Mapping a Tensional Shear-related Auriferous Zone in the Meander River at Greenhill, Hants County

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The Meander River area of Hants County has been known to produce sporadic returns of gold from placer investigations that have taken place there for over a century (Mills, 1994). It is rumored that in the 1870s a prospect along the river between MacKay Section and Ashdale provided enough gold to sustain a small, two man tributing operation for two years. Close to MacKay section an adit is visible on the south bank of the river, not far upstream from the bridge. Quartz veins outcrop approximately 300 to 500 m upstream from this location.

Roland Anthony, a local self-employed tradesman and part time prospector, began to prospect the area in the late 1980s with a small, portable trommel and sluice. By trenching the alluvium along this section of the river he proved the presence of gold in economic quantity (Jensen and Anthony, 2000). Mr. Anthony continued his work assessing the potential of the river over the following decade by moving farther upstream every year, continually assessing the alluvium with a sluicing technique that he continued to improve. Further assessment would prove more fruitful.

In 2008 Mr. Anthony moved into a section of the river between Greenhill and South Rawdon to assess its potential (Fig. 1). He determined that this section of the river has a strong potential to carry alluvial gold, especially at the alluvium/bedrock interface. The author, under the Nova Scotia Department of Natural Resources policy of exploration assistance, became focused on this site of previously unrecognized gold potential. The main objective is to assist with interpretation and understanding as to why there is more gold along this river section and to predict where additional gold-rich zones might be present upstream or out from the stream bed.

Local Geology

Mapping was carried out by the author along the river section in the summer of 2010. The section is underlain mainly by slate (pelite) of the Cambrian to Ordovician Halifax Group, interrupted by short sections of (1) well sorted, massive quartzite (psammite), (2) graphite-rich, friable, sheared layers, and (3) veins of massive quartz. This reflects a genetic history of deep water bed development under calm conditions, broken by periodic, sudden introduction of well sorted offshore sands connected to onshore flooding events on the side of, or close to, relatively steep marine topography. These sections were subsequently invaded by silica-rich fluids synchronous with regional faulting, resulting in development of hydrothermal veins along dip-slip shear zones. Veins occur on a large scale as massive, thick quartz veins and on a smaller, bedding scale as diffuse invasions resulting in ladder vein development close to, but oblique to bedding. The episode of shearing is revealed by very sheared and friable sections where faults intersect the pelites, as described by Horne et.al. (2001). These features may be seen at locations 3 and 7 on the mapped section (Fig. 2). At location 3 (Fig. 3), a displaced block is noted where a large fault intersects the stream at a bend in the river, and at location 7 (Fig. 4), highly friable and graphitic pelite is exposed in the stream bank.

Quartz Veins

Quartz vein rubble is present in abundance in several areas along the river section, and is also evident in alluvium in the stream bed as quartz gravel, cobbles and rare boulders as large as 0.5 m^3. Massive fluid inclusion-rich (milky) quartz

Mills, R. F. 2011: *in* Mineral Resources Branch, Report of Activities 2010; Nova Scotia Department of Natural Resources, Report ME 2011-001, p. 111-118.

