



GEOLOGICAL
SURVEY
OF
CANADA

DEPARTMENT OF MINES
AND TECHNICAL SURVEYS

PAPER 64-29

PRELIMINARY APPLICATION OF HEAVY MINERAL
ANALYSES TO METALLOGENY OF CARBONIFEROUS AREAS,
NOVA SCOTIA AND NEW BRUNSWICK

(Report and 3 figures)

W. D. McCartney and C. R. McLeod

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ABSTRACT

As a preliminary field test of a method of mineral exploration, nineteen heavy mineral concentrates from stream gravels were collected by panning, concentrated, and analyzed for lead, zinc, barium, manganese and tin. Samples from a Carboniferous basin in eastern Cape Breton, Nova Scotia, known to contain a large, low-grade deposit of galena in grey sandstone and siltstone, as well as galena in Windsor limestone, contained 1,000 to 4,000 parts per million zinc, 1,000 to 3,000 parts per million lead, and up to 1 1/2 per cent barium. Samples from an area underlain by Mississippian sediments not known to contain sulphides in central Nova Scotia contained up to 460 parts per million zinc, up to 125 parts per million lead, and up to 0.5 per cent barium. A tin content of 0.2 per cent in one sample was probably derived from nearby Devonian granite. The consistently low values near the presumably barren sediments, as opposed to consistently high values near galena-bearing sandstones, suggest that the method warrants further field tests as an aid to metallogenic study and mineral exploration in Carboniferous basins and elsewhere in the Canadian Appalachians.

PRELIMINARY APPLICATION OF HEAVY MINERAL ANALYSES TO METALLOGENY OF CARBONIFEROUS AREAS, NOVA SCOTIA AND NEW BRUNSWICK

INTRODUCTION

The purpose of this limited study is to evaluate the usefulness of heavy mineral studies in metallogenic investigations in the Canadian Appalachians. Nineteen samples of heavy mineral concentrates from selected Carboniferous areas of Nova Scotia and New Brunswick were collected, concentrated, and analyzed. Preliminary publication is undertaken because other workers may be encouraged to augment their normal soil- or stream-sampling procedures and because samples 307 (0.22% Pb; 0.24% Zn) and 315 (0.2% Sn) may be of economic interest. Initial results are encouraging and suggest that a more extensive trial of the method in other carefully selected geological environments in the Atlantic Provinces is warranted.

Discussions with C.F. Gleeson and analyses by R.J. Bolton and J.J. Lynch, Geological Survey of Canada, are acknowledged with thanks.

GEOLOGICAL FACTORS

A continuing study of the age and distribution of mineralization within the regional geological framework of the Canadian Appalachians supports the general outlines of a working hypothesis formerly published (McCartney and Potter, 1962)¹.

Mineralization of the late (post-orogenic) stages of geological development in this region is of late Devonian to Triassic age.

The types of mineralization to be expected during the late and final stages of geosynclinal development include deposits associated with small igneous intrusions, such as porphyry copper deposits (not yet recognized in the Appalachians) and cassiterite-stannite-sulphide mineralization (part of the mineralization at Mount Pleasant, southern New Brunswick). Mineralization having no clear affiliation with igneous activity appears to fall within two broad classes. One class of deposits occurs in limestone or shale at or near the Mississippian Horton-Windsor contact and commonly displays a dependence on structural deformation as well as on stratigraphic position. Mineralization varies, but has resulted in combinations of barite-lead-zinc-silver (Walton, N.S.), barite-siderite (Brookfield, N.S.), lead-zinc-minor barite (Smithfield, N.S.), disseminated lead-zinc (Gays River, N.S.), and barite-fluorite-calcite veins (Lake Ainslie, N.S.). The second class of deposits occurs in grey and green

¹Names and/or dates in parentheses refer to publications listed in the References.

Pennsylvanian (more rarely Mississippian) sandstone and siltstone, in places associated with plant remains. Sedimentary features appear to have controlled primary mineralization. The two principal types in this class are sandstone-copper-uranium occurrences in northern Nova Scotia and a large, low-grade deposit of disseminated galena in grey Pennsylvanian sandstone and siltstone in the Salmon River Carboniferous basin, Cape Breton, Nova Scotia (Fig. 1).

