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RE-INVESTIGATION AND RE-INTERPRETATION OF THE SILURIAN LA POILE GROUP OF SOUTHWESTERN NEWFOUNDLAND

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ABSTRACT

The Silurian La Poile Group, confined to the west-central part of the Hermitage Flexure in southern Newfoundland, occurs in two elongate subbasins separated by older and younger rocks. Interlayered subaerial felsic volcanic and fluvial sedimentary rocks are the predominant deposits of the subbasins. They display facies changes that are the combined result of juvenile paleotopography and proximity to eruptive centres and syndepositional faults.

The La Poile Group was originally deposited as a cover sequence on a basement of upper Precambrian to lower Ordovician sedimentary, plutonic and gneissic rocks. The unconformity separating cover and basement rocks is locally preserved in marginal, southeast-dipping, imbricate thrust zones that presently define the boundaries of the La Poile Group. The cover basins exhibit strong, coincident, thermal and strain gradients increasing from their depocentres (strain augen) to their margins (mylonitic shear zones). An upright to recumbent structural transition in the group reflects inhomogeneous, simple shear deformation, related to basin inversion and the northward translation of large-scale Silurian thrust sheets. Regional low-P, low-T dynamothermal metamorphism has affected the La Poile Group throughout most of the 5-km-thick strain augen. A low-P, high-T metamorphism, restricted to parts of the marginal shear zones, produced concordant belts of locally auriferous, hornfelsic schists near early synkinematic granites. Younger Silurian granites, which are themselves variably deformed, crosscut structures related to basin inversion, and commonly produced static hornfelses in their thermal aureoles.

The Hope Brook Gold Mine and the Peter Snout gold–base-metals prospect occur in the hanging wall and footwall, respectively, of the fault zone along the southeastern margin of the La Poile Group. Imbricate thrusts of this zone merge with those along the northwestern margin of the group, in the area separating these deposits. There, a major tectonostratigraphic boundary exists where the upper Precambrian gneissic and plutonic rocks of the sub-La Poile Group basement block come in direct contact with Ordovician strata of the Dunnage Zone.

PURPOSE AND SCOPE

This paper summarizes, for the first time, the geological development of the entire tract of the La Poile Group in southwestern Newfoundland (Figure 1). The principal aims of this investigation are, firstly, to document the regional relationships of this unique belt of Silurian rocks and, secondly, to establish the relationships of the Hope Brook Gold Mine and the Peter Snout gold–base-metals prospect to the La Poile Group. This report is based, in part, on a recently released 1:100,000 scale map of the western Hermitage Flexure (O'Brien and O'Brien, 1989). Various parts of the region have been mapped by the authors on 1:25,000, 1:50,000 and 1:100,000 scales. The authors have also re-examined La Poile Group contacts with all other rocks between La Poile Bay and Top Pond, a distance in excess of 80 km.

The re-interpretation of the La Poile Group and surrounding rocks is significant because it departs from previous interpretations, upon which exploration philosophies for precious and base metals in the region had been formulated. These results are also timely, as they may have important bearing on modelling the recently acquired deep seismic data along the Burgeo Road leg of the Lithoprobe East Transect (Route 480; Figure 1).

PREVIOUS INVESTIGATIONS

Cooper (1954) proposed the name 'La Poile' for a unit of sedimentary and volcanic rocks that he mapped northeast of La Poile Bay. He assigned these rocks group status and considered them to lie unconformably above metasedimentary and metavolcanic rocks of the Bay du Nord Group, which he inferred to be of Devonian age. Cooper (1954) divided the La Poile Group into basal conglomeratic, intermediate epiclastic and upper volcanic-dominated units, without formally defining the group.

