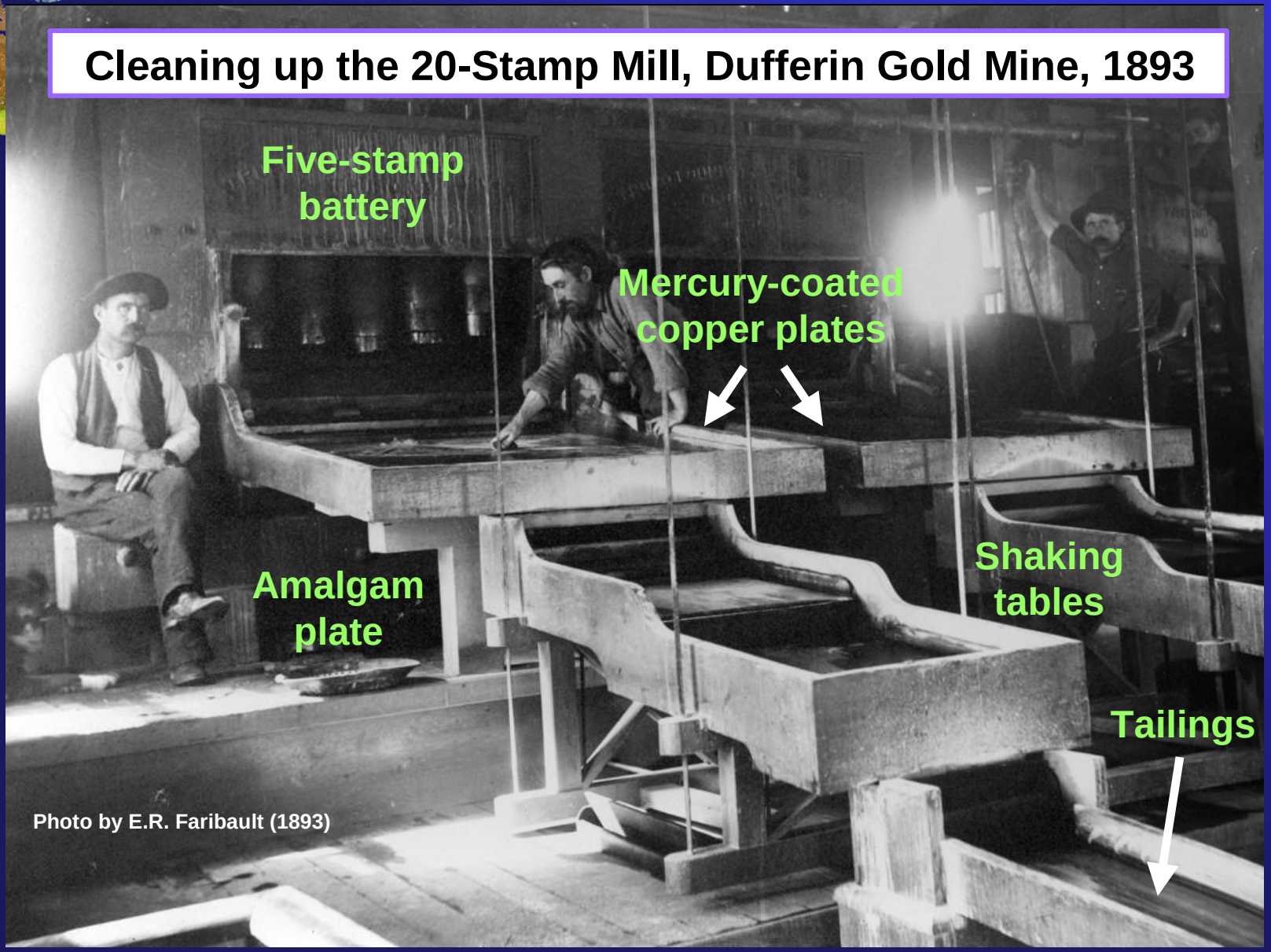

Nova Scotia
Gold Deposits
Avalon
Meguma
1
2
3
4
5
6
7
8
9
10
=>20,000 oz. historical production
=producing district
100 km