Bedrock in areas underlain by Carboniferous sediments is normally poorly exposed, and disseminated sulphides in sandstone and siltstone can be easily overlooked. Thus a method of indicating the presence of possible mineral deposits in promising Carboniferous areas would be of value in defining metallogenic provinces and in mineral exploration.

Soil and stream-sediment sampling by normal geochemical methods, in which unconcentrated samples are analyzed, is one such method in widespread use in the Maritime Provinces. The analysis of concentrated samples of heavy minerals, as described in this report, is a second method and warrants further field trials.

AREAS SELECTED

With only five days available for sample collecting, two areas were chosen that could be compared after brief testing. The Salmon River Carboniferous sandstone-siltstone-shale sequence (Fig. 1) was selected because galena is disseminated over a long strike length in a bed at the Talisman property (Nova Scotia Report on Mines, 1962, p. 61). Exposures are rare and fine-grained galena in grey siltstone is inconspicuous. Galena is also present in nearby Windsor limestone lower in the stratigraphic column. Lead and zinc in the samples may have been derived from both the siltstone and the limestone.

The West River St. Mary's (Fig. 2) was selected as an interesting metallogenic area, which might indicate the relative importance of major transverse faults as opposed to the favourable Windsor-Horton contact as controls of specific types of mineralization. The course of the river is controlled by a major east-trending fault separating Horton clastic beds from granite and Meguma sediments to the south. The extension of this major fault zone to the west is marked by numerous mineral occurrences and deposits (Walton, Brookfield, Smithfield, etc.) in areas where both Horton and Windsor beds are preserved.

In addition, two samples (318, 319) were collected from Hammond River near Upham, New Brunswick, where the river overlies sediments of the Hopewell and Windsor Groups. Time did not permit extension of the sampling to the north.