Chorlton (1978, 1980b) remapped this area and expanded the boundaries of the La Poile Group to include clastic and metabasic rocks that Cooper (1954) considered likely equivalents of the Bay du Nord Group, and granitoid and quartz–feldspar porphyry intrusions that Cooper (*op. cit.*) interpreted as postdating both groups. Chorlton (1980b) reported Ordovician Rb–Sr ages for the La Poile and Bay

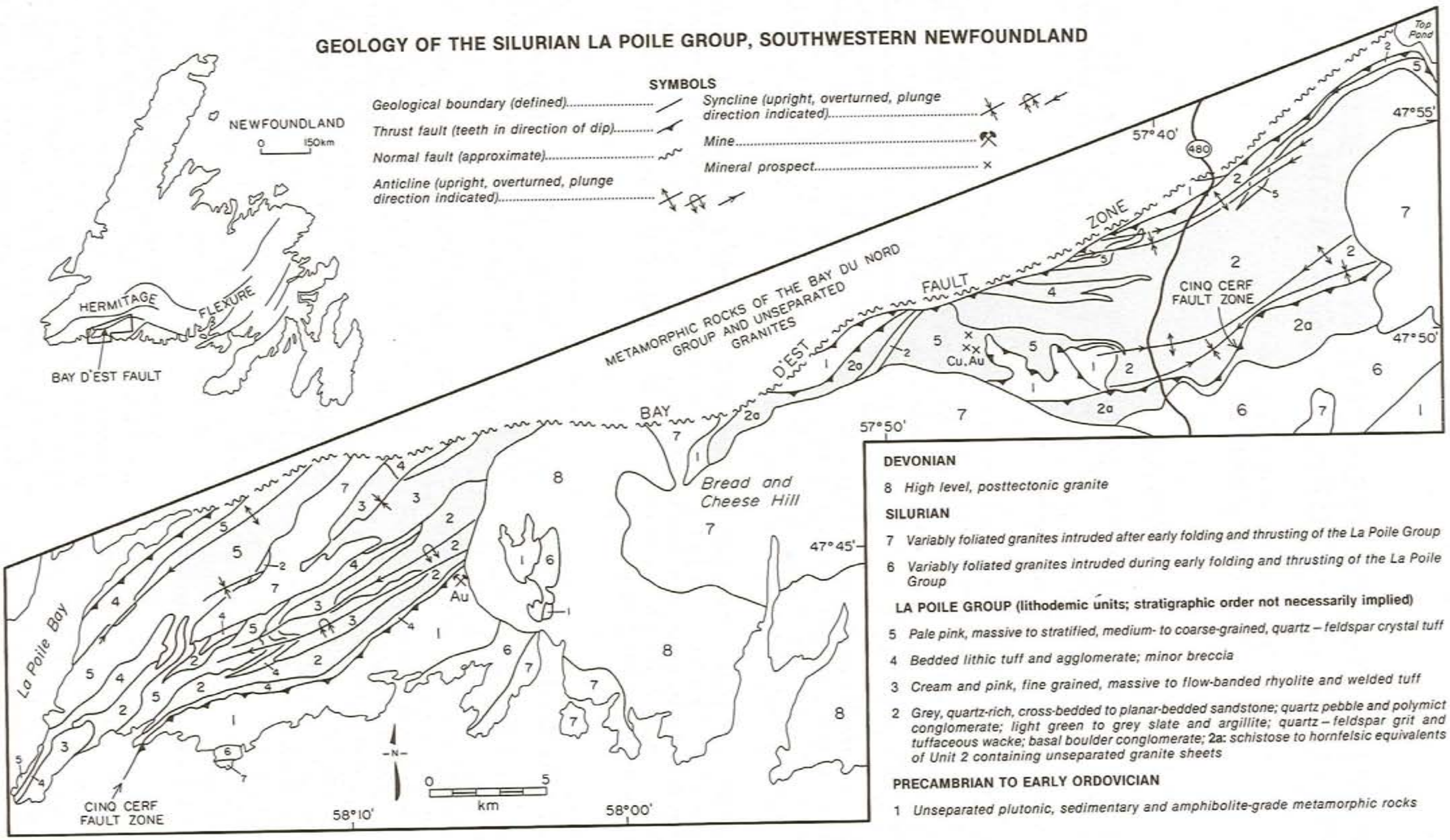

Figure 1. *Geology of the Silurian La Poile Group, southwest Newfoundland (simplified after O'Brien and O'Brien, 1989). Unnumbered areas north and south of the normal fault structure in the Bay d'Est Fault Zone are Middle Ordovician Bay du Nord Group (which may include younger and older metamorphic rocks) and unseparated granitoids.*