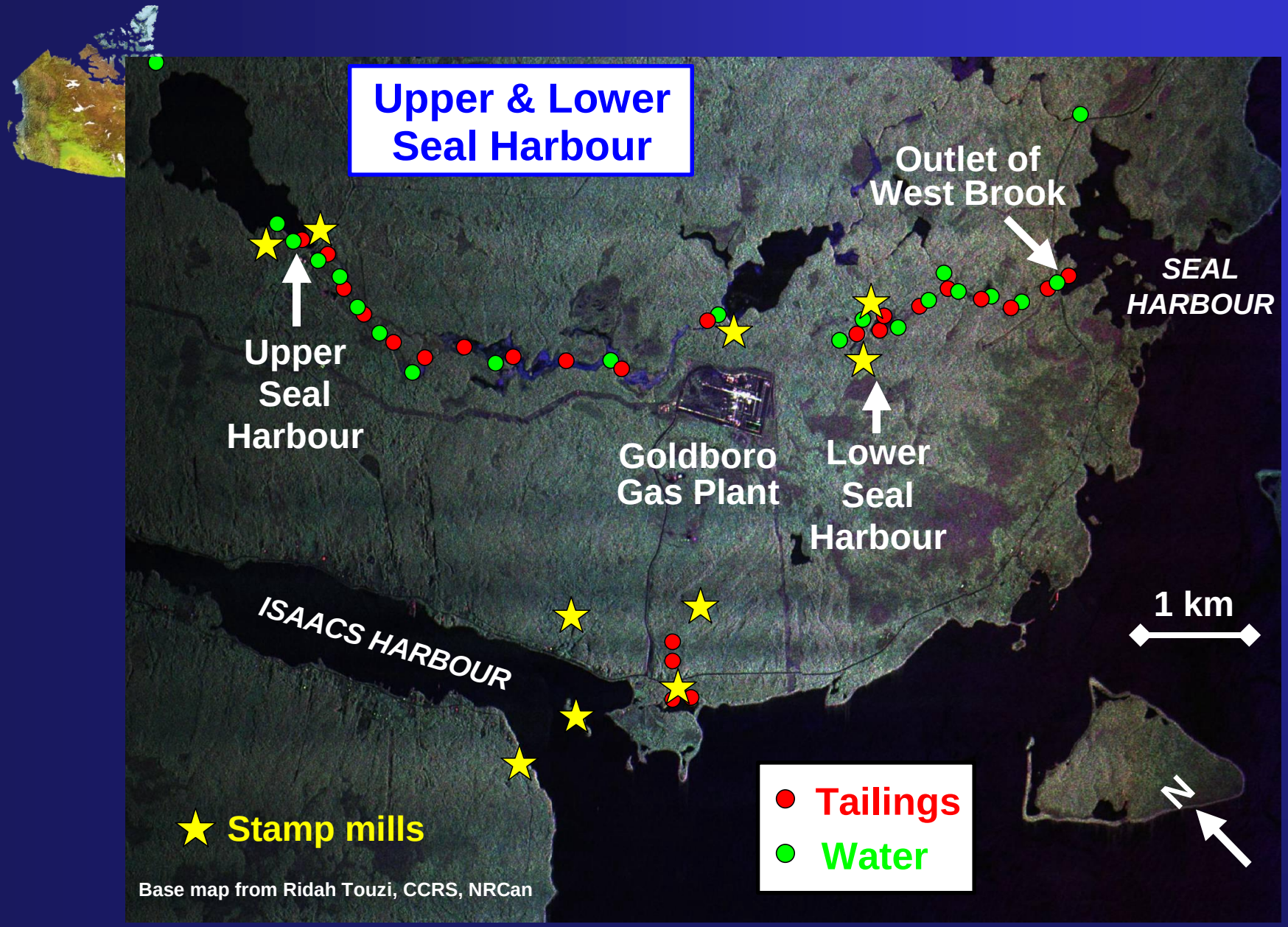
Geological Setting

- Meguma Group: 450-km strike length of a basal sequence of intercalated metamorphosed sandstone (meta-greywacke), siltstone and shale (slate to schist) of the Goldenville Formation conformably overlain by slates (schist) and meta-siltstones (slate to schist) with minor interbedded, fine-grained meta-quartz-arenite and meta-greywacke of the Halifax Formation

- Gold initially discovered within interbedded turbidites in 1858; auriferous veins are narrow (1-50 cm), dominated by quartz and carbonate and contain up to ~5% sulphides (arsenopyrite-pyrrhotite-pyrite ± base metal sulphides)
  - Lode Au deposits were mined through crushing of ore in stamp mills followed by extraction using gravity, Hg amalgamation and cyanidation

