

Parallels between paleoplacer development in northern Nova Scotia and southern New Brunswick

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Introduction

The potential for Upper Carboniferous rocks in northern Nova Scotia and southeastern New Brunswick to host paleoplacer gold deposits is being examined in light of new discoveries made in New Brunswick. Recent

mapping has led to a better understanding of strata in the area (Johnson and MacLeod, 1998). Upper Carboniferous rocks are present in the Sackville Subbasin of New Brunswick and the Cumberland Basin of northern Nova Scotia (Fig. 1). Johnson and MacLeod (1998) observed a relationship between local geochemical gold

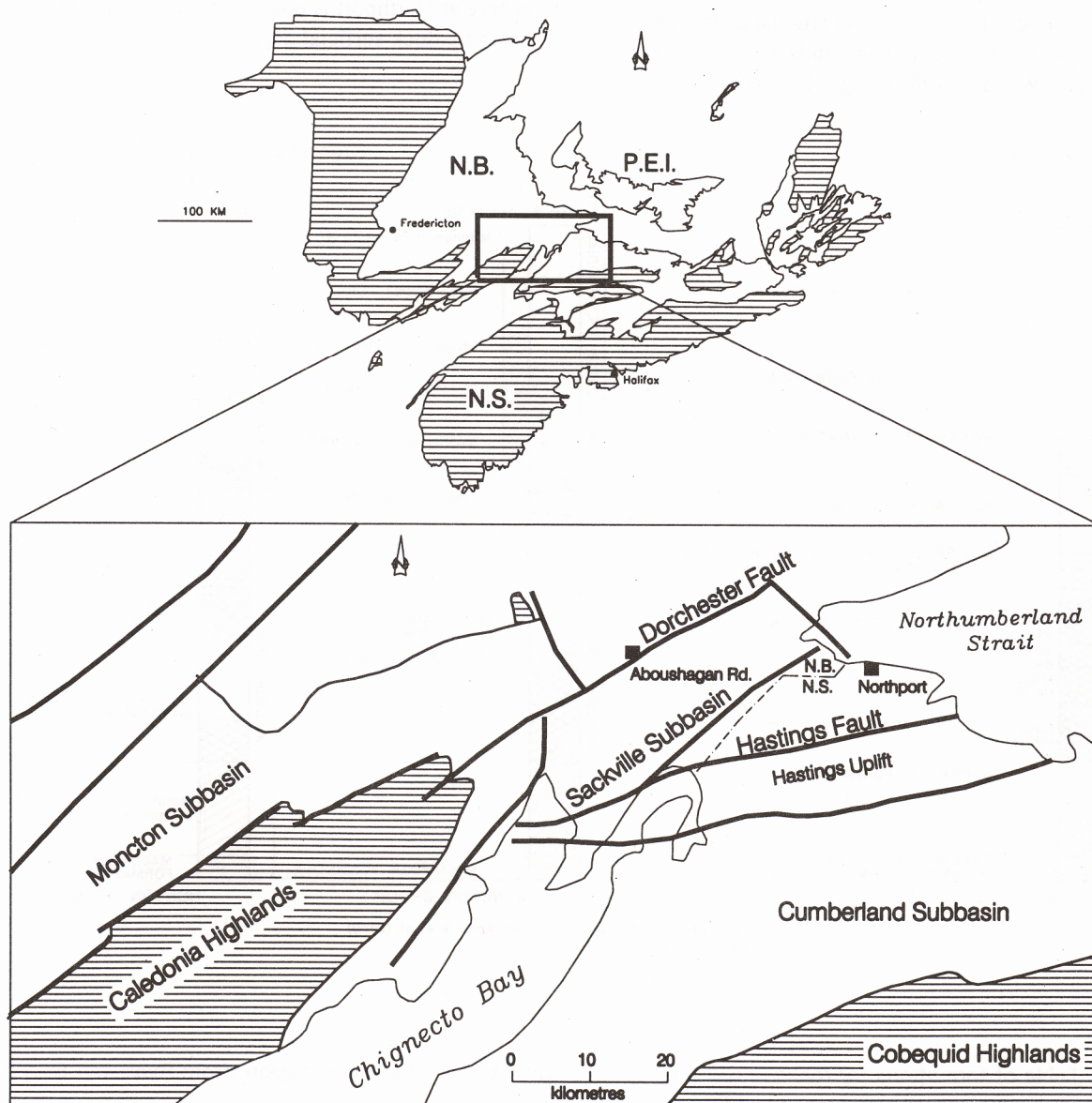


Figure 1. Location of the (New Brunswick) Sackville Subbasin in relation to major regional topography (after Johnson and MacLeod, 1998).