du Nord groups, and on this basis, she correlated both groups. The extension of the La Poile Group northeast of Bread and Cheese Hill (Figure 1) was initially outlined by Riley (1959) and surveyed in more detail by Chorlton (1980a) and O'Brien (1982). A variety of geological maps of segments of the group, at various scales, have been produced by mineral exploration companies; amongst the most significant of these are Holmes (1985a,b, 1986), Thompson (1985) and Pickett (1985). Since the production decision on the Hope Brook Gold Mine in 1986, the La Poile Bay area has been mapped in detail with emphasis on the structure and stratigraphy of the La Poile Group (O'Brien, 1987, 1988, 1989). The mapping of the La Poile Group and surrounding rocks, reported herein, has been augmented by precise U–Pb dating in the La Poile Bay area (e.g., Dunning *et al.*, *in press*; Dunning and O'Brien, 1989) and in the area northeast of Bread and Cheese Hill (Dunning, unpublished data).

HISTORY OF INTERPRETATION

Previous workers have reported a variety of relative and absolute ages for a wide spectrum of rocks that have been both included within, and excluded from, the La Poile Group. Some of the reported contact relationships, however, are inconsistent with some of the age assignments. The error of including all of the rocks in question in a single chronostratigraphic unit of group status (the Silurian La Poile Group) is highlighted by several of these inconsistencies. The prime focus of our reinvestigation has been the reconciliation of reported ages and relationships, the most significant of which are summarized below.

Chorlton (1978, 1980b) described intrusive contacts between the Roti Granite of Cooper (1954) and stratified rocks, but also documented the presence of Roti Granite clasts in these same strata. She included the distinctive blue-quartz-phyric granitoids and the intruded strata within her Ordovician La Poile Group. This assignment, and the observations upon which it was based, were rationalized by the existence, in different places, of venting (cf., Chorlton, 1978) or intrusive relationships between the hypabyssal phases of the Roti Granite and the volcanic carapace of the La Poile Group. Swinden (1984) and McKenzie (1986) subsequently adopted Chorlton's concept of high-level, subvolcanic Ordovician magmatism and invoked a related epithermal system to explain the alteration and mineralization at the Hope Brook Gold Mine. Using Chorlton's (1978) model, the presence of pre-incorporation foliations within the Roti Granite clasts can only be explained by deriving the clasts from synvolcanic or synplutonic faults, and depositing them within tectonically active parts of the La Poile basin.

However, in the area northeast of Bread and Cheese Hill, fanglomerates, which contain abundant clasts of foliated Roti Granite, rest directly upon a regolith that overlies fractured Roti Granite (O'Brien, 1982, unpublished data). This unconformity is now recognized to be regionally developed (O'Brien and O'Brien, 1989); the fanglomerate is now considered part of a widespread conglomeratic unit that is located at or near the base of the La Poile Group. The profound nature of this unconformity is highlighted by U–Pb isotopic age determinations on the upper volcanic unit of the La Poile Group as defined by Cooper (1954), dated as Silurian (Dunning *et al.*, 1988), and on the Roti Granite, dated as Late Precambrian (Dunning and O'Brien, 1989; Dunning, unpublished data). These ages, coupled with the recognition of the sub-La Poile Group unconformity, have challenged earlier interpretations of the relationship between the Roti Granite and the stratified rocks of the La Poile Group.

Unequivocal intrusive relationships, however, do exist between the Roti Granite and low-grade sedimentary and volcanic rocks southeast of dated Silurian strata. These strata, which were included in the La Poile Group by Chorlton (1978), Swinden (1984),McKenzie (1986) and O'Brien (1987, 1988), correspond to the pre-La Poile Group succession of Cooper (1954). However, it is also true that several generations of texturally variable granitoids intrude Silurian rocks of the La Poile Group, as well as all of the above mentioned rocks.

The integration of all of these relationships is the focus of this report.

GEOLOGICAL SETTING OF THE LA POILE GROUP SUBBASINS

The term La Poile Group is herein used to denote those sedimentary and volcanic rocks of Silurian age (and their metamorphic equivalents) that occur south of the Bay d'Est Fault Zone, between La Poile Bay and Top Pond (Figure 1). These rocks are confined to the west-central part of the Hermitage Flexure, in the southern Newfoundland Appalachians. Strata that are assigned by us to the Silurian La Poile Group have, in different locations, either depositional, tectonic or intrusive contacts with adjacent rocks. An unconformity at the base of the group separates basal boulder conglomerate from the dated Upper Precambrian Roti Granite. Major fault zones, however, bound the group for most of its length, separating Silurian strata from upper Precambrian and middle Ordovician rocks to the northwest, and from upper Precambrian and upper Cambrian–lower Ordovician rocks to the southeast. The boundary of the group is also demarcated, in places, by younger granites that comprise parts of the Silurian Burgeo and La Poile intrusive suites and the Devonian Chetwynd Granite (O'Brien and O'Brien, 1989).

