Current Research (1995) Newfoundland Department of Natural Resources, Geological Survey, Report 95-1, pages 139-144

MIDAS POND GOLD PROSPECT, VICTORIA LAKE GROUP, CENTRAL NEWFOUNDLAND: A SHEAR-HOSTED QUARTZ VEIN SYSTEM

D.T.W. Evans and D.H.C. Wilton[1]
Mineral Deposits Section

ABSTRACT

The Midas Pond gold prospect is hosted by sheared and altered felsic and mafic pyroclastic rocks of the Tulks Hill volcanics, Victoria Lake Group. Alteration and mineralization are confined to a 200-m-wide, brittle, ductile-shear zone, which formed in response to regional D_1 deformation. D_2 deformation resulted in broad Z-shaped flexuring of the shear zone accompanied by an inhomogeneously developed fracture cleavage (S_2).

Gold occurs within three structurally controlled vein sets that are confined to the contact between a highly deformed mafic breccia (banded mafic unit) and the structurally overlying, altered felsic pyroclastic rocks. These veins are: V_1 boudinaged veins developed parallel to the shear-zone fabric (C-shear veins), and V_2 and V_3 extensional fracture veins. V_1 veins are the earliest set and contain the lowest concentrations of gold. V_2 and V_3 veins appear to be concentrated within the hinges of the D_2 flexures and their distribution is controlled by the S_2 fracture cleavage. Both the V_2 and V_3 veins locally exhibit vuggy and comb textures.

INTRODUCTION

The Midas Pond gold prospect (Plate 1) was discovered by BP Canada Incorporated in 1985 as part of a re-evaluation of ASARCO Limited archived soil samples. The prospect has been trenched and tested by 19 diamond-drill holes. Midas Pond is located in south-central Newfoundland approximately 50 km southwest of Buchans (Figure 1). The prospect was the focus of a M.Sc. study (Evans, 1993), which was initiated in 1986 as part of detailed metallogenic studies of the Victoria Lake Group (Kean, 1985; Evans and Kean, 1987; Evans *et al.*, 1990). The object of the Midas Pond study was to document the geology and alteration of the prospect.

Access to the area is provided by privately owned gravel logging roads that originate at Millertown, a small community on the shores of Red Indian Lake, approximately 70 km to the northeast. The prospect is reached by a twenty-five minute walk from the nearest road.

Plate 1. *Aerial view of the study area. Glitter Pond is in the foreground, Tulks Valley (Tulks Valley fault) in the distance. Midas Pond is the narrow pond located between the two bogs to the left of Glitter Pond.*

GEOLOGY

The study area lies within the Dunnage Zone (Williams, 1979), which records the development and subsequent destruction of an early Paleozoic Iapetus Ocean. The Dunnage Zone has been subdivided into Notre Dame and Exploits subzones, which are separated by an extensive fault system called the Red Indian Line (Williams *et al.*, 1988).

The Midas Pond prospect is located at the southwest end of the Cambro-Ordovician Tulks Hill volcanics, Victoria Lake

---

[1] Department of Earth Sciences and Centre for Earth Resources Research, Memorial University of Newfoundland, St. John's, Newfoundland, Canada, A1B 3X5

Group (Figure 1). The Victoria Lake Group lies within the Exploits Subzone immediately south of the Red Indian Line. The group is a structurally complex assemblage of Cambro-Ordovician island-arc and back-arc volcanic, volcaniclastic and epiclastic rocks that have been metamorphosed in the lower greenschist facies and subjected to inhomogeneous regional deformation (Evans *et al.*, 1990).