Cleaning up the 20-Stamp Mill, Dufferin Gold Mine, 1893




Upper & Lower Seal Harbour
Outlet of West Brook
SEAL HARBOUR
Upper Seal Harbour
Goldboro Gas Plant
Lower Seal Harbour
ISAACS HARBOUR
1 km
N
Tailings
Water
Stamp mills
Base map from Ridah Touzi, CCRS, NRCan

Mining History

- Mining began in 1892 and continued intermittently until 1958; about 57, 850 oz. were mined from moderately plunging, high-grade ore shoots on both the north and south limbs of the Upper Seal Harbour Anticline.
- The Lower Seal Harbour mine produced about 34, 350 oz. between 1904 and 1941. The lode Au occurred in smoky grey and crack-seal textured quartz veins having both concordant and discordant geometry, and grey, sulphide-rich (arsenopyrite and minor galena, pyrite, pyrrhotite, chalcopyrite and sphalerite) slate.
- Historical mining at both these localities left behind large volumes of tailings that contain significant amounts of Hg, As and Au. These tailings are continually being eroded and dispersed downstream throughout the watershed, towards the ocean.

Lower Seal Harbour Tailings

Main tailings impoundment

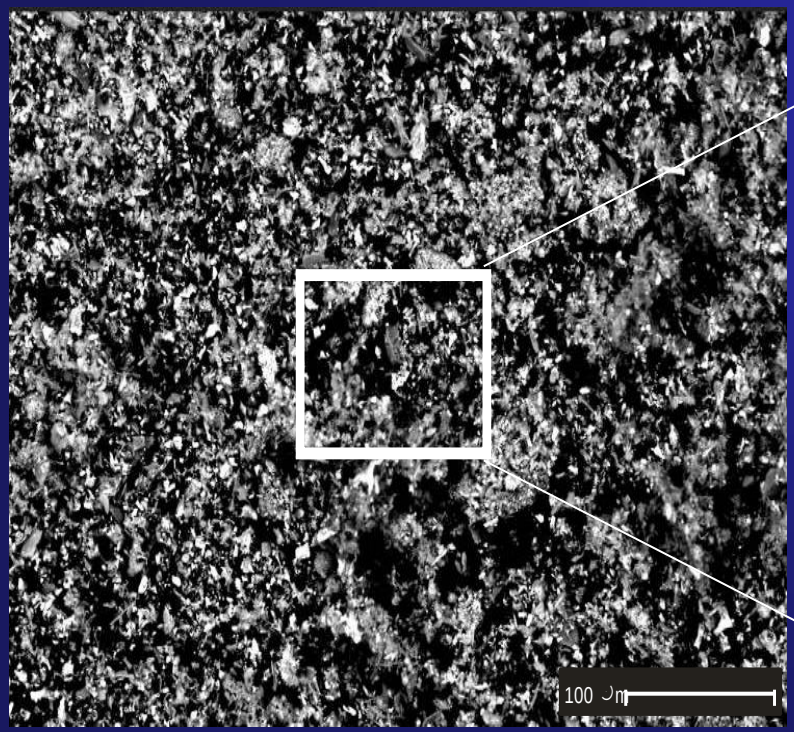
Tailings in tidal area, Seal Harbour

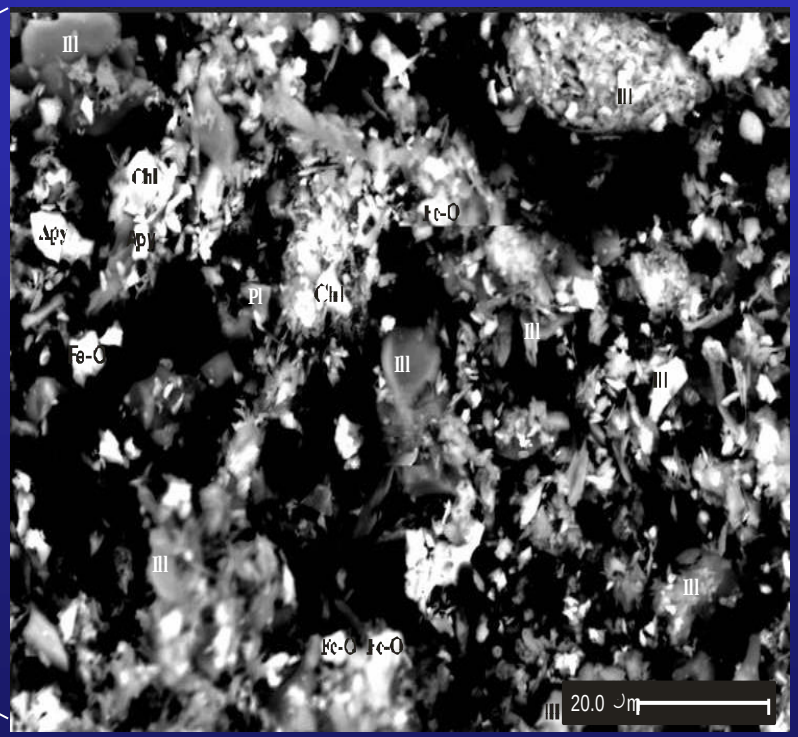
Tailings Mineralogy

- silt-rich materials of relatively uniform composition, poorly sorted with subangular grains
- dominated by quartz with minor feldpsar, mica and chlorite
- clay-size fractions of most samples are dominated by illite (24-60%; avg. 42%) with subequal proportions of quartz (8-30%; avg. 20%), plagioclase feldspar (7-29%; avg. 14%) and chlorite (8-24%; avg. 18%)
- trace minerals include gypsum, ilmenite, Fe-oxides (goethite), arsenopyrite, pyrite, galena, sphalerite, zircon, monazite, xenotime, allanite, thorite and an As+S-bearing mineral, possibly realgar.

Sample PNA03-07A

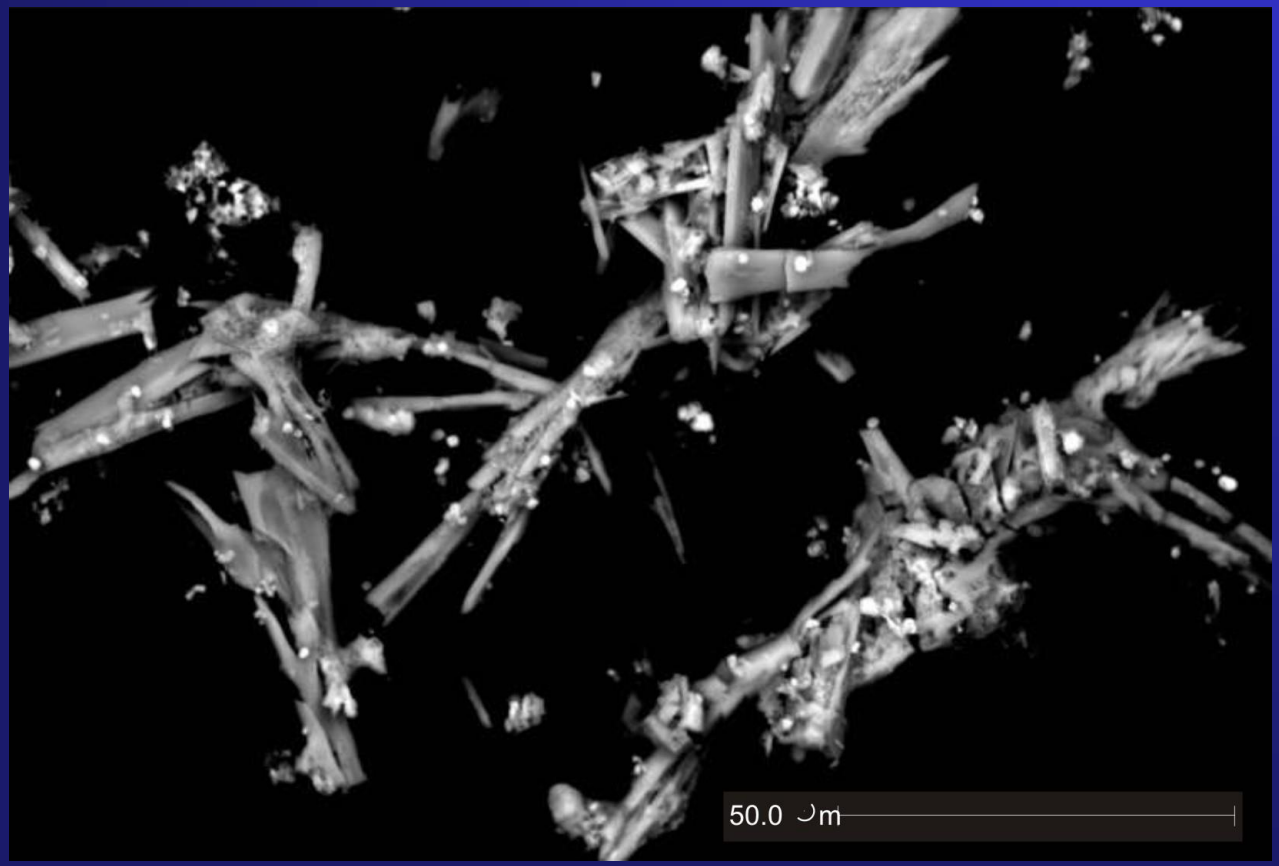
56% mica/illite, 18% chlorite, 15% quartz, 11% plagioclase, and trace amounts of Fe-oxides, arsenopyrite, galena and thorite