The La Poile Group comprises two, elongate, physically separate, generally northeast-trending outcrop belts or subbasins. The dominantly volcanic southwestern outcrop area, here named the La Poile Bay subbasin, is the informal type area of the La Poile Group. The mainly clastic Rocky Ridge subbasin lies approximately 10 km northeast of the La Poile Bay subbasin and is separated from it by granitoids and metamorphic rocks that predate and postdate the deposition of the La Poile Group.

In the type area, where stratigraphical thickness is estimated at between 3 and 5 km (Cooper, 1954; Chorlton, 1978; O'Brien, 1988, 1989), felsic volcanic units from the base and the top of the succession have been radiometrically dated as Early to Late Silurian (420^{+8}_{-2} Ma, 424^{+7}_{-3} Ma and 428 ± 6 Ma; Dunning *et al.*, 1988, *in press*). A recently determined age from felsic tuffs near the base of Rocky Ridge subbasin (Dunning, unpublished data, 1989) confirms the overall synchroneity of volcanism in both subbasins.

The U–Pb ages from the La Poile Group support correlation of the entire lithostratigraphic sequence with similar assemblages of Silurian rocks elsewhere in Newfoundland (Dunning *et al.*, *in press*). These include the Cape St. John Group (DeGrace *et al.*, 1976), the Mic Mac Lake Group (Hibbard, 1983), the Bear Pond rhyolite (Chandler and Dunning, 1983; Dunning *et al.*, *in press*); the Springdale Group (Chandler *et al.*, 1987), the Stony Lake volcanics (Dunning *et al.*, *in press*) and volcanic units of the Botwood Group (Williams, 1967) and of the Topsails Igneous Suite (Whalen *et al.*, 1987). The age, general character and regional setting of the La Poile Group argues against its previous correlation with the Ordovician oceanic rocks of the Dunnage Zone (e.g., Chorlton and Dallmeyer, 1986).

LITHOLOGY AND STRATIGRAPHY

The La Poile Group is characterized by subaerial felsic volcanic and associated epiclastic rocks interdigitated with, and underlain by, crossbedded quartz-rich clastic sedimentary rocks of fluvial and alluvial origin. The group consists of alternating units that form wedges or splits and terminate by stratigraphical pinch-out (O'Brien, 1988). In the type area, individual lithostratigraphic units have been mapped and their stratigraphic relationships have been established. They have been grouped into four regional lithodemic units, which are recognized in both subbasins. There are significant differences between the La Poile Bay and Rocky Ridge basin-fills although several marker units are present in both, occupying similar stratigraphical positions.

In the La Poile Bay subbasin, pyroclastic rocks and lava flows, exclusively of felsic composition, are predominant; these are most extensive in the upper parts of the group. Clastic sedimentary facies, including conglomerate, pebbly sandstone, tuffaceous sandstone, wacke, shale and argillite, occur mostly in the lower parts of the group, but are also represented as thinner units throughout most of the succession. In the Rocky Ridge subbasin, greenish-grey, crossbedded sandstones comprise most of the La Poile Group. The sandstone beds, which form a continuous succession greater than 3 km in thickness, interdigitate southwestward with volcanic units.

The main volcanic rock types are air-fall tuffs, lava flows, ash-flow tuffs, volcanic breccias (including lahars) and related finer grained, epiclastic rocks. In the type area, the ash flows are variably welded and quartz-phyric, and are rhyolitic to rhyodacitic in composition (Chorlton, 1980b). They occur within a northeastward-fining sequence of lahar deposits and northeastward-thinning successions of breccia and agglomerate (Chorlton, 1978; O'Brien, 1987, 1988). Neither welded ash flows nor rhyolite flows were developed in the Rocky Ridge subbasin, where volcanic rocks are subordinate and mainly of air-fall and epiclastic origin (O'Brien, 1983).