anomalies and underlying basement topography. This has lead to an interpretation that heavy mineral paleoplacer deposition is governed by a combination of paleotopographic and stratigraphic controls. Laterally equivalent rocks in Nova Scotia have displayed anomalous gold concentrations in stream sediments near the village of Northport, Cumberland County (Miller, 1987). Gold has also been panned from sand at Northport beach (Milner, personal communication, 1989).

Regional Geology

The oldest basement rocks in the region are Proterozoic gneiss and schist, and lower Paleozoic volcanic and sedimentary rocks of the Caledonia Highlands in New Brunswick and the Cobequid Highlands in Nova Scotia (Donohoe and Wallace, 1982) (Fig. 2). The basement

rocks are overlain by Silurian to Devonian meta-sedimentary rocks, some with intercalated volcanics. These rocks are overlain by fine- to coarse-grained, clastic sediments of the Early Carboniferous Horton Group. The top of the stratigraphic sequence includes Lower to Upper Carboniferous rocks of the Windsor, Mabou, Cumberland and Pictou groups (Ryan *et al.*, 1990), representing evaporitic and basin infill sequences consistent with marine regression, followed by a molassic sequence of coal measures and redbeds.

Northport is underlain by the Pictou Group. These rocks consist of silty to sandy, sometimes coarse-grained conglomerates representing a fluvial basin-fill sequence. Exposure at Northport is poor, and much of the area is overlain by thick surficial deposits.