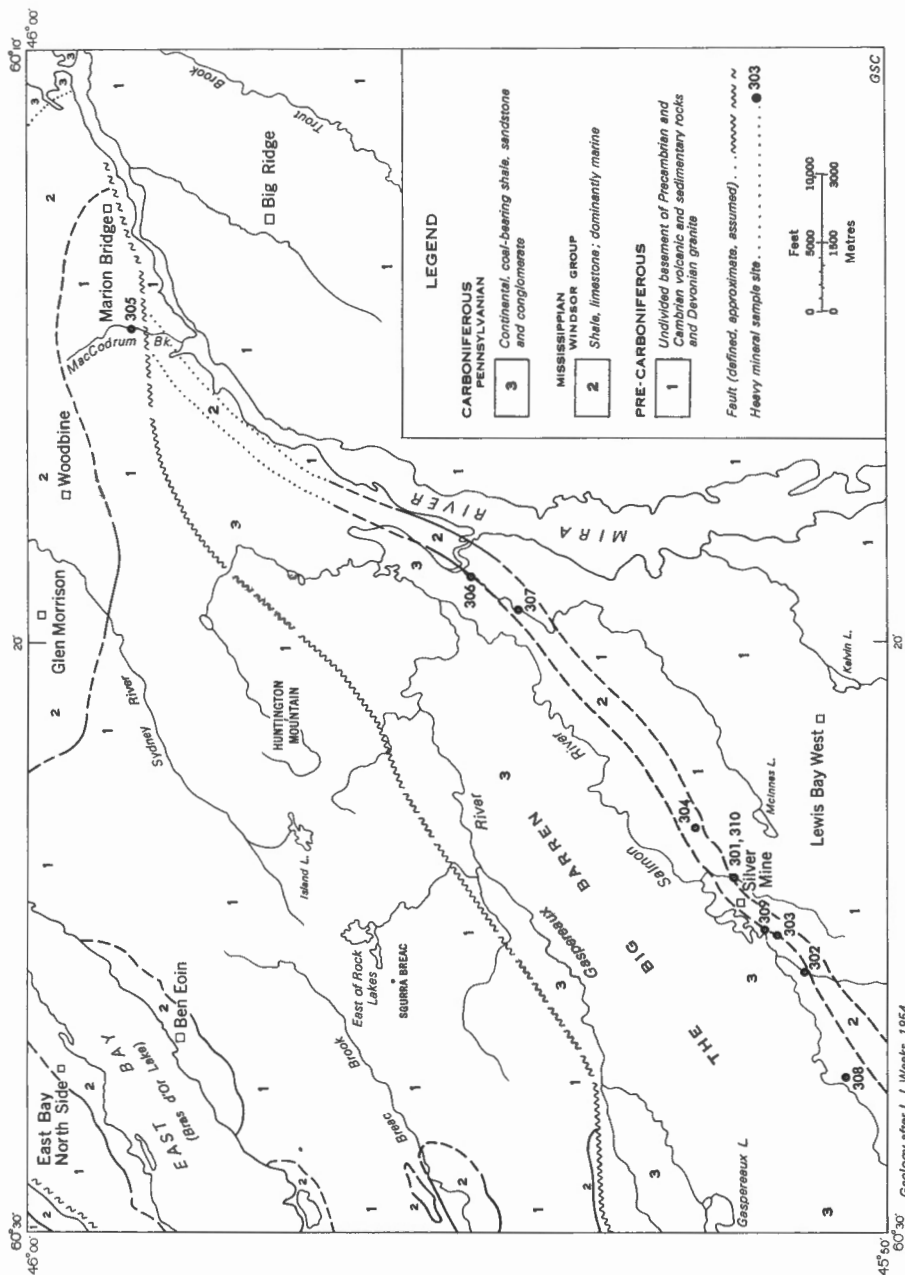


Figure 1. Part of the Salmon River Carboniferous basin, Cape Breton Island, Nova Scotia, showing the locations of samples of heavy minerals

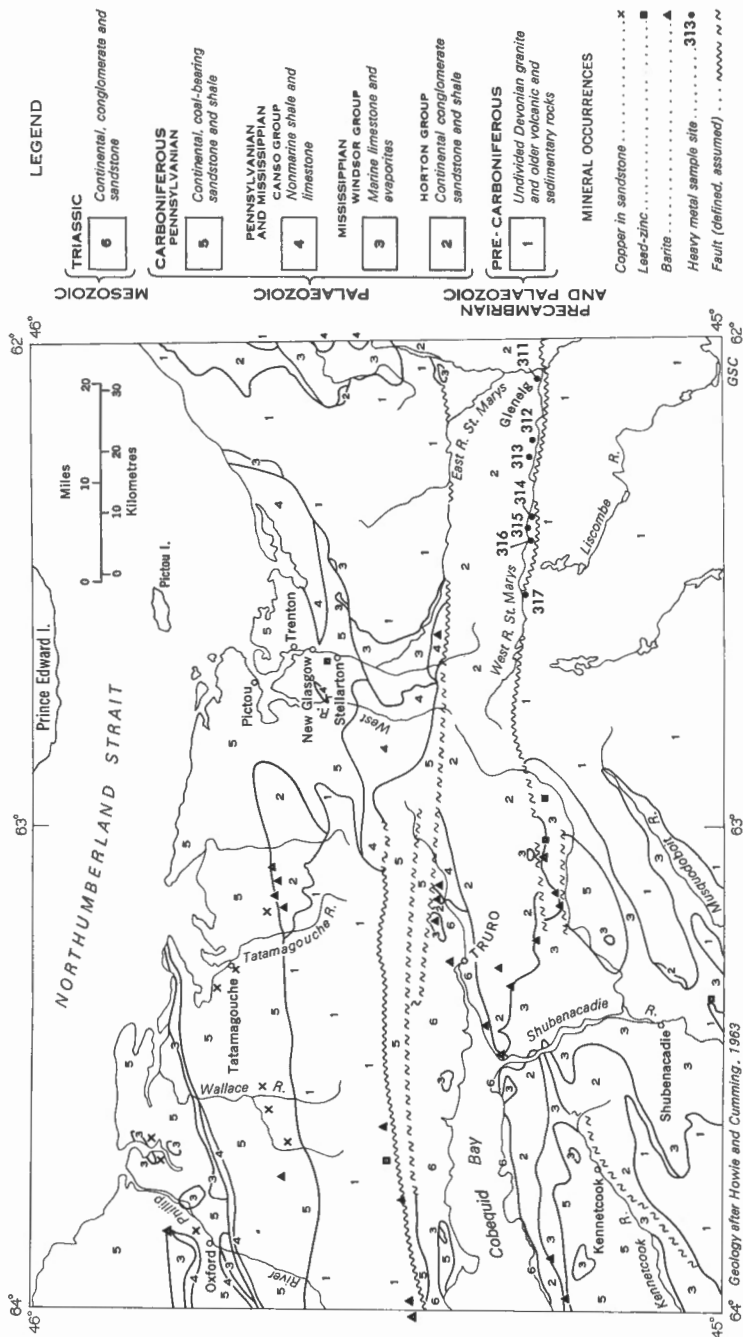


Figure 2. Truro area, Nova Scotia, showing the locations of heavy minerals and some mineral occurrences characteristic of those in Carboniferous sedimentary rocks