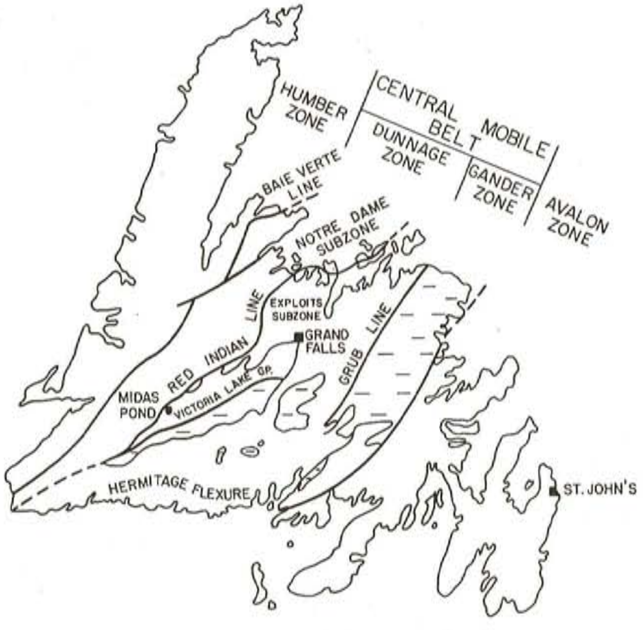

Figure 1. *Tectonostratigraphic map of Newfoundland showing the location of Midas Pond, and the Victoria Lake Group (modified after Williams* et al., *1988; Swinden* et al., *1988).*

Rocks in the Midas Pond area are subdivided locally into 4 units (Figure 2), which include: Unit 1, coarse mafic breccia; Unit 2, mafic, feldspar-crystal tuff; Unit 3, felsic, quartz-, feldspar-crystal tuff, lapilli tuff and breccia; and Unit 4, a deformed breccia called the banded mafic unit. All rock units are variably deformed by a 200-m-wide, northwest-dipping shear zone that transects the Midas Pond area.

Alteration, spatially associated with the gold mineralization at Midas Pond, has an estimated strike length of 800 m and a width of 70 m. Within the shear zone, the alteration is pervasive, but it is most strongly developed in the structural hanging wall to the mineralized veins. It exhibits a zonation from weakly altered mafic tuffs at the northern shear zone margin to highly altered felsic tuffaceous rocks and mafic breccia proximal to the veins. Two styles of alteration are present within this zone, these are: 1) epithermal-like, argillic-advanced argillic alteration accompanied by localized silica remobilization and albitization; and 2) widely developed pyritization and carbonatization that overprint the argillic alteration.

STRUCTURE

Two episodes of deformation affected the Midas Pond area. The earliest deformation (D_1) produced the regional, east-northeast-trending, penetrative foliation (S_1) characteristic of the Victoria Lake Group (Kean and Jayasinghe, 1980; Evans *et al.*, 1990). Kean and Jayasinghe (1980) interpreted this east-northeast-trending foliation to be, in part, related to major regional faults that were active during the Silurian. In the Midas Pond area, this foliation trends 52°/85°NW and is defined by chlorite, mica, flattened crystal augen and pyroclastic fragments.

The Midas Pond prospect occurs within a 200-m-wide, northeast-trending, steeply dipping shear zone (Plate 1). The shear zone consists of a system of smaller, anastomosing high-strain zones preserved as pyrophyllitic and micaceous schists, which wrap around more competent, lozenge-shaped siliceous pods. Trends within the shear zone approximately parallel the regional northeast-trending S_1 cleavage. The shear zone is interpreted to be related to D_1 deformation.

The second phase of deformation observed at Midas Pond (D_2) is preserved as: 1) broad, asymmetrical Z-shaped flexures of the shear zone (Figure 2), defined by variations in the shear-zone foliation and its contained elements; 2) a fine crenulation cleavage; 3) conjugate kink bands, and 4) a prominent fracture cleavage (S_2).

The largest of the Z-shaped flexures extends from approximately line 44+00 to line 48+00 and is visible as a slight bend in the shear-zone boundaries on Figure 2. Along this flexure, variations in the shear-zone foliation are as follows: line 44+00, 43°/64°NW; line 45+15, 70°/52°N; and, line 48+00, 45°/60°NW. A smaller flexure is located between lines 42+00 and 43+00.

A fine crenulation cleavage dipping 40° toward 273° is preserved within the schistose felsic rocks exposed in trench 45+15. This trench is located immediately north of Midas Pond near the shear-zone margin. In thin section, this cleavage defines the intersection of the S_1 foliation with a sigmoidal-shaped fabric that is defined by wispy pyrophyllite and mica. This cleavage appears to be restricted to the flexured portions of the shear zone and adjacent country rocks and is therefore considered to be a D_2 fabric.