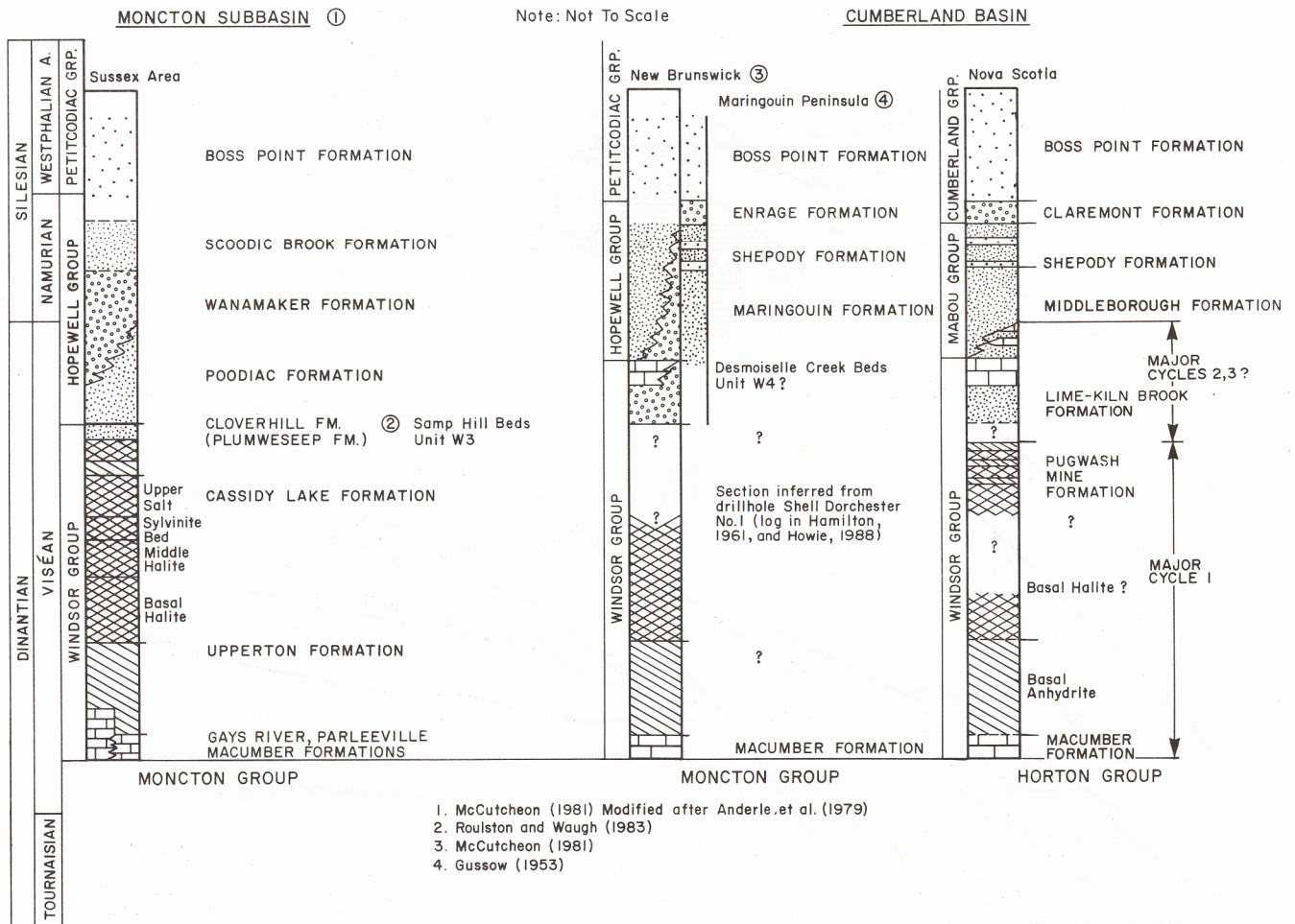


Figure 2. Table of formations for rocks in the Nova Scotia - New Brunswick border region (from Ryan and Bohner, 1994).

Regional Gold Anomalies and Paleoflow Association

Paleoplacer depositional models based on contact relationships have been common for many years and have been reviewed by Boyle (1987). A sedimentary model for deposits similar to those at Northport has been postulated in north-central Saskatchewan (Leckie *et al.*, 1998) where Cretaceous sediments of the Mannville Group display anomalous gold concentrations above a lithologic contact interpreted as an unconformity. The Cretaceous rocks above this unconformity record paleocurrent directions that indicate a clastic provenance from a suitable (Canadian shield) source.

Understanding the flow directions of ancestral streams that provided conduits between gold-bearing source rocks and sites of deposition is essential to exploration. In southern New Brunswick, paleoflow has been established for regional current directions (Gibling *et al.*, 1991). These regional directions suggest that rocks in the Northport area originated in the Caledonia Highlands, to the west-southwest of Northport (Johnson and MacLeod, 1998). Local paleochannels are believed to have also developed with sediment finding its way into the Moncton Subbasin from adjacent highland areas, including the Westmoreland Uplift (Fig. 3). The highland areas would provide suitable source rocks for paleoplacer gold deposition (Johnson and MacLeod, 1998).

Regional paleocurrent directions in the western part of the Cumberland Basin are from west-southwest close to the New Brunswick border, with a more northerly flow in the eastern Cumberland Basin, originating from the Cobequid Highlands (Fig. 4). Regionally, the Carboniferous basin-fill was derived from the Caledonia and Cobequid highlands, for the most part. These rocks are host to several small gold showings that would provide a suitable source for reconcentrated material (Northcote *et al.*, 1989).

Gold Anomalies at Northport and Southeastern New Brunswick

Geologist Michael W. Milner discovered that free gold could be panned from beach sediments at Northport in 1979 (Milner, personal communication). This occurrence was subsequently confirmed when a provincial government survey of stream sediment geochemistry revealed Northport as the location of a 99th percentile gold anomaly (Fig. 5). Considering the geology in the vicinity of Northport, with no known source of gold, this anomaly is considered to be remarkably strong. Three stream sediment samples taken from the area returned concentrations of 850 ppb, 806 ppb and 46 ppb, respectively, from material sieved smaller than the -230 mesh size (Mills, 1989). The 99th percentile threshold level for gold in this dataset, including the Cobequid Highlands, is 14 ppb. The bedrock source of the anomaly

