



GEOLOGICAL  
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OF  
CANADA

DEPARTMENT OF MINES  
AND TECHNICAL SURVEYS

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PAPER 59-12

HEAVY-METAL (Zn, Pb, Cu) CONTENT OF STREAM SEDIMENTS  
OF PART OF  
WESTMORLAND COUNTY, NEW BRUNSWICK

Arthur Y. Smith



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# HEAVY-METAL (Zn, Pb, Cu) CONTENT OF STREAM SEDIMENTS OF PART OF WESTMORLAND COUNTY, NEW BRUNSWICK

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## INTRODUCTION

The investigation described in this paper forms part of a continuing reconnaissance geochemical survey of Nova Scotia and southern New Brunswick, begun in Nova Scotia in 1956 by R. W. Boyle and continued in 1957 and 1958 by R. H. C. Holman. The results of these investigations have been published (Boyle et al ., 1958<sup>1</sup>; Holman, 1958), or are in preparation. The field work for the present project was carried out in the summer of 1959.

The heavy-metal (Zn, Pb, Cu) values reported on the accompanying maps (Figures 2, 3, 4) are for total extractable metal. Analyses were carried out in the Ottawa laboratories of the Geological Survey of Canada on dried samples sieved to minus-80 mesh. Samples were fused with potassium bisulphate, and the heavy metals determined separately using dithizone (diphenylthiocarbazone) methods (see Gilbert, 1959).

Preliminary analyses were carried out in the field on the wet, unsieved samples, using a modification of the technique for copper described by Holman (1956). For the determination of zinc the technique was modified by using an alkaline citrate extractant (pH 8.5), benzene as the solvent for dithizone, and preparing zinc standards for colour comparison. The results of these preliminary field analyses have not been included because the values were so uniformly low that little information was revealed.

The results of the investigation indicate that the amounts of total extractable zinc, lead, and copper in the stream sediments of the area are low. Anomalous amounts of zinc are more widespread than those of lead and copper; and appear to have less meaning. Copper and lead anomalies are clustered within the Dorchester area, particularly in the vicinity of the old Dorchester copper mine. Some of these are definitely related to the dumps of this mine; others in the area, however, are well removed from known dumps and may indicate other deposits of the Dorchester type.

Elsewhere, anomalous amounts of lead and copper occur in isolated samples in areas of low background. These must be regarded as real features, particularly where the sample is anomalous for more than one metal. In assessing such anomalies the nature of

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<sup>1</sup>Names and dates in parentheses refer to publications listed in the Selected Bibliography.

the known deposits, such as their small size and sporadic distribution in the bedded sedimentary rocks, must be considered.

### Acknowledgments

The writer is grateful to A. D. Edgar and E. W. Presant for willing and able field assistance including analytical determinations.

Thanks are also due to D. H. Williamson, A. C. Cuthbertson, R. E. Beschel, and Murray Sears of Mount Allison University, Sackville, for their kind cooperation during the course of the field work; to the Regents of the University for providing laboratory facilities; and to W. C. Gussow for permitting the inclusion of his geological map of the area in this paper.

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### TOPOGRAPHY AND GEOLOGY<sup>1</sup>

Topographically the area may be divided into two parts. From Morice Lake westward to Dorchester and Memramcook, and beyond to the Petitcodiac River, the country is gently rolling and hilly. The highest of these hills rises to over 550 feet. The area is cut by Memramcook and Petitcodiac Rivers which lie in broad, tidal valleys. Streams in the uplands are clear and fast flowing, but where they approach the two main rivers they become slow and muddy and are generally unfit for sediment sampling.

In the eastern part of the area the topography is characterized by a low flat plain, with elevations rarely reaching 150 feet. The country is swampy in places and south of Sackville is covered by the famous Tantramar marshes. Streams in the eastern part are generally slow but clear, whereas in the Tantramar marshes they are almost invariably tidal and unsuitable for sediment sampling.

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<sup>1</sup>For a detailed description of the geology of southeastern New Brunswick, the reader is referred to Gussow (1953).



In general, the topography reflects the geology of the underlying bedrock. The western upland region is underlain by Mississippian sediments of the Horton, Moncton, Windsor, and Hopewell groups which rest on a pre-Carboniferous basement complex (see Figure 1).