FIELD METHOD

Samples weighed about 55 to 60 pounds and consisted of about 1/2-cubic-foot or three 16-inch gold pans of gravel and sand from which the larger material (over 3 inches in diameter) had been removed. A concentrate weighing 2 to 3 pounds was obtained by panning. The panned concentrate was later separated with heavy liquids.

Samples 304, 308, and 309 were taken from poorly stratified but well-worn outwash gravels exposed in road-cuts. All other samples were from the gravels of active streams.

ANALYTICAL RESULTS

The panned heavy mineral concentrates were separated in bromoform (specific gravity 2.89) and the sink product was further separated in methylene iodide (specific gravity 3.3). The final sink product was split and half the sample was pulverized; (a) semi-quantitative analyses were done on the optical spectrograph by R.J. Bolton, and (b) colorimetric analyses for lead and zinc were done by J.J. Lynch using a $K_2 S_2 O_7$ fusion (Gilbert, 1959).

The spectra were seriously complicated by heavy iron and titanium lines. Thus it is recommended that future spectrographic analyses be undertaken only on the non-magnetic heavy minerals after removal of ilmenite and magnetite.

The lead, zinc, and barium results, shown in Table I and Figure 3, clearly reflect the differences in the geological environment of the two areas. The lead and zinc values within the Salmon River belt are consistently high. Sample 305 is low but is a control sample collected immediately north of the Carboniferous basin. Samples 306 and 307 are of interest because they were collected about 6 miles north of the principal Talisman mineral showing, yet contain high lead and zinc values.

Barium appears to show a direct relation to zinc content and was included in the analyses because of the common association of barite with sulphides in Windsor beds.

Manganese averages 10 per cent in concentrates from West River St. Mary's and 5 per cent in the Salmon River samples. This is believed to be related in part to spessartite garnets derived from Meguma beds in the former locality.

Tin comprises 0.2 and 0.03 per cent in samples 315 and 316. These samples were taken from stream gravels immediately south of the road at McQuarrie Brook and Chisholm Creek, respectively. The two streams are 0.3 and 1.2 miles west of Caledonia. The source of their anomalous tin content is probably associated with granite near the upper reaches of the streams.