Lower parts of the La Poile clastic succession, especially that part exposed in the Rocky Ridge subbasin, consist of grey and grey-green, fine and medium grained, immature quartz arenite, feldspathic lithic arenite, pebbly sandstone and granule conglomerate; all are rich in blue quartz (O'Brien, 1983). The sandstones display large-scale cross-stratification typical of fluvial facies, and are rarely planar bedded. Granule to boulder conglomerate beds, up to 5-m thick, are both clast and matrix supported, subrounded, poorly sorted and locally display scoured bases. A thick-bedded, polymictic conglomerate unit occurs near the structural top of the La Poile Group in the type area. As well as intrabasinal volcanic detritus, the conglomerate contains boulders and cobbles of extrabasinal sedimentary, plutonic and metamorphic rocks, including blue-quartz-phyric tonalite and granodiorite, vein quartz, quartz pebble conglomerate, schist and granitoid injected by diabase. Similar boulder conglomerates (Plate 1), which contain highly altered net-veined rocks and banded amphibolite (Plate 2), in addition to the above detritus, occur near, and at the stratigraphic base of, the group in the Rocky Ridge subbasin.

The nature and distribution of volcanic facies in the La Poile Group (O'Brien, 1988), which are generally comparable to deposits accumulated within and adjacent to calderas (see Fisher and Schminke, 1984), indicate that the main centres of Silurian volcanism were sited in the La Poile Bay subbasin. The thickest eruptive deposits occur in the top of the succession and are most extensive along the northwestern margin of the subbasin. They become thinner to the northeast and southeast, where the tuffs and flows interdigitate with sedimentary rocks. Sedimentary facies of the Rocky Ridge subbasin (Unit 2, Figure 1) can be directly linked with equivalent facies in the La Poile subbasin. However, the lava flow facies (Unit 3, Figure 1), extends as a thick succession, to the northeastern limit of—but not beyond—the La Poile Bay subbasin. The observed relative distribution of volcanic and sedimentary facies within the La Poile Group, in part controlled by the morphology of the volcanic landforms, is also consistent with the presence of an emergent interbasin divide. This suggests that the mainly fault-controlled topography became progressively more juvenile during the Silurian. The distribution of fanglomerate facies relative to other sedimentary facies and the generally high accumulation rates of basin-fill are also indicative of syndepositional faulting.

BOUNDARIES OF LA POILE GROUP SUBBASINS

The northern boundary of the La Poile Group is the Bay d'Est Fault Zone, one of the fundamental structural zones of the Hermitage Flexure (Figure 1). Southeast-dipping imbricate thrusts, one of the main constituents of the Bay d'Est Fault Zone, separate structurally overlying greenschist-facies rocks of the La Poile Group from underlying higher grade rocks that include the Ordovician Bay du Nord Group.