Sample PNA03-04D

Gypsum crystals 30-35 cm depth



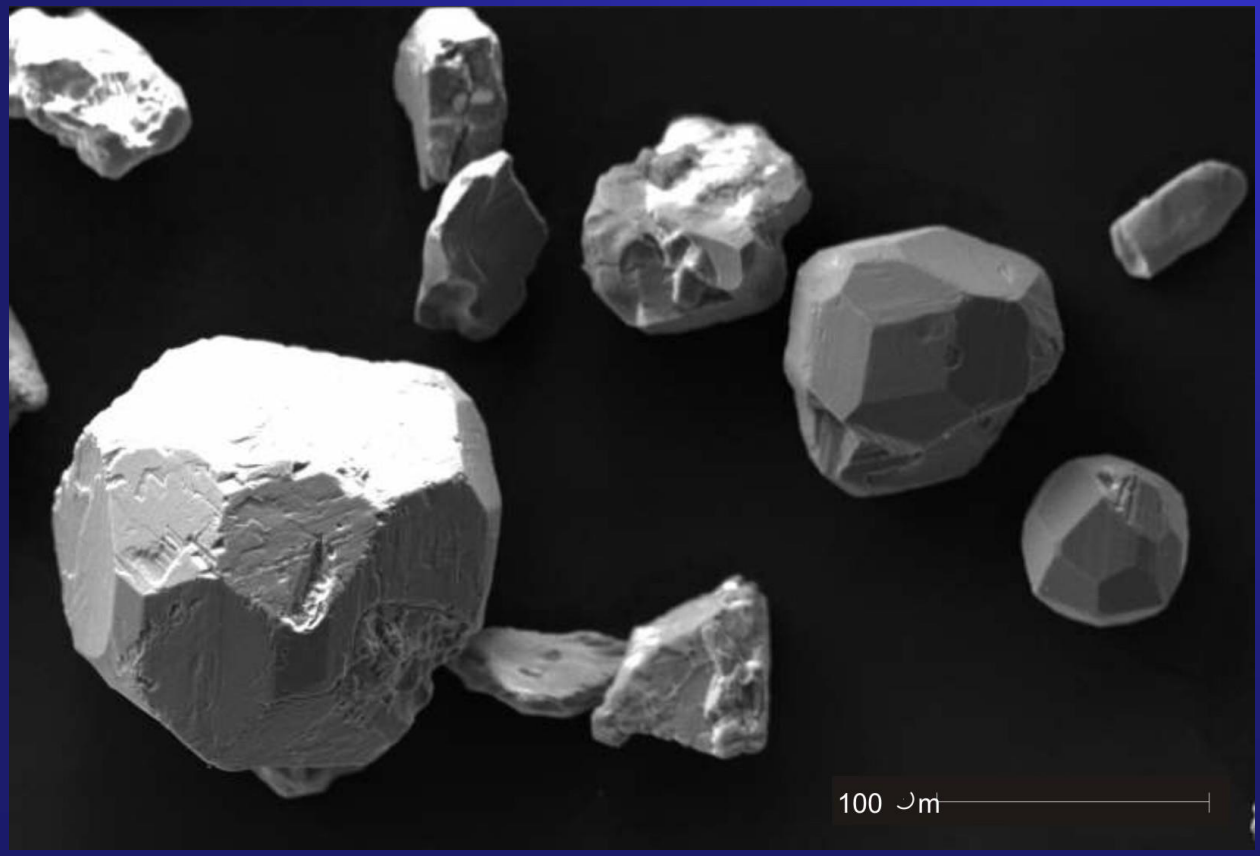
Heavy Mineral Separates
Regional Meguma Samples

- Samples are dominated by hematite, ilmenite and/or garnet

- Also contain lesser amounts of pyrite, arsenopyrite, zircon, magnetite and anatase