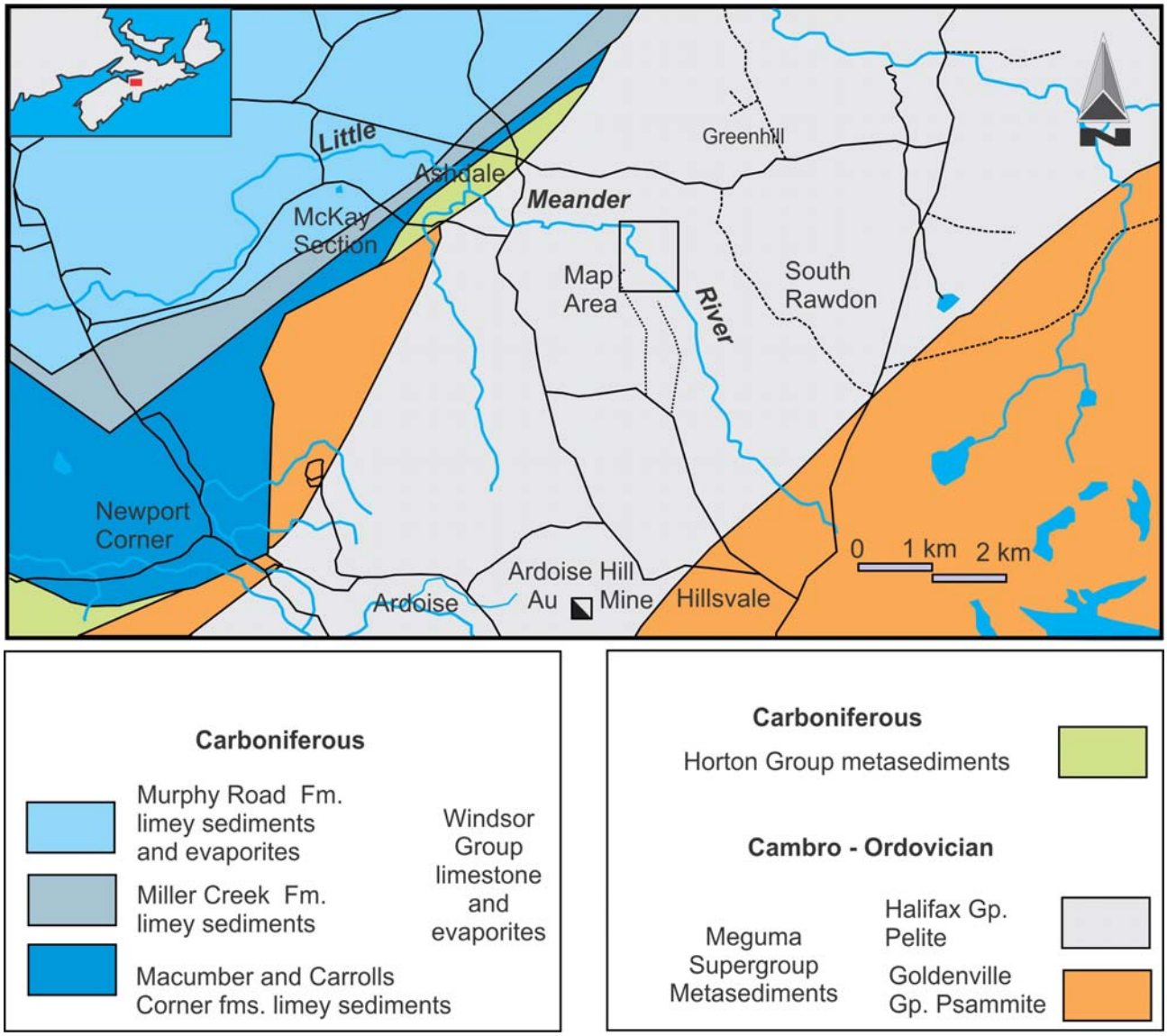


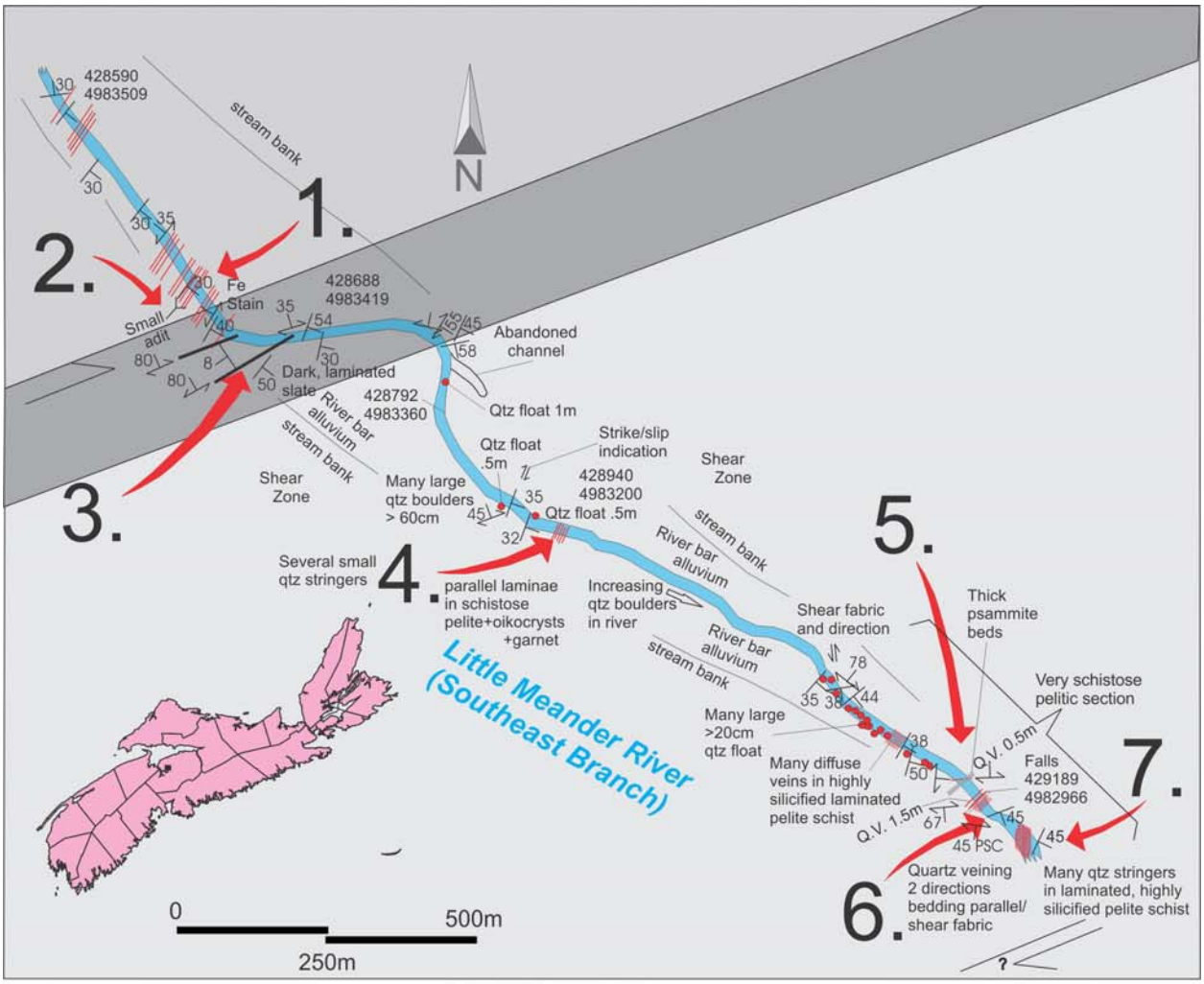
Figure 1. Geology of the western Rawdon Hills region and location of the Meander River section mapped in this study.

veins as thick as 35 cm cut obliquely across bedding in the stream (Fig. 5).

One quartz vein package, near the downstream end of the mapped section, has attracted prospectors for many years and has been excavated to such an extent that a short adit has been created in bedrock in the wall of the stream bank.

Most of the section has seen large-scale quartz fluid invasion and replacement, changing the original pelite to a much more siliceous nature. The massive veins appear to have been emplaced quickly as part of a fluid over-pressure release system. This is suggested by their milky white appearance and abundance of fluid inclusions. The diffuse, widespread silica replacement does not reflect the same character of sudden pressure release, and consists of clear to oily looking quartz for the most part. These different phases of quartz emplacement suggest at least a two-fold history of hydrothermal activity for the rocks seen in the section.

Quartz veins, as opposed to massive silica alteration, are seen in the section and they are oriented slightly oblique to bedding. Dip-slip faults are predominant in the section (R. J. Horne, personal communication). This bedding-oblique orientation is also noted on a thin, sub-millimeter



Notable quartz boulder

Psammite bed > 0.3 m thick

quartz vein

6. Corresponds to features described in this report

428855
4983250 Universal Transverse Mercator (UTM) projection grid location

Glen Brook Pelite. Schistose, highly silicified pelite often displaying large-scale replacement by chlorite, dominated by muscovite along cleavage development, displaying oikiocrysts oriented along cleavage; often accompanied by abundant garnet and secondary pyrite, arsenopyrite, quartz veins and quartz-carbonate veins. Minor intercalated beds of silicified psammite up to 2 m thick. Some fluid invasion events manifested by relatively thick (up to 40 cm) quartz veins sub-stratabound through the section.
Zones of northeast-trending shear in the map area are often marked by highly graphitic sections of brecciated pelite.
Significant placer gold is found throughout the section.