The pre-Carboniferous basement complex is exposed at Calhoun, north of Memramcook. There it consists of a coarse granite gneiss. West of the Petitcodiac River the Caledonia massif consists of metamorphosed sediments and volcanic rocks, as well as intrusive granite and diorite. The Caledonia massif has served as a source of all the later sediments.

The Horton group rests unconformably on the basement complex and includes the Memramcook, Albert, and Weldon formations. These are red conglomerate, sandstone, and shale sequences, with the exception of the Albert formation which is made up of grey marine shales and limestones, generally rich in hydrocarbons.

Overlying the Horton group unconformably is the Hillsborough formation. The Hillsborough rests unconformably on the Weldon, and together these two make up the Moncton group. Overlying the Moncton group are the marine sediments of the Windsor group composed of limestone, gypsum, and salt. Only the gypsum member is present in the area under consideration. Overlying the Windsor group are the red sandstones and siltstones of the Mississippian part of the Hopewell group which includes the Maringouin and Shepody formations.

Two periods of deformation have affected the Mississippian rocks of the region. The first was post-Weldon at which time the Memramcook, Albert, and Weldon formations were folded and faulted. The second period of deformation occurred at the end of Mississippian time during which the Hillsborough, Windsor, and Mississippian part of the Hopewell group were intensely folded and faulted.

In the eastern part of the area the flat topography reflects the relatively flat underlying Pennsylvanian rocks. The eastern edge of the western upland region is underlain by rocks of the Pennsylvanian part of the Hopewell group, the Enrage formation, and the Boss Point formation of the Riversdale group. There these two formations are draped over the underlying Mississippian rocks, and their structure is, for the most part, derived from them. Eastward, the underlying Mississippian rocks are apparently absent. There, the Pennsylvanian rocks rest on a pre-Carboniferous erosion surface and are nearly structureless. They are represented by the Riversdale and Pictou groups. The Cumberland group, so prominent in Nova Scotia for its coal-bearing measures, is absent.

The Pennsylvanian part of the Hopewell group is represented by the Enrage formation, a series of red siltstones and shales with some conglomerate and sandstone at its base. Overlying the Enrage with apparent conformity is the Boss Point formation composed of grey conglomerate and sandstone with minor amounts of siltstone and shale.

Gussow (1953) has made a fourfold subdivision of the Pictou group in the area. This subdivision includes: the Salsbury formation, a sequence of red sandstones, shales, and conglomerates, resting with disconformity on the Boss Point; the Scoudouc formation of greenish grey arkosic sandstone resting conformably upon the Salsbury; the Richibucto formation of brown arkosic sandstone resting with disconformity upon the Scoudouc; and the Tormentine formation of bright red sandstone resting conformably upon the Richibucto. The Tormentine beds are the youngest rocks in the southeastern part of New Brunswick.

The effects of glaciation have been relatively mild. The area is drift covered to a depth of from 15 to 20 feet, but in one place at least, drift to a depth of 300 feet is known. Ice-movement has been mainly from north to south, but it is probable that the drift has not been transported for any great distance. In the western uplands the streams have cut through the drift and flow over bedrock. In the eastern part the streams flow across the low flat-lying plains and bottom in drift.

### MINERAL DEPOSITS

Known mineral deposits are rather sparsely distributed in the area. Two copper deposits and one barite deposit are known, and these are described briefly below.

At East Memramcook, 2 miles from Memramcook, a deposit of barite has been known for many years. It occurs in a northwest-trending fracture system in red shales of the Memramcook formation. The extent of the deposit is not well known. The red shales in the vicinity of the main vein have been highly brecciated and bleached to a buff-grey. The breccias are cemented by amethystine quartz, fluorite, and barite. Within the main vein, barite and green to purple fluorite predominate. Minor amounts of galena and chalcocite are scattered throughout the main barite zone together with blooms of malachite and azurite. The deposit is presently being investigated by Sheraton Mining Corporation.

The old Dorchester copper mine is situated on the Fairfield Road, 3 miles east of Dorchester. Work was done on this property around the turn of the century, and again from 1915 to 1917, when a small amount of copper ore was won from the deposit. Since then the property has been abandoned and, except for a little exploration work in the years 1950, 51, it has remained idle ever since.