GGS04-11

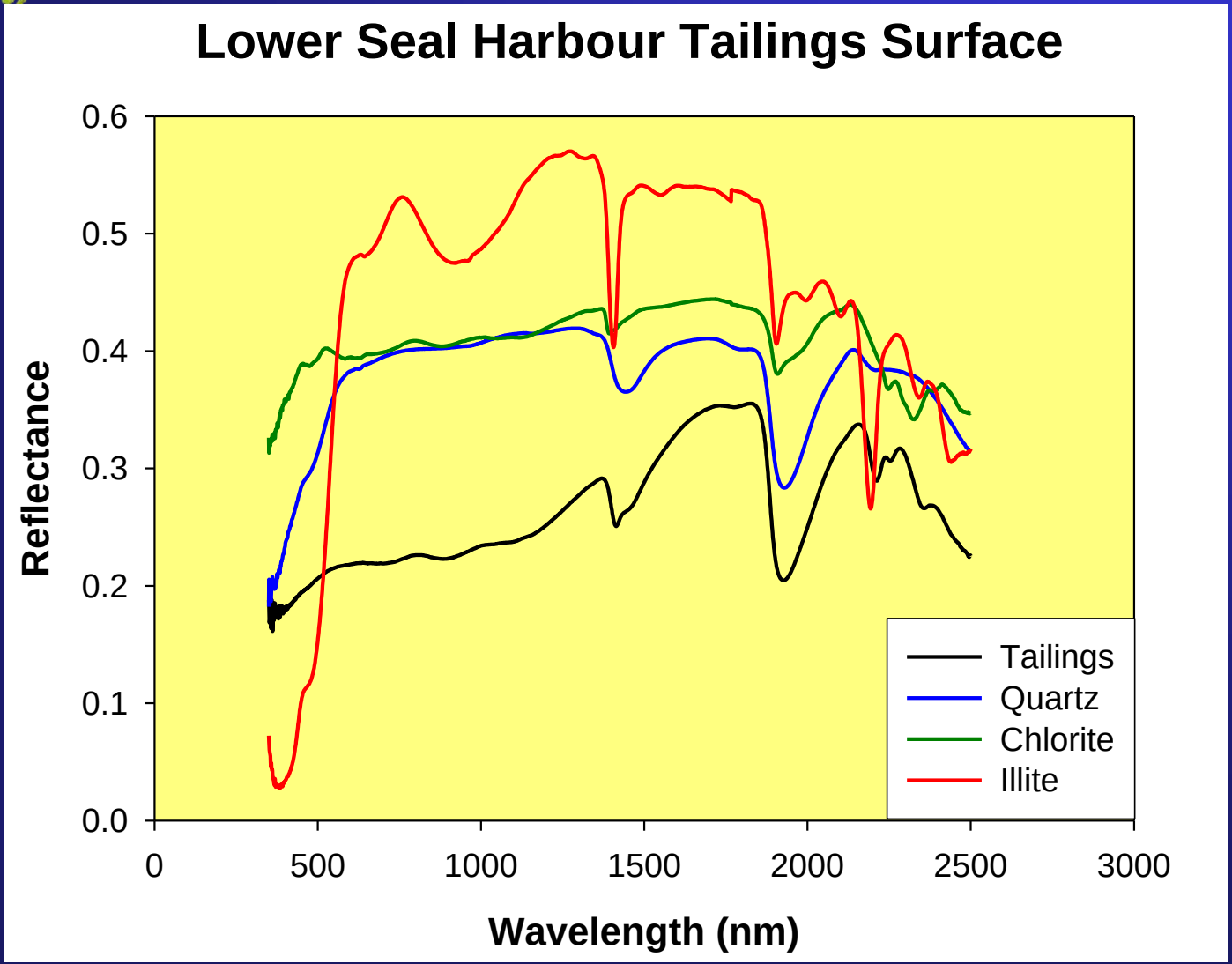
Garnets in Meguma metasandstone



Infrared Study

- Testing of two field portable instruments
- GER and ASD

Infrared Spectra



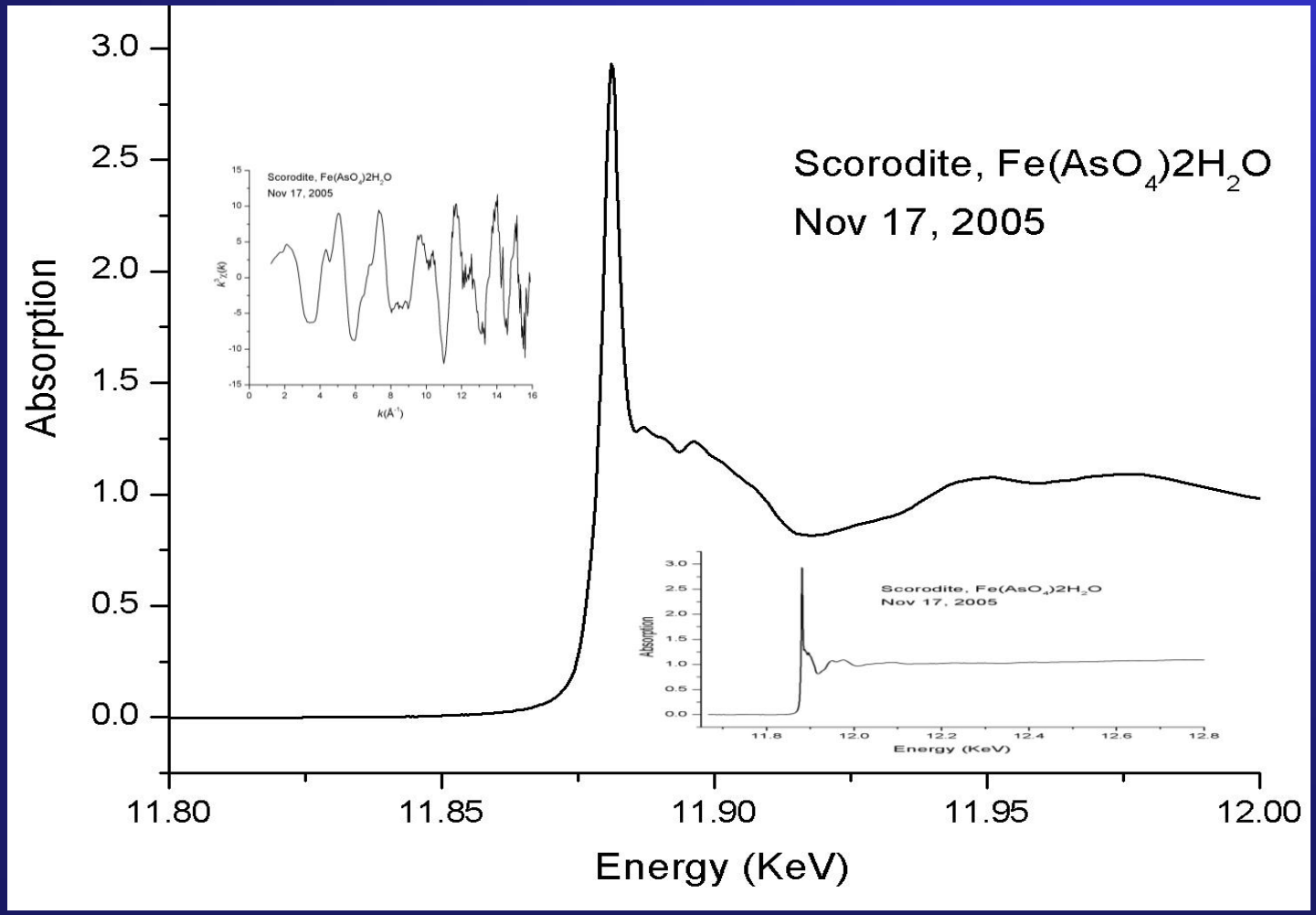
Synchrotron Study

- Fluorescence experiments using a Lytle detector filled with Ar gas were carried out on the Hard X-ray Micro-Analysis (HXMA) beamline at the Canadian Light Source.
- Several spectra (10-20) were collected for each of the 4 reference minerals and 4 samples and averaged to improved resolution.
  - scorodite, arsenopyrite, As_2O_3 and As_2O_5