Pelite. Highly graphitic and brecciated. Broken bits of quartz and shattered veins in matrix. Secondary sulphides common.

Cunard Unit Pelite. Highly silicified pelite, marked by abundant stratabound quartz veins from stringer to tens of centimetres thick. Widespread secondary pyrite common, arsenopyrite, quartz veins and quartz-carbonate veins, and Fe gossan. Some quartz invasion manifested by relatively thick quartz veins. Highly graphitic sections of brecciated pelite are also noted.
Significant placer gold is found throughout the section.

Figure 2. The South Branch Meander River section, Greenhill Falls area, mapped in 2010.

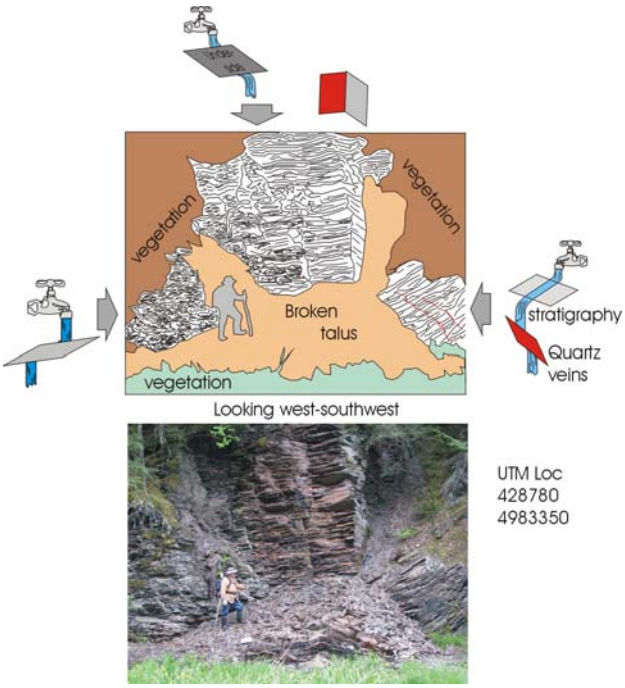


Figure 3. Displaced block close to the north end of the mapped section (location 3, Fig. 2).

scale (Fig. 8). Veins appear to infill dip-slip structures.

The geometric relationship between these veins is further explained in Figure 9, which displays directional relationships between the beds, the faults, the veins and the general river direction.

Regional Faulting

Regional faulting along this section of the river is manifested by major zones of east/northeast to west/southwest intense shear. The shear zones are marked by sections of highly graphitic, friable pelite. Close to the shear zones, hydrothermal quartz veins, oriented oblique to bedding, northeast to southwest, intrude the extensional environment consistent with a dilational intrusion system (Fig. 3.). The extensional environment has resulted in emplacement of a series of en echelon dilational veins. The veins follow a northeast trend within an east-northeast trending zone of shear. The difference between the shear zone trend and the oblique vein emplacement direction is approximately 38 degrees, which is consistent with the extensional model.