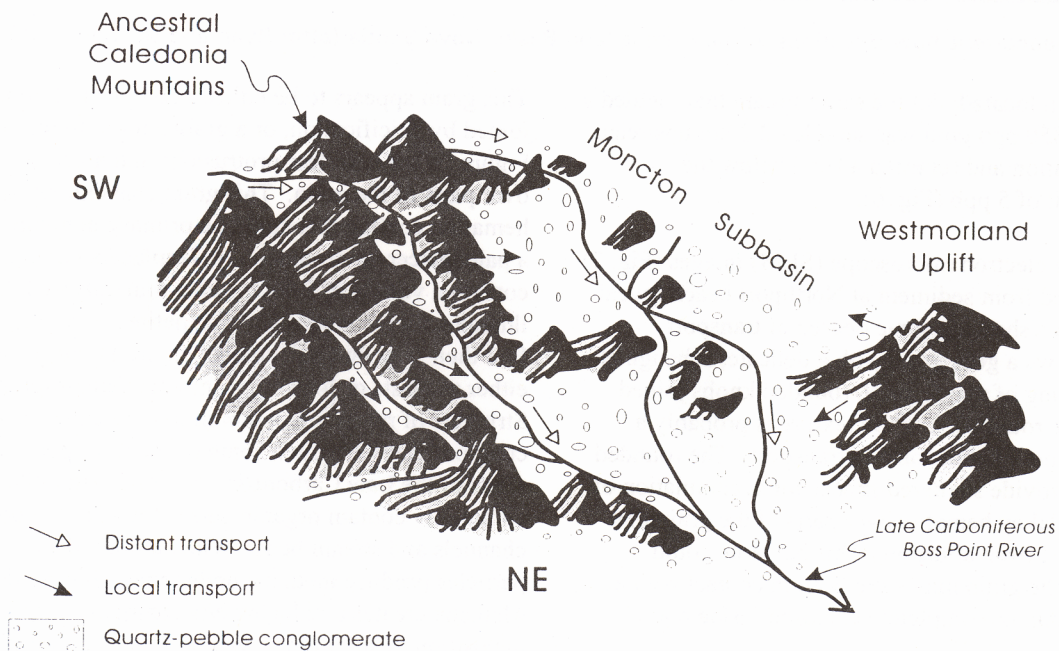


Figure 3. Inferred source rocks of the Sackville Subbasin, New Brunswick (from Johnson and MacLeod, 1998).