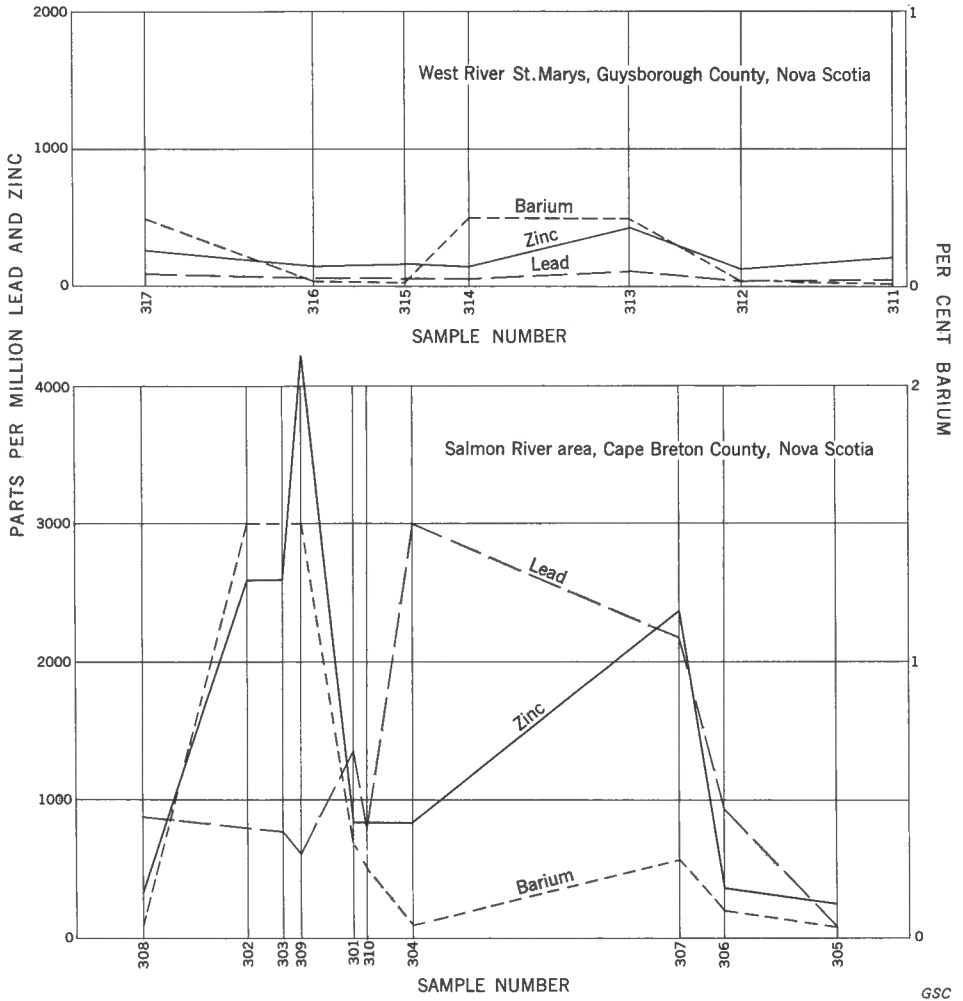


Figure 3. Variation in barium, lead, and zinc in heavy mineral concentrates. Sample localities plotted on Figures 1 and 2

Table I
Analyses of Heavy Mineral Concentrates,
Nova Scotia and New Brunswick

Area	Sample Number	Zinc* (ppm)	Lead* (ppm)	Tin** (%)	Barium** (%)	Manganese** (%)
Salmon River, N.S.	301	820	1,300		0.3	5
	302	2,600	800		1.5	7
	303	2,600	760		1.5	7
	304	860	3,000		0.05	7
	305	270	80		0.03	0.5
	306	1,000	1,200		0.1	5
	307	2,400	2,200		0.3	5
	308	360	900		0.05	3
	309	4,200	600		1.5	3
	310	840	800		0.5	5
West River St. Mary's, N.S.	311	250	25		0.02	10
	312	190	25		0.015	10
	313	460	120		0.5	10
	314	160	30		0.5	15
	315	170	60	0.2	0.03	10
	316	160	80	0.03	0.02	10
	317	280	100		0.5	10
Upham, N.B.	318	200	200		0.2	2
	319	230	80		0.1	2

* Colorimetric analyses by J.J. Lynch, Geological Survey of Canada.

** Semi-quantitative spectrographic analyses by R.J. Bolton, Geological Survey of Canada.

CONCLUSIONS

The consistently high values of lead, zinc, and barium indicated in heavy mineral concentrates from the Salmon River basin, Cape Breton Island, which contains known galena-bearing sandstone and limestone, as opposed to the consistently low values in similar samples from the West River St. Mary's, where no disseminated sulphides are known in Carboniferous sandstone or limestone, suggest that the technique described in this report deserves further field trials. In particular, disseminated sulphides in grey or green Carboniferous siltstone or sandstone are remarkably inconspicuous in hand specimens, and outcrops are not normally abundant in Carboniferous areas. Thus the method may help to select promising basins or parts of basins for more detailed mineral exploration, and help to define metallogenic provinces.

The method could augment standard geochemical soil and stream-sediment sampling and analysis. Heavy mineral concentrates should probably be collected at more widely spaced intervals than is common in geochemical exploration, because of the general consistency of the results reported here and because of the additional time required to pan the material. The larger amount of material panned as compared to normal geochemical soil or stream-sediment samples gives a more representative sample of sand-gravel beds and a better concentrate of heavy minerals that may contain valuable elements above normal, detectable, analytical limits. Thus elements such as tin, tungsten, gold, and barium are more readily detected, and minerals commonly associated with specific types of mineralization such as unoxidized sulphides, fluorite, tourmaline, or topaz may be identified in the heavy mineral concentrates. The results of rapid chemical analyses reported here indicate that useful data can be obtained for some types of deposits without exhaustive microscopic identification of minerals. Mineral identification can be undertaken where warranted and as time permits.

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