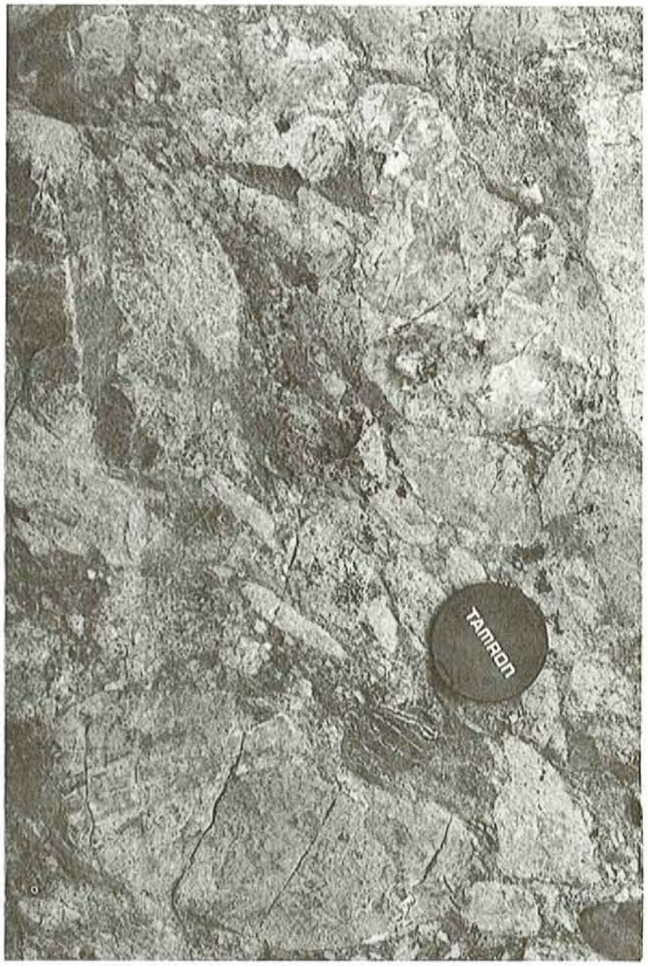

Plate 1. *La Poile Group boulder conglomerate containing basement-derived clasts.*

Plate 2. *Banded amphibolitic gneiss clast in La Poile Group conglomerate.*

However, in several localities, discontinuous thrust sheets of Upper Precambrian Roti Granite intervene between the La Poile and Bay du Nord groups (Figure 1). Locally, the Roti Granite overthrusted the La Poile Group (Plate 3); both were mylonitized and together they form mesoscopic-scale schuppen structures.

The southern boundary of the La Poile Group is the Cinq Cerf Fault Zone, in large part, a southeast-dipping listric thrust zone (O'Brien, 1987, 1989). This major fault zone separates the La Poile Group from a belt of upper Precambrian to lower Ordovician rocks (grouped as Unit 1 in Figure 1). Precambrian rocks in this belt are amphibolitic gneiss, schist and intrusive rocks (Cinq Cerf gneiss), lower grade stratified rocks (Whittle Hill sandstone and Third Pond tuff), and a tonalitic pluton ('Old Roti' Granite of O'Brien and O'Brien, 1989). Upper Cambrian−lower Ordovician components of this belt are plutons of mafic (Ernie Pond gabbro) and felsic ('Young Roti' granite of O'Brien and O'Brien, 1989) composition, and are intrusive into the upper Precambrian rocks. The Cinq Cerf Fault Zone, which was originally defined in the La Poile Bay type area, is now recognized, in places, along the southern margin of the Rocky Ridge subbasin. There, the fault zone is a stack of imbricate thrusts juxtaposing Cinq Cerf gneiss, 'Old Roti' Granite and La Poile Group, all of which were truncated by young phases of the Burgeo intrusive suite. In several localities near the margins of the Rocky Ridge subbasin, both within, and to the north of the Cinq Cerf Fault Zone and within the Bay d'Est Fault Zone, conglomerate of the La Poile cover sequence unconformably overlies foliated 'Old Roti' Granite of the upper Precambrian−lower Ordovician basement (O'Brien *et al.*, 1989; Plate 4).

DEFORMATION AND METAMORPHISM

Both the Ordovician and Silurian rocks that define the Hermitage Flexure in southern Newfoundland have been affected by middle Paleozoic orogenesis (Dunning *et al.*, 1988). The regional folds of the Silurian La Poile Group outline a second-order oroflex related to this major tectonic feature. However, the La Poile Group is, in general, less regionally metamorphosed than the juxtaposed Bay du Nord Group and, whereas recumbent structures control the essential disposition of Ordovician strata, upright structures govern the outcrop pattern of Silurian sedimentary and volcanic rocks. This structural and metamorphic gradation from generally steep, lower grade phyllitic rocks to generally

Plate 3. *Mylonitic thrust contact between overlying Upper Precambrian Roti Granite (R) and underlying basal conglomerate of the Silurian La Poile Group (L).*

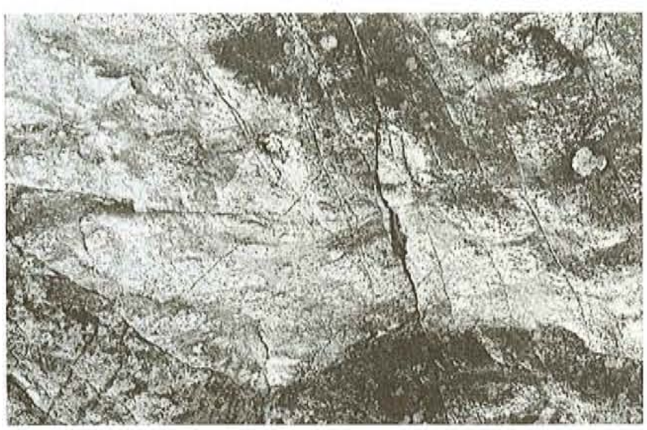

Plate 4. *Unconformity of Silurian La Poile Group on Upper Precambrian Roti Granite showing a regolith zone of foliated granite.*

flat, higher grade, schists and migmatites is typical of the transition from orogenic suprastructure to infrastructure (cf., Zwart, 1981).