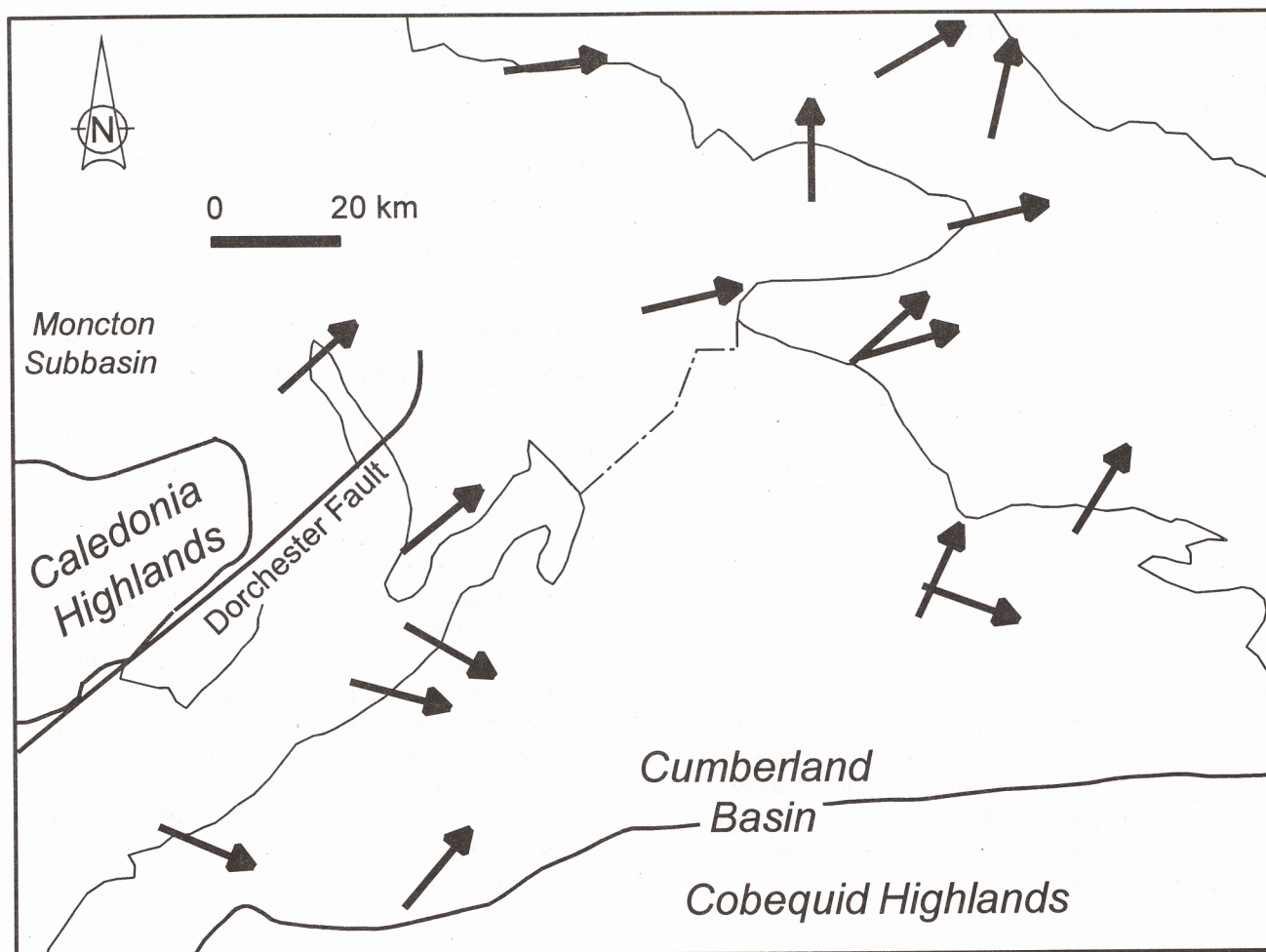


Figure 4. Paleocurrent flow directions in the Cumberland Basin, Nova Scotia (after Ryan and Boehner, 1994).

has never been located, but the same stream that yielded a sample with 850 ppb gold was sampled 2.2 km upstream from this location and returned a level below the detection limit of 5 ppb (Fig. 6).

Scanning electron microscope (SEM) images (Fig. 7) of gold panned from sediment at Northport beach reveal abraided grains showing some degree of transport. Figure 7a shows a gold grain with a delicate, subangular shape consisting of many small, rounded knobs joined together. The rounded, knobby texture is probably a nuggetty product of abrasion and transport. The rounded protrusions provide sheltered spaces for accumulation of a coating of flakey hematite over parts of the grain that were protected from abrasion. This hematite could indicate that the grain may have been in contact with a sulphide crystal, or completely enclosed inside one.

Figure 7b shows a gold grain with a different habit.

This grain appears to be either a composite of other grains joined by silicification, or a grain similar to that in Figure 7a but with less protrusions and a silicate coating over parts of the grain. This grain also exhibits a flakey hematitic coating that could be primary in nature or from a paleoplacer environment. Paleoplacers commonly contain a variety of heavy, stable minerals such as ilmenite, native metals and magnetite. Sulphides often find their way into paleoplacer environments as well, either as clasts or forming from later fluid migration. Stringers of pyrite are common in permeable rocks. Basal conglomerates are often some of the most permeable in strata of the Late Carboniferous. Basal lag units also commonly contain organic debris found at the bottoms of channels and stream beds. When buried, these organic particles produce methane under anaerobic conditions. Methane creates a reducing environment suitable for the deposition of sulphides invading strata in migrating solutions. The grain in Figure 7b also exhibits hints of a