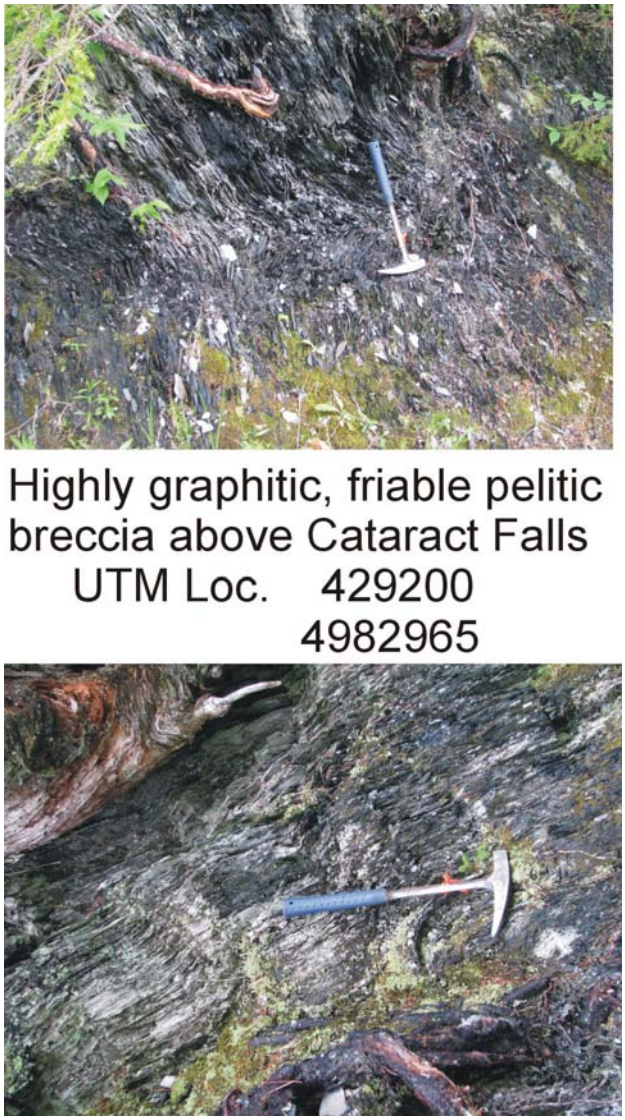


Figure 4. Pelitic breccia seen near falls on the Meander River section (location 7, Fig. 2).

Discussion

Placer deposits are classified depending upon provenance, sorting and subsets of different depositional environments (Stanaway, 2010). For the most part, classification consists of five main placer environment types: eolian, washout, river, beach and continental shelf. By the time placers are formed into economic sized deposits, they often go through a complex chronology of development that consists of elements of more than one model type. Each placer type may further be divided into, “denudation” or “accumulation” types as well,

Figure 5. Massive veins in the Meander River at location 5, Figure 2.

resulting in ten separate models. Of these ten models, the river systems that provide a combination of denudation and accumulation are some of the most complex, intensely studied and fascinating. The placer gold found at Meander River fits into this river denudation category, as well as having elements of the washout model since all of Nova Scotia is well glaciated. This is common to Nova Scotian placer development (Mills et al., 2005). There are also plenty of indicators to suggest that the entire bedrock foundation along the Meander River has the potential to host lode gold. Veins at nearby Hillsvale (Fig. 1) occur along the same anticlinal structure as the occurrence at Greenhill (Horne et al., 2005). Veins at Ardoise have been mined in the past (Faribault, 1908). Placer gold is found over the section at Greenhill (Anthony, personal communication), but it is not known whether the gold at Greenhill originates from the quartz veins, the diffuse silicate-altered zone, an upstream section, or glacial tills now eroded away.

The topography of Nova Scotia has been affected by multiple glacial advances and retreats (Stea et al., 1989). The Meander River consists of a modified, dendritic drainage pattern that drains a basin bordered by a regional horst and graben that has developed north of the Rawdon Hills Anticlinorum (Horne et al., 2005). Large outwash plains developed as ice phases melted, leaving outwash over much of the province.

These outwash plains are present today in the Rawdon area and often produce economic deposits of gravel and other aggregates that need no crushing prior to sale (D. Meehan, personal communication, 2007). The dendritic drainage