Three episodes of regional deformation accompanied greenschist-facies dynamothermal metamorphism of the La Poile Group. Deformation related to all three events is most intense near bounding shear zones, which are southeast-dipping listric mylonite zones or fold slides. Primary features are commonly well preserved in the shear augen or steeply to moderately northwest-dipping internal part of the group. In the Rocky Ridge subbasin, where older phases of the Burgeo intrusive suite were intruded into the marginal imbricate thrust zones, amphibolite-facies hornfelsic schists have been produced locally in the La Poile Group.

The lithodemic units of the La Poile Group outline regional folds that trend northeast and east and, for the most part, have upright axial surfaces (Figure 1). These folds are, however, locally overturned to the northwest where inverted members of the La Poile Group were faulted against older rocks (Figure 2). Nevertheless, since the major folds display a consistent sense of asymmetry and have relatively short middle limbs, the La Poile Group can be considered, in regional terms, as a right-way-up, northwest-younging succession.

The La Poile Group is fault-bounded for most of its length. Although the bounding fault zones yield evidence of a long history of reactivation, most of the component faults are now observed as early phase, north-directed Silurian thrusts, so that the La Poile Group occupies a parautochthonous thrust sheet or major horse about 5 km in structural thickness (O'Brien, 1989a). Where the La Poile Group is missing and the sub-La Poile basement lies directly against the Ordovician Bay du Nord Group, the bounding faults zones merge to form one imbricate thrust zone. The area of merger, which is now largely occupied by late syntectonic to posttectonic granite, coincides with the postulated site of a basement-cored interbasinal divide that existed during the deposition of the La Poile Group. Correlation of the rocks southeast of the Cinq Cerf Fault Zone and immediately south of the La Poile subbasins, with the Ordovician Bay du Nord Group, is considered unlikely despite the fact that these pre-Silurian rocks may be imbricated with the Bay du Nord Group, north of the Bay d'Est Fault Zone.

MAJOR INTRUSIONS INTO LA POILE GROUP SUBBASINS

The La Poile Group is host to abundant, fine grained, minor intrusions of mafic to felsic composition and several major intrusions that are characterized by coarse grained porphyritic granite. The latter are the extremities of the batholithic-scale Burgeo and La Poile intrusive suites (Units 6 and 7, Figure 1). These intrusions were probably generated during the high-grade metamorphism of the Bay du Nord Group (O'Brien *et al.*, 1986) and the remobilization of pre-middle Ordovician basement rocks (O'Brien and O'Brien, 1990; Dunning, unpublished data). The Silurian intrusive suites were subsequently emplaced at higher crustal levels and were apparently intruded preferentially into areas external to the Silurian subbasins. High-level Devonian granite (Chetwynd Granite; Chorlton and Dallmeyer, 1986) trends