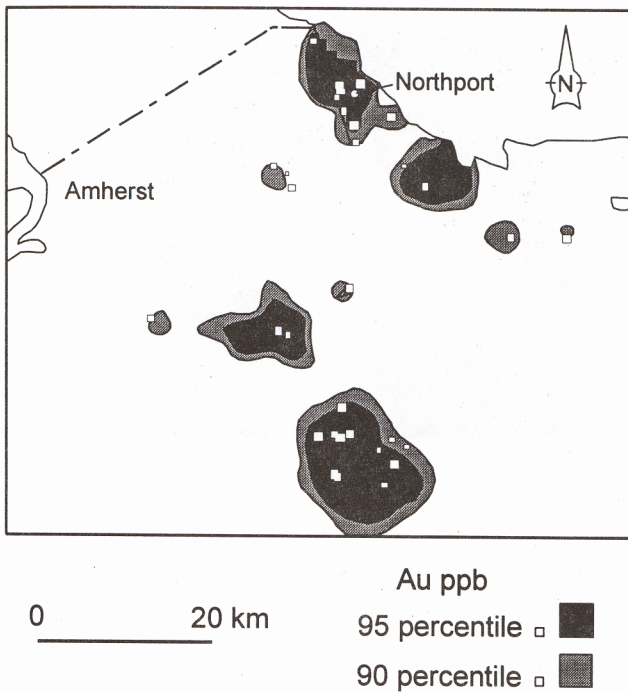


Figure 5. 90th (and greater) percentile gold anomalies of -230 mesh stream sediments for the Cumberland Basin, in the area around Northport, Nova Scotia (after Mills, 1989).

once wiry nature. One small bit of delicate wire protrudes from this grain on one corner. The grain has an overall subangular shape but exhibits nuggety characteristics on most corners, not unlike the grain in Figure 7a.

Several parallels can be drawn between Northport and the Aboushagan area of southeastern New Brunswick (Fig. 8) where gold was discovered in a boulder of veined, silicified sandstone in 1996 by prospector Emilio Doiron. This boulder yielded 11.5 g/t gold (Johnson and MacLeod, 1998). This area was known to host native copper visible in the peat of modern bogs (Gussow, 1953). The area was subsequently investigated for base metals in the 1960s (Dome Exploration Canada Ltd., 1964). Investigation has also focused on local structural features, such as fault scarps, in an attempt to find the source of these occurrences. Anomalous concentrations as high as 6.8 g/t Au have been found in samples of overburden along a local scarp (Mills, 1996). This scarp is interpreted to be a splay of the northeast-trending Dorchester Fault, a major structural feature in southern New Brunswick (Fig. 4).

The boulder at Aboushagan was investigated by Johnson and MacLeod (1998), who found that gold was enclosed in a quartz grain and, therefore, probably

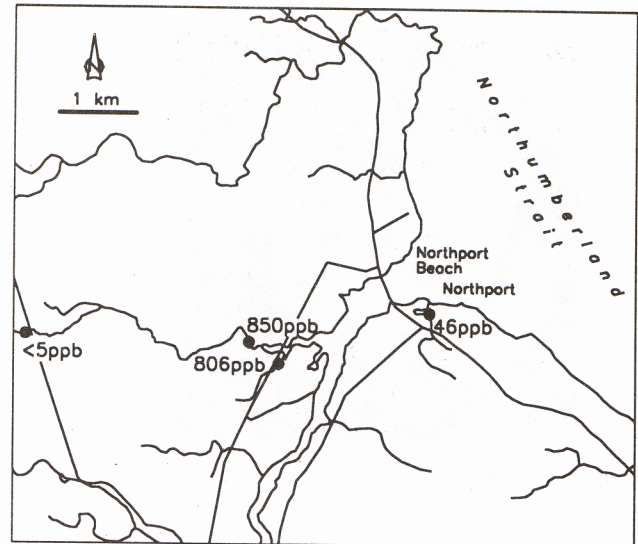


Figure 6. -230 mesh stream sediment gold anomaly levels for the area around Northport, Nova Scotia (after Mills, 1989).

paleoplacer in origin. Structural features such as fault scarps and bedrock contacts are interpreted as good exploration targets as they offer suitable basement topographic depression for fluvial concentration of heavy elements in ancient, buried environments.