The deposits occur at the base of the Boss Point formation, a few feet above its contact with the underlying Enrage formation of the Hopewell group. The ores occur in grey arkosic conglomerates and sandstones and are of four types: chalcocite nodules up to 2 inches long; chalcocite stringers and patches replacing pyrite and plant remains; finely disseminated chalcocite in fine-grained micaceous sandstone beds; and stains and disseminations of malachite replacing the calcite cement of the sandstones and conglomerates. A considerable quantity of the grey sandstone and conglomerate has been extracted and dumped on the surface in several places. The small extent and low grade of this deposit has rendered it of marginal economic value at best.

Of mainly scientific interest is a copper swamp 1/4 mile east of the Aboushagan road, 3 miles north of Upper Sackville. The swamp occurs in a small hollow in the glacial drift and was covered by normal forest growth prior to 1898. At that time the tree cover over part of the swamp was destroyed by fire, and has never grown back. The swamp is fed by several springs, the water of which may contain several parts per million of copper. Copper is concentrated in a black peaty muck which assays up to 4 per cent copper. No copper minerals have been recognized in this muck.

The source of the copper being supplied to this swamp is in doubt. R. E. Beschel, formerly of the Department of Botany, Mount Allison University, who has studied the deposit extensively, believes that the copper is being supplied by the leaching of the underlying glacial drift. Others, including the writer, consider it more probable that the copper is being supplied by the leaching of an underlying deposit of the Dorchester type.

The small size and difficulty of treatment renders the copper swamp of questionable economic value.

## RESULTS OF THE INVESTIGATION

The results of this investigation are presented in the form of three maps of the general area, one each for copper, lead, and zinc, and three additional maps showing detailed investigation of several streams in the area around the Dorchester mine.

Values have been recorded for all stream sediments containing more than 75 ppm zinc, 10 ppm lead, or 5 ppm copper. These 'background' values may seem somewhat arbitrary, and in fact are, for the area contains rocks of several types. They were arrived at by statistical analysis of samples in areas of similar rock types in Nova Scotia, collected by R. H. C. Holman in 1957 and 1958. In an area such as this the assignment of a background value is a matter of some importance. It is probable that, in view of the type and extent of known mineral deposits, anomalous values, if any, will be low and restricted in areal extent. For this reason, it is felt that all anomalies, however low in value, restricted, or isolated must be treated as real.

Greater than background values in all three metals were found in several stream systems. Surrounding the Dorchester mine, a concentration of copper highs occurs, particularly in the streams draining the mine area. These high values on the south branch of Beau Creek are undoubtedly due to metal supplied from the mine dumps. Copper in the streams tributary to this main stream is not due to any known dump, but is probably due to small deposits of the Dorchester type. The several scattered copper highs north of Sackville, on Aulac ridge, and near Tidnish may also reflect deposits of this type. The several values of the order of 5 ppm, in the Memramcook area, may be due to the small amounts of copper present in the Memramcook barite deposit mentioned above, or to similar deposits.

Higher than average lead values in general support the copper anomalies. Several of these are clustered around the Dorchester mine area, and are probably due to dump material from the mine, although no lead minerals have been reported from this deposit. No explanation can be offered for the lead anomaly north of Minudi station. Repeat samples from the same stream gave lower, but decidedly anomalous, values.

Higher than average values in zinc are much more widely scattered than those of the other metals. Again, these are concentrated around the Dorchester mine and are probably due to dump material. Elsewhere in the area north of Sackville, several streams gave appreciable values in zinc. Detailed sampling of several of these streams revealed that the anomalies were related to the pres-

ence of a coating of black manganese oxide on the stream sediment. In these streams, lead is concentrated to some degree as well. The significance of these anomalies can only be ascertained by more detailed geological and geochemical work.

### CONCLUSIONS

The results of the survey indicate that small increases in the heavy-metal content of stream sediments above background can be readily detected. In an area such as this, only small and isolated anomalies can be expected, and, for this reason, each must be examined on its own merits.

Several anomalous streams within the area are of interest, and merit further investigation. These include the stream systems near the Dorchester mine that drain areas uncontaminated by known dumps, the stream system north of Midgic station which contains anomalous amounts of lead, and the area in the vicinity of the Memramcook barite deposit.