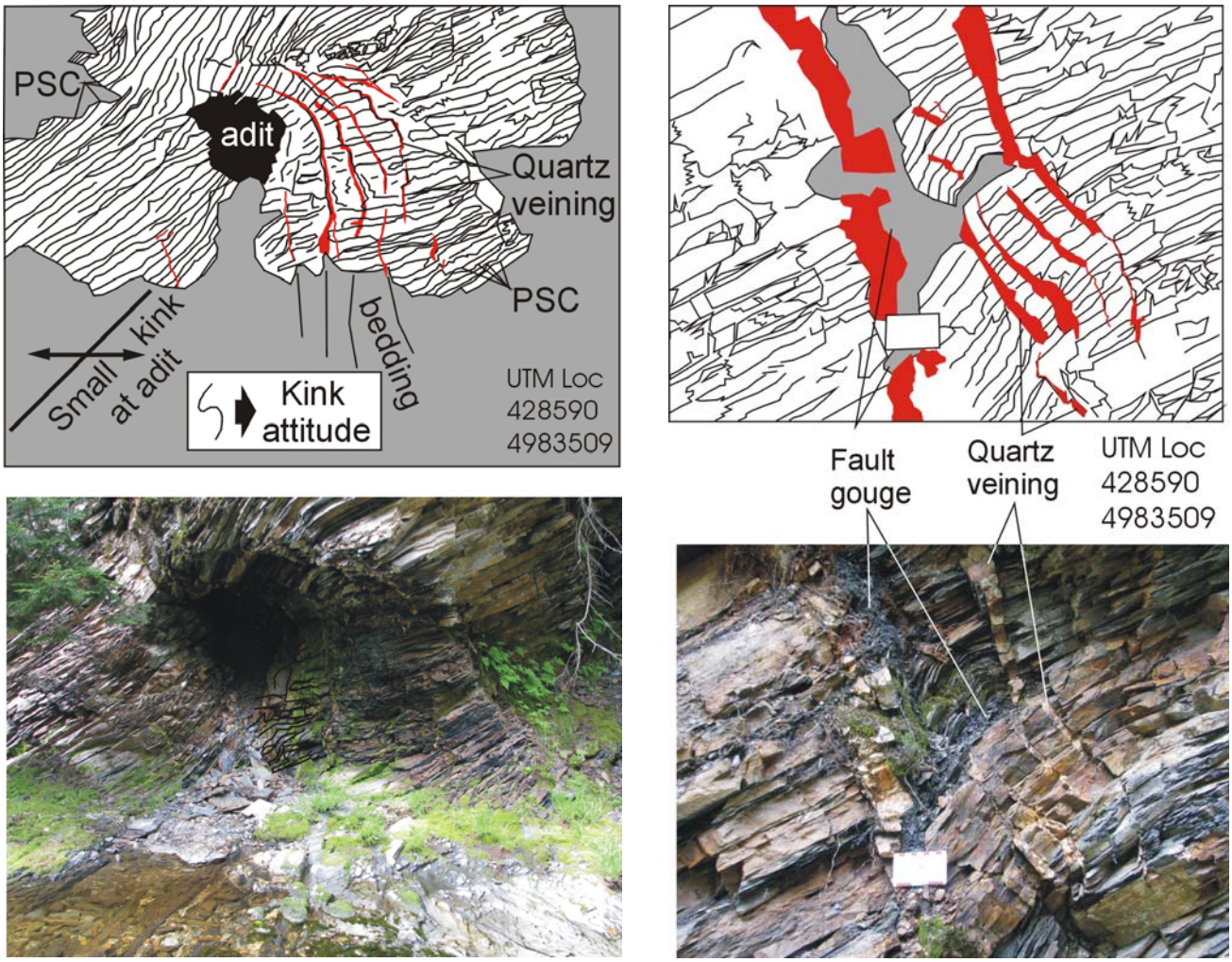


Figure 6. Adit seen close to the northern extremity of the section mapped in 2010 (location 2, Fig. 2).

pattern that developed after glaciation intercepted many of these outwash deposits as stream cuts developed through buried outwash and channel gravels and denuded them. This process further concentrated heavy elements that were present in the outwash, and in the local and hybrid tills that bordered or were overlain on them, accumulating modern placer deposits in streams in Nova Scotia such as the Meander River (Mills, 1992). These deposit types have been described as carrying potential for economic development in Nova Scotia (Stea et al., 2005).

The Meander River has formed river bars in a meandering stream environment overlying bedrock consisting of Cambro-Ordovician Meguma Supergroup rocks to Lower Carboniferous Horton Group metasediments. Placer gold in the Meander River is found in environments related to cracks and jointing systems in bedrock, river bar channel lag at the base of stream bars in the river overbank or flood plain, and active sediment and channel lag in the stream itself (Anthony, 2007).

Lode gold deposition in the vicinity of the Meander River area could have followed two directions. The trend of east/northeast regional faults should be followed and explored further for oblique vein emplacement along the trend. This direction lines up well with Rawdon Gold Mines, a former gold producer and well established gold district.