Structural features present at Northport offer much of the same type of environment for deposition. Mineralized bogs have been documented in the Cumberland Basin (Feetham, 1996a and 1996b) and in the Cobequid Highlands as well (Smitheringale, 1928). Recently published vertical gradient aeromagnetic data (Geological Survey of Canada, 1994) reveal an anomalously low vertical gradient signature coincident with the unexplained stream sediment gold anomaly at Northport. This geophysical anomaly closely follows an inferred (buried) topographic depression (Fig. 9).

Conclusions

Paleoplacer gold occurrences in southeastern New Brunswick may be derived from a similar source as the Northport showing in Nova Scotia. It is conceivable that mineralization coincided with highland erosion and deposition in the Moncton Subbasin and Cumberland Basin. Additionally, paleoflow indicators in Nova Scotia suggest the Cobequid Highlands may have been a possible contributing source. It is also conceivable that gold present at the Northport anomaly could be formed from parental material derived from the Middle Devonian (and older) to Lower Carboniferous rocks of the

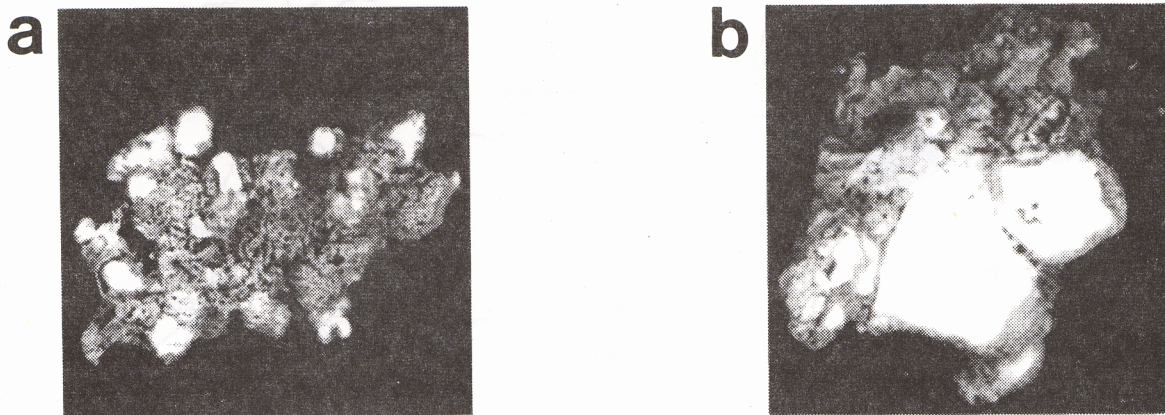


Figure 7. S.E.M. micrographs of gold grains taken from the beach at Northport, Nova Scotia.

Cobequid Highlands, which are known to host numerous, small gold occurrences. A placer deposit could form from distal material originally derived from the Cobequid Highlands by being re-concentrated in suitable environments along local paleotopographic sinks, such as contacts. This could help offer an explanation for the anomaly at Northport, as well as other small, unexplained gold anomalies in the Cumberland Basin.