Both S- and Z-shaped kink bands (locally conjugate sets) are preserved within the Midas Pond shear zone. These structures fold or kink the shear-zone fabric with little apparent brittle offset. Both sinistral and dextral offsets are exhibited by these kink bands. The kink bands have the same orientation as a prominent, conjugate fracture cleavage that is developed throughout the shear zone. The average orientation of this fracture cleavage is: S_2, 144°/79°SE, and S_2', 64°/79°SE. The kink bands are locally tightly folded.

AURIFEROUS QUARTZ VEINS

Dilational structures containing quartz veins occur along the entire length of the shear zone. However, the auriferous quartz veins are only developed near the contact between the banded mafic unit and a structurally overlying unit of altered

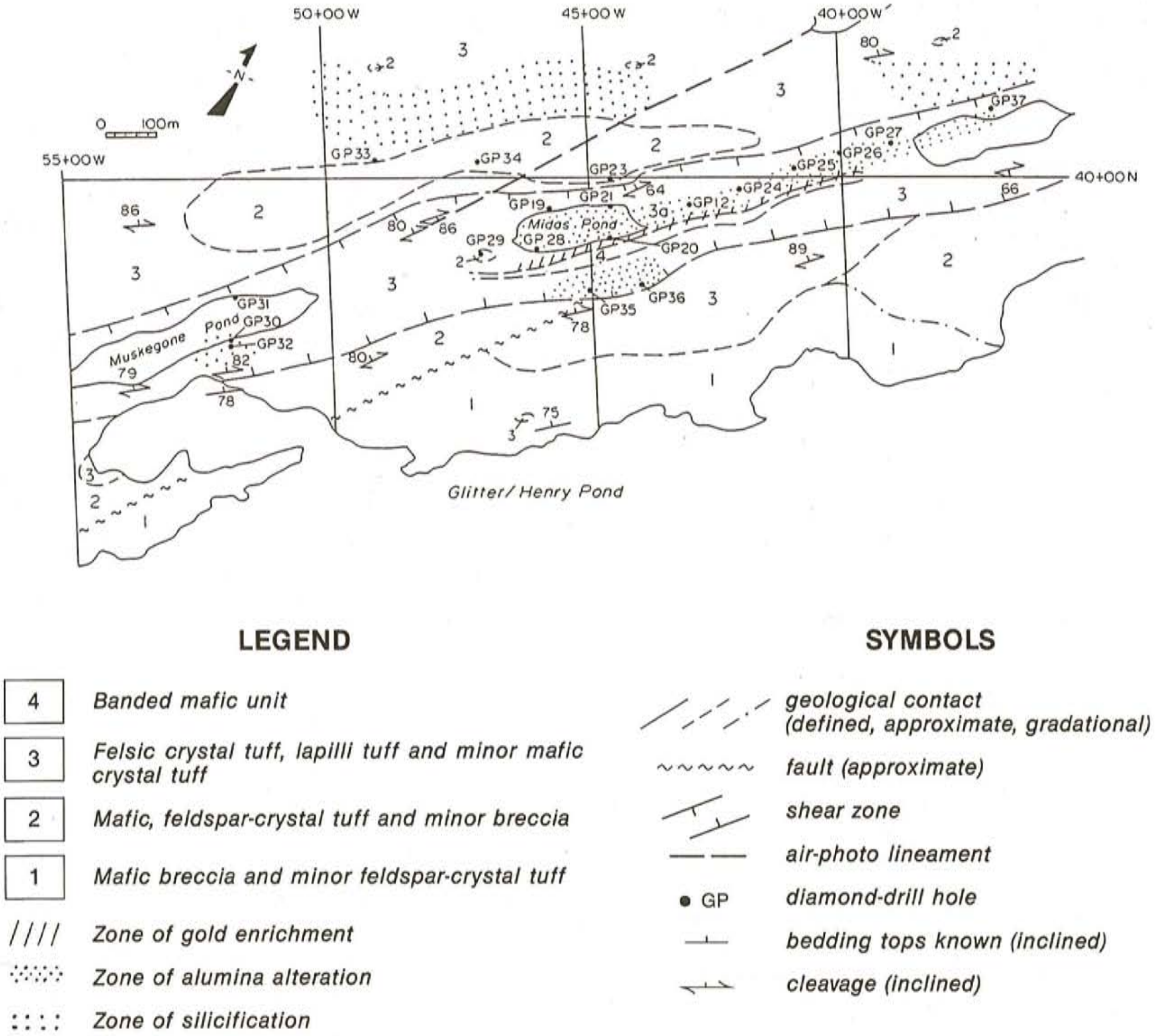

Figure 2. *Geology of the Midas Pond area.*

felsic volcanic rocks. These veins occur over a strike length of approximately 800 m and a width of 10 to 12 m. Over much of the strike length the veining is narrow, but there are locally thicker concentrations of veins (7 m wide in trench 45+00), which appear to coincide with the flexures.

Three sets of fracture-controlled auriferous quartz veins (V_1, V_2, and V_3) are developed along the contact between the banded mafic unit and the altered felsic volcanic rocks. V_1 veins are the earliest veins and are considered to be related to D_1 structures. These are central shear veins (after Hodgson, 1989) that parallel the shear-zone fabric (Plate 2). Figure 3 illustrates the relationship between V_1 and S_1. The average trend of these veins is 55°/81°NW, the average trend for the shear-zone fabric is 52°/85°NW. They contain coarse-grained, milky-white quartz, rusty carbonate and minor pyrite. A grab sample from one of these veins exposed in Trench 46+00 assayed 1150 ppb Au.