En echelon dilational vein development following a more northeast trend is also a possibility and should be explored further. This trend lines up with Centre Rawdon, another Nova Scotia gold district and former gold producer. The axis of the Central

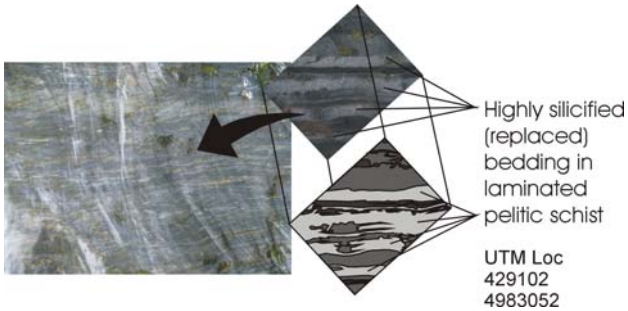
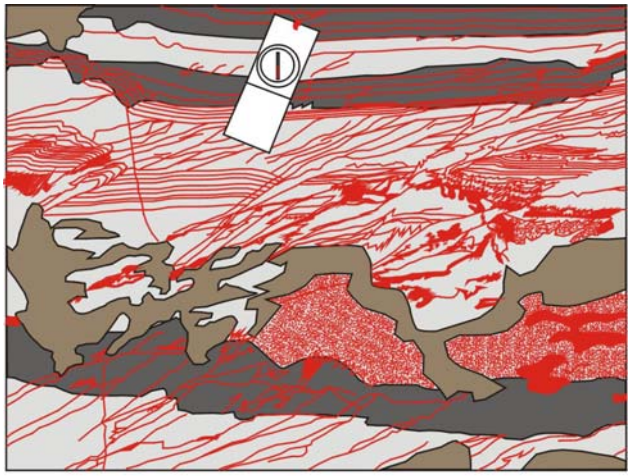


Figure 7. Large-scale, pervasive silica alteration seen at location 4 in Figure 2 in the Glen Brook pelite. The Glen Brook pelite is a member of the Halifax Group pelitic package. The type section for this unit is exposed in Glen Brook, in the Rawdon area, and has been described as a mapped unit in the area by Horne et al. (2001).

Rawdon anticline, while not seen over the mapped section, is believed to be very close.



UTM Loc. 429189
4982966

Figure. 8. Oblique veins in the Meander River section seen near the falls at the southern end of the section.

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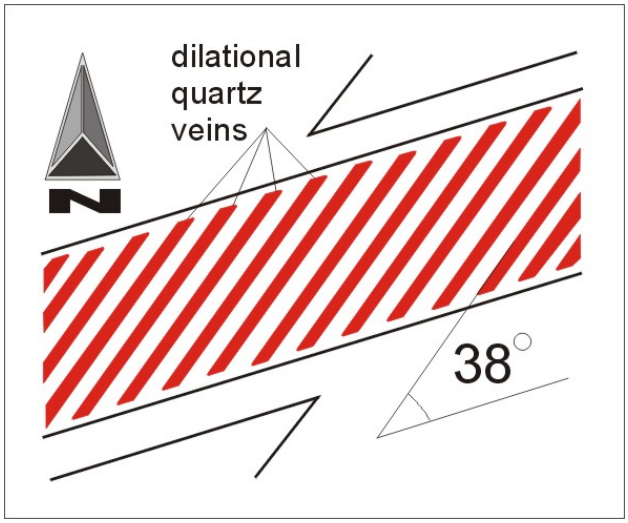

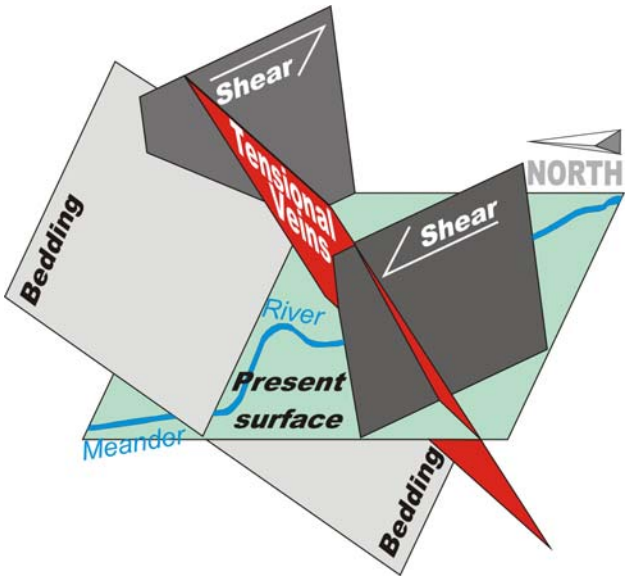

Figure 9. Relative relationship between bedding, shear direction, extensional veins and river direction in the Meander River at Greenhill, Hants County.

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