Acknowledgments

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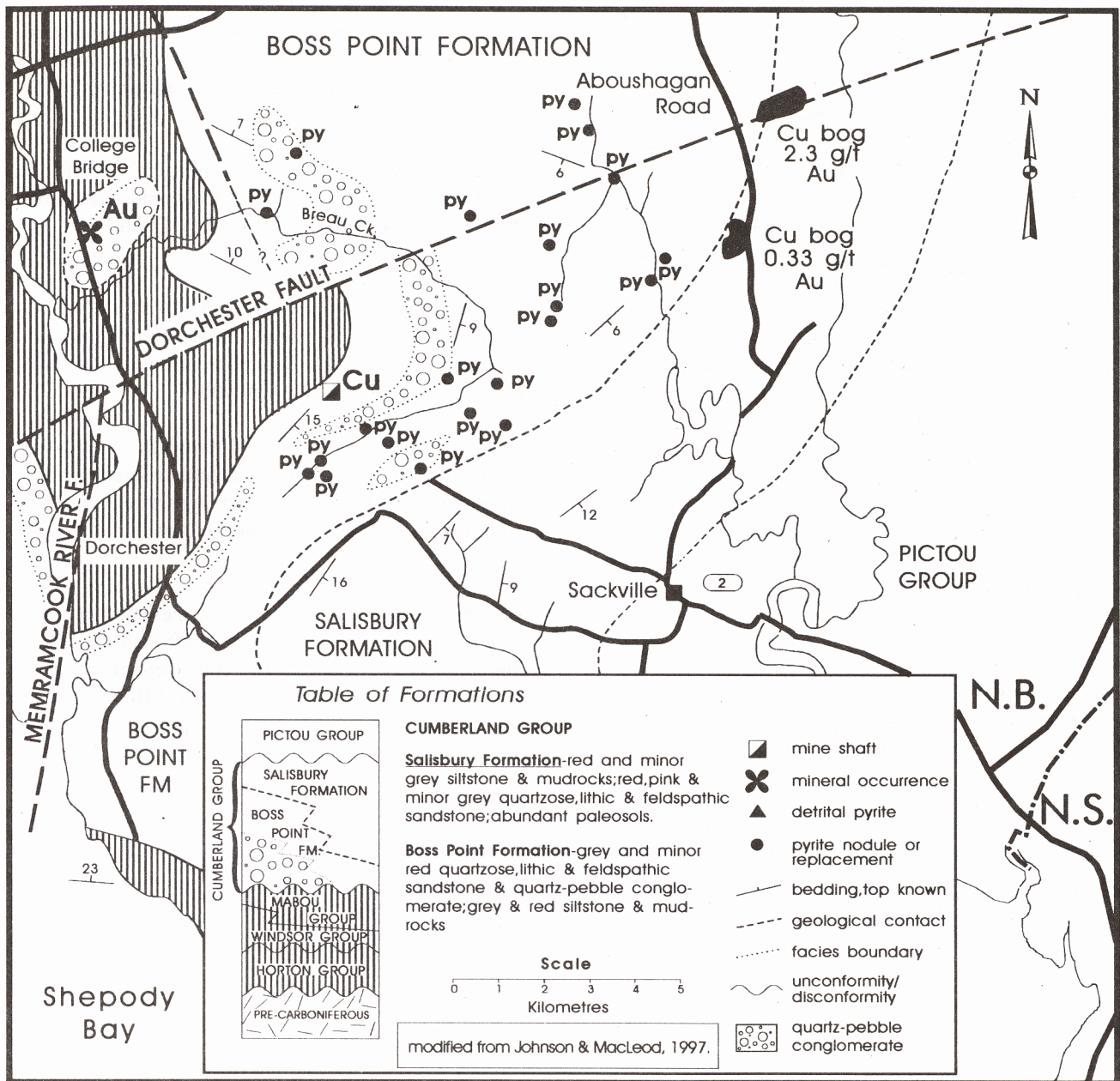


Figure 8. Proximity of Aboushagan gold anomaly and cupriferous bogs described by Gussow (1953) to the Dorchester Fault, southern New Brunswick (after Johnson and MacLeod, 1998).

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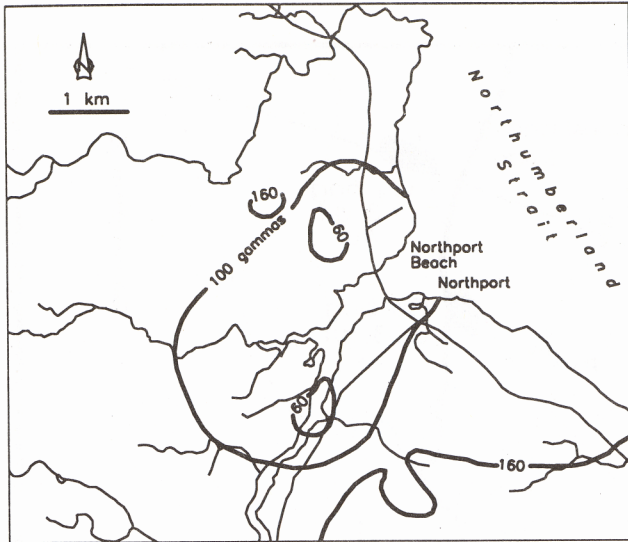


Figure 9. Vertical gradient aeromagnetic anomaly depression in the vicinity of the Northport gold anomaly. This anomaly for the Cumberland Basin, in the area around Northport, Nova Scotia could be interpreted as a basement depression (after Geological Survey of Canada, 1994).

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