Veins 2 and 3 ($V_{2,3}$), which occur in crosscutting D_2 structures, are extensional fracture veins (Plate 3), which have average orientations of 54°/76°S (Vein 2) and 124°/71°S (Vein 3), respectively. Vein 2 is developed approximately parallel to the weakly developed fracture cleavage S_2', which has an average orientation of 64°/79°SW. Vein 3 is developed approximately parallel to the prominent fracture cleavage S_2, which trends 144°/73°SW. The relationship between these vein sets and the fracture cleavages is shown on the equal area stereographic projection (Figure 3).

V_2 and V_3 veins consist of milky-white, coarsely crystalline quartz having locally developed comb structures and vuggy quartz-lined cavities. The veins are generally thin, less than 1 cm, but locally are up to 1 m thick; sections with multiple veins are up to 7-m thick. These veins formed in a relatively strain-free domain.

Plate 2. *Boudinaged, V_1 quartz veining developed parallel to the shear-zone fabric. These veins have anomalous gold concentrations.*

Plate 3. *Vein network formed by V_2 and V_3 quartz veins, Trench 46+00.*

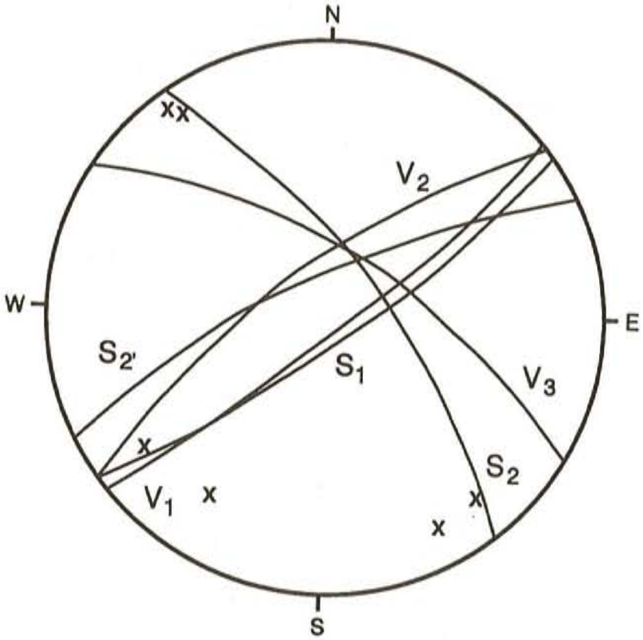

Figure 3. *Equal area stereographic great circle projections of the average orientation of: a) the shear-zone fabric, S_1 (87 measurements); b) the fracture cleavage, S_2 and S_2' (18 measurements); c) shear central veins, V_1 (4 measurements), and d) extensional fracture veins, V_2 and V_3 (12 measurements).*

Figure 4 is a schematic diagram that illustrates the orientation of the S_1 foliation and S_2 fractures and their relationships to the V_1, V_2 and V_3 veins. The location of the veining is primarily controlled by the intersection of these D_1 and D_2 structures with the banded mafic unit. Slightly thickened sections of veining (V_2 and V_3) appear to coincide with the flexures. Therefore, the hinges of these flexures may form the best target for gold exploration.