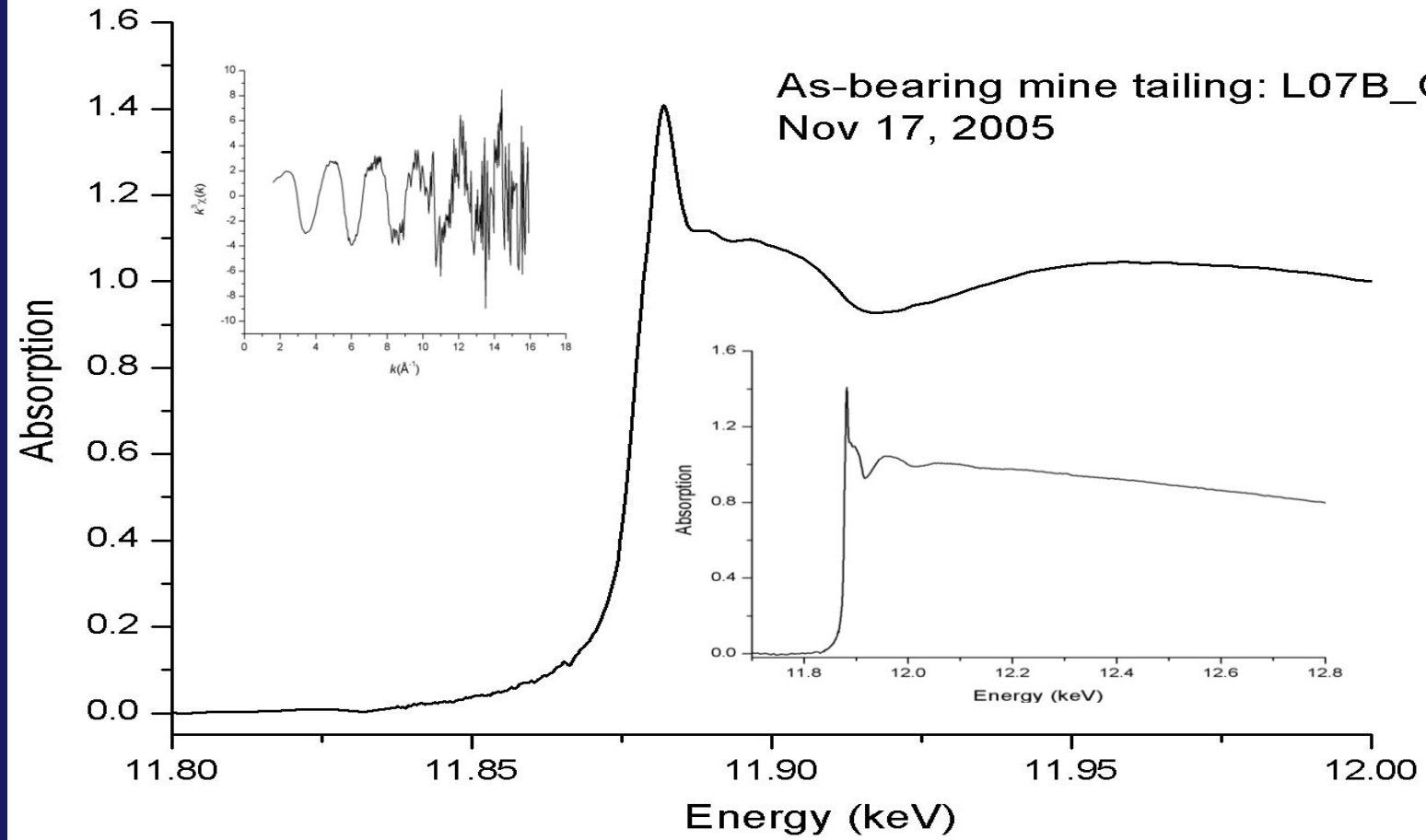
Purpose of Study

- How does the solid-phase speciation of As change at a given sample site as you move from the deep, reduced tailings into more oxidized tailings near the surface?
- How does As speciation change in surface sediments as you move through the Upper /Lower Seal Harbour drainage system?

Natural Scorodite
Mt. Pleasant, N.B.



Lower Seal Harbour Sample



Conclusions

- There is an extensive dispersion of Hg-and As-bearing tailings downstream of the gold mine camps.
  - Concentrations range from about 12 to 29 ppm for Hg and 150 ppm to 31 wt % for As
  - Tailings are comprised essentially of silt-sized quartz, feldspar, illite and chlorite with minor to trace arsenopyrite, pyrite, galena, chalcopyrite, pyrrhotite and sphalerite.
- Mercury concentrations are highest near the mine site and decrease rapidly downstream; There is less variation in As content in the tailings downstream suggesting a correlation with arsenopyrite.
  - The presence of arsenopyrite minerals in exposed tailings along the drainage pathway provides an on-going supply to receiving waters through oxidation and weathering.