Surface exposures of the V_1 veins are limited, therefore, making petrographic comparisons with the V_2 and V_3 veins difficult. In diamond-drill core it is not possible to distinguish between V_1, V_2 and V_3 veins, hence petrographic descriptions are from vein samples collected from outcrop. Thin-section analyses of V_1 veins indicate that these veins contain deformed and recrystalized quartz, minor wispy mica and small oxidized pyrite cubes. Tourmaline was not observed in thin section, however, it was observed in some hand samples.

The V_2 and V_3 veins are mineralogically similar, containing large patches of Fe-carbonate, pyrite, chlorite, fine-grained pale-green paragonite, pyrite and fine needles of tourmaline. Thin-section analyses indicate that both vein sets contain coarse crystals of variably deformed quartz, Fe-carbonate, paragonite, pyrite, plagioclase, chlorite, tourmaline and minor pyrophyllite. Abundant CO_2-rich fluid inclusions are present in the large quartz crystals.

Pyrite within the V_2 and V_3 veins occurs as fine disseminations, coarse-grained patches and as single euhedral crystals up to 2 cm in diameter. Pyrite also forms stringers that crosscut the quartz veins. Patches and single crystals of pyrite occur along the vein margins.

Gold is associated with the pyrite and occurs as inclusions, veinlets developed along fractures and as patches developed along the margins of the pyrite grains. Gold values are sporadic along the strike length of the mineralized zone. Selected gold assays include 7.3 g/t over 0.9 m from diamond-drill hole GP-21 and 14.74 g/t over 1.15 m in Trench 45+10 (Barbour *et al.*, 1988). Background gold values in both mafic and felsic units outside of the mineralized zone are generally less than 5 ppb. Host rocks to the quartz veins have slightly elevated gold values associated with pyrite.

SUMMARY

Gold mineralization at Midas Pond occurs within three sets of fracture-controlled quartz veins (V_1, V_2 and V_3), which are developed along the contact between a deformed breccia (the banded mafic unit) and felsic volcanic rocks. Along this

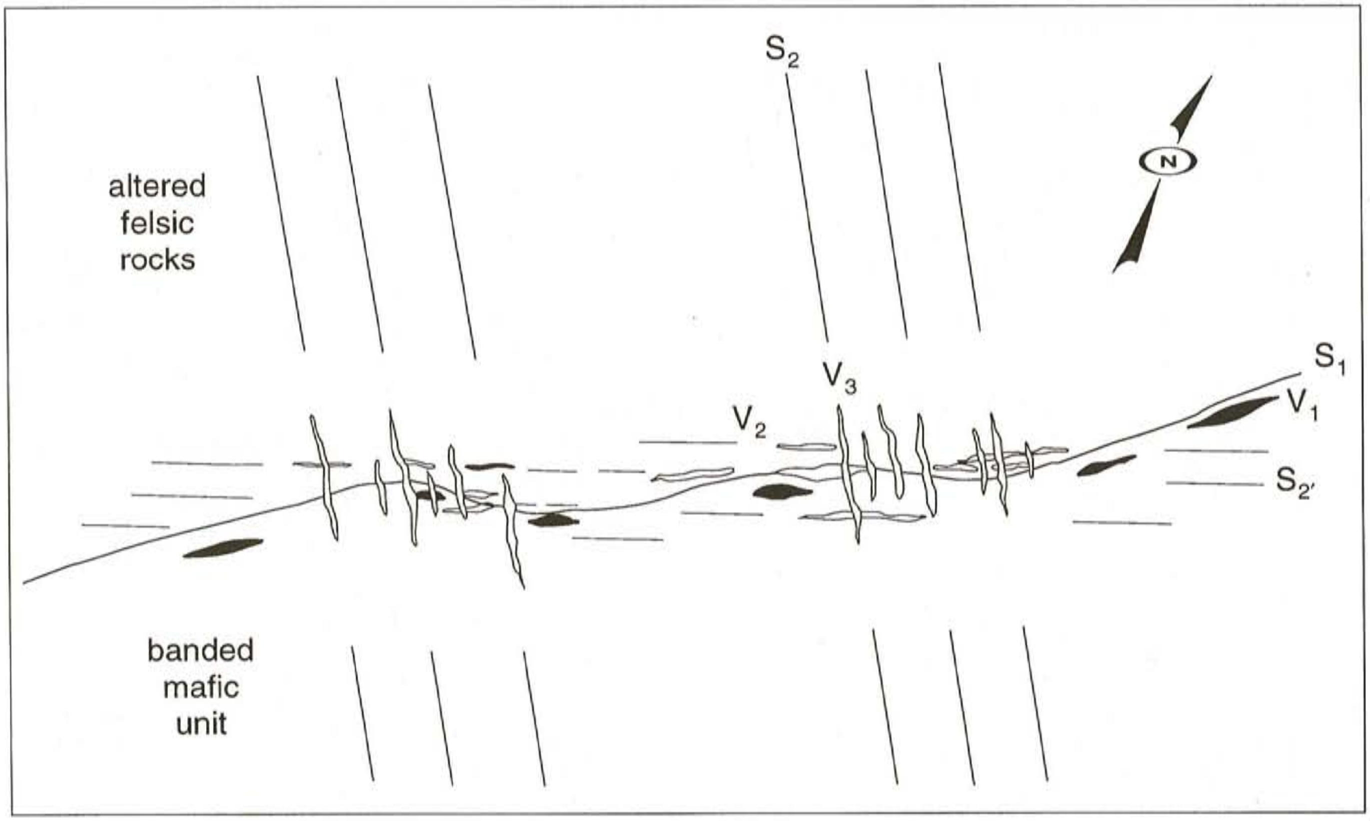

Figure 4. *Schematic diagram illustrating the relationships between:* S_1 *and* V_1*, and* S_2-S_2' *and* V_2-V_3.

contact, there appears to have been sufficient competency contrast to allow dilational structures to develope. These dilational structures were enhanced by flexuring of the Midas Pond shear zone as part of the regionally extensive Dunnage Zone flexuring (Blackwood, 1985; O'Brien *et al.*, 1986). Large flexures, such as the Hermitage and Baie Verte flexures and similar flexures eleswhere in the Central Mobile Belt, have been interpreted to result from sinistral movement along the major fault zones (Long Range–Cabot faults and the Cape Ray–Hermitage Bay–Dover faults) bordering the Central Mobile Belt (Blackwood, 1985; O'Brien *et al.*, 1986; Figure 5). This sinistral movement would result in a anti-clockwise rotation of the structural elements within the Central Mobile Belt resulting in the flexured pattern. Such flexuring is observed on a variety of scales throughout the Victoria Lake Group as is illustrated by the orientation of the geological units (Figure 1).

The presence of comb structures and vuggy cavities in the mineralized quartz veins, together with the epithermal-like argillic alteration observed within the shear zone, indicates that the Midas Pond prospect may have formed at fairly shallow depths. Midas Pond may represent a deposit style that is transitional between mesothermal and epithermal systems.

ACKNOWLEDGMENTS

This paper has benefitted from reviews by Anne Hogan and Baxter Kean. Field assistance was provided by Robert Lane.

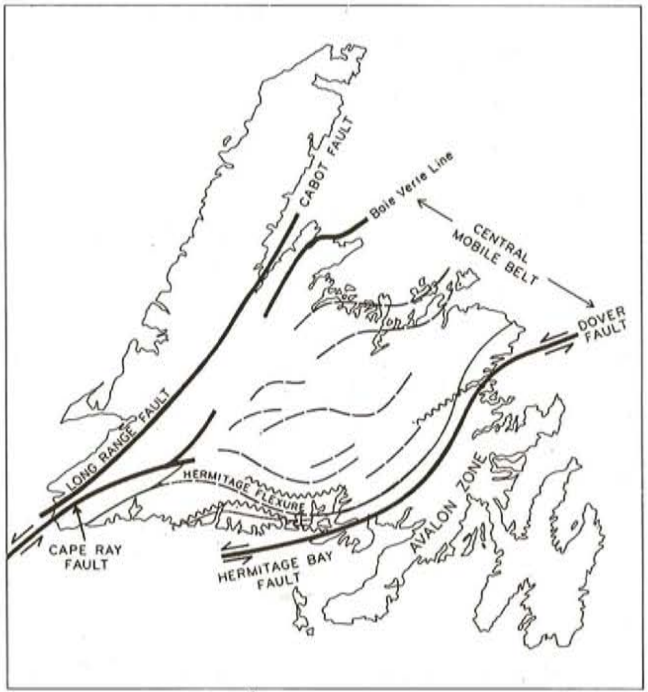

Figure 5. *Flexuring of the Central Mobile Belt due to sinistral movement along the major bounding wrench faults (Dover–Hermitage Bay fault and the Cape Ray fault). This sinistral movement produced clockwise rotation of the Central Mobile Belt resulting in the Hermitage and Baie Verte flexures (after Blackwood, 1985).*

REFERENCES

Barbour, D.M., Desnoyers, D.W., Gubins, A., McKenzie, C.B., Thurlow, J.G. and Woods, G.
1988: Assessment report on geological, geochemical, geophysical and diamond drilling exploration for 1987 submission on Reid Lots 227-229, 231-235 and 247 and Crown Lease Lot B in the Valentine Lake, Tulks River, Victoria River and Horseshoe Pond areas, Newfoundland. BP Resources Canada Limited, Unpublished Report, 1368 pages.

Blackwood, R.F.
1985: Geology of the Grey River area, southwest coast of Newfoundland. *In* Current Research. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 85-1, pages 617-629.

Evans, D.T.W.
1993: The Midas Pond gold prospect, Victoria Lake Group: geology, alteration and mineralization. Unpublished M.Sc. thesis, Memorial University of Newfoundland, St. John's, Newfoundland, 209 pages.

Evans, D.T.W. and Kean, B.F.
1987: Gold and massive sulphide mineralization in the Tulks Hill volcanics, Victoria Lake Group, central Newfoundland. *In* Current Research. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 87-1, pages 103-111.

Evans, D.T.W., Kean, B.F. and Dunning, G.R.
1990: Geological studies, Victoria Lake Group, central Newfoundland. *In* Current Research. Newfoundland Department of Mines and Energy, Geological Survey Branch, Report 90-1, pages 144-151.

Hodgson, C.J.
1989: Patterns of mineralization. *In* Mineralization and Shear Zones. *Edited by* J.T. Bursnall. Geological Association of Canada, Short Course Notes, Volume 6, pages 51-88.

Kean, B.F.
1985: Metallogeny of the Tally Pond volcanics, Victoria Lake Group, central Newfoundland. *In* Current Research. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 85-1, pages 89-93.

Kean, B.F. and Jayasinghe, N.R.
1980: Geology of the Lake Ambrose (12A/10) and Noel Paul's Brook (12A/9) map areas, Newfoundland. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 80-2, 29 pages.

O'Brien, S.J., Dickson, W.L. and Blackwood, R.F.
1986: Geology of the central portion of the Hermitage Flexure area, Newfoundland. *In* Current Research. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 86-1, pages 189-208.

Swinden, H.S., Kean, B.F. and Dunning, G.R.
1988: Geological and paleotectonic settings of volcanogenic sulphide mineralization in central Newfoundland. *In* The Volcanogenic Sulphide Districts of Central Newfoundland. *Edited by* H.S. Swinden and B.F. Kean. Geological Association of Canada, Mineral Development Division, pages 5-26.

Williams, H.
1979: Appalachian Orogen in Canada. Canadian Journal of Earth Sciences, Volume 16, pages 792-807.

Williams, H., Colman-Sadd, S.P. and Swinden, H.S.
1988: Tectonic-stratigraphic subdivisions of central Newfoundland. *In* Current Research, Part B. Geological Survey of Canada, Paper 88-1B, pages 91-98.