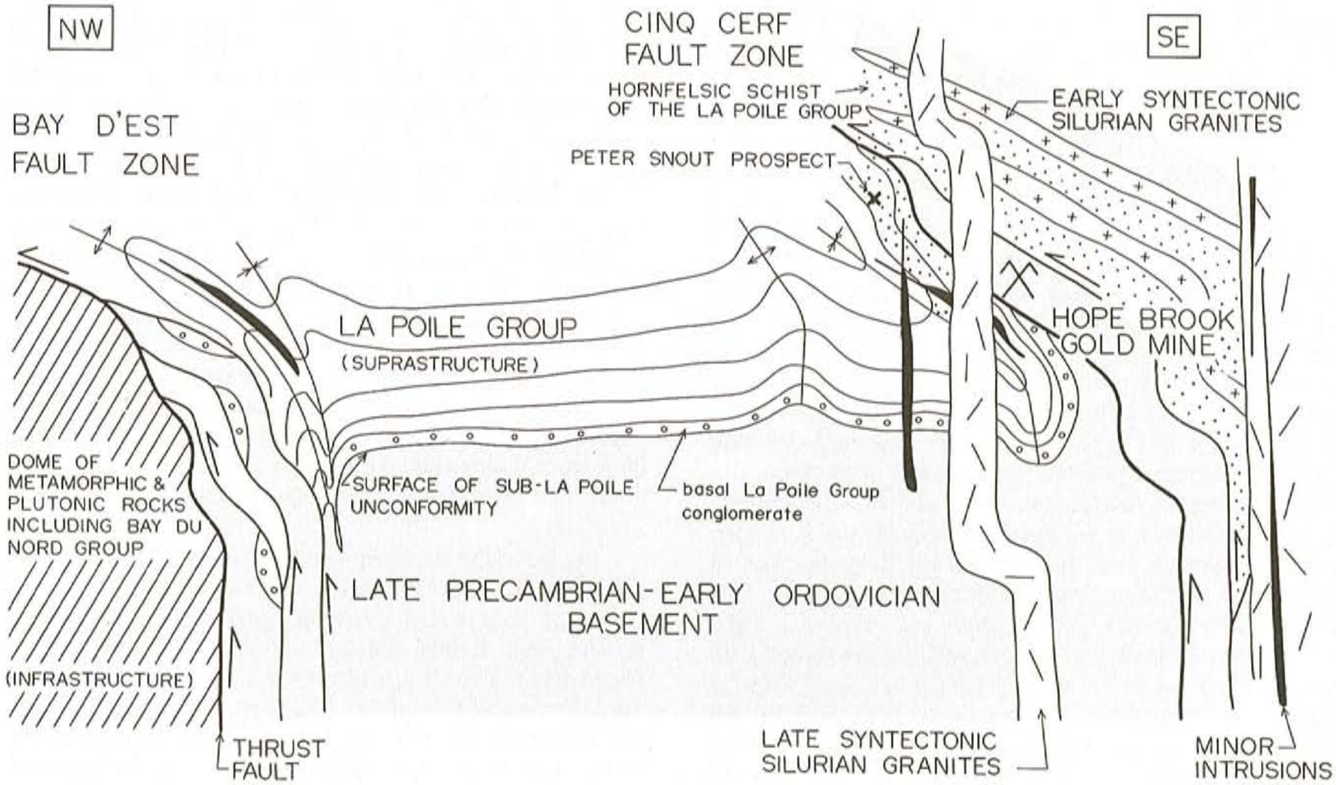

Figure 2. *Schematic cross-section of the La Poile Group and adjacent rocks. Fold axial surfaces correspond to fold axial traces on Figure 1.*

northwesterly across the region, truncating tectonic structures in the Silurian intrusions.

At the southern margin of the La Poile Bay subbasin, thin lenticular bodies of fluidized felsite and quartz–feldspar porphyry intruded the La Poile Group adjacent to the Cinq Cerf Fault Zone. In the central part of this subbasin, several larger northeast-trending, subvertical bodies of biotite-bearing, quartz–feldspar porphyry are present. Some sheet intrusions of this Silurian porphyry are concordant and were emplaced along the limbs of first generation, regional folds in the La Poile Group. Other similarly oriented bodies of this porphyry are discordant and were injected into the hinge zones of these same fold structures; all are locally folded and foliated with the La Poile Group during its second regional deformation. These porphyries are viewed, therefore, as syntectonic intrusions like many of the other Silurian units that comprise the La Poile intrusive suite (O'Brien, 1988; O'Brien and O'Brien, 1989). Thermal aureoles are conspicuously absent around intrusions from this suite.

In the Rocky Ridge subbasin, one of the oldest porphyritic biotite granites of the Burgeo intrusive suite was emplaced as gently inclined sheets, late during first-generation recumbent folding and thrusting of the La Poile Group (Plate 5). This early plutonic activity was responsible for mimetically recrystallizing and metamorphically upgrading the La Poile Group above regional greenschist-facies conditions. These early granite sheets are associated with localized belts of coarse porphyroblastic schist that are marginal to, and concordant with, regionally developed phyllite belts in the La Poile subbasins. Younger phases of this suite, commonly forming static hornfelses in their thermal aureoles, crosscut regional folds and thrusts of La Poile Group strata.

Plate 5. *Early granite (G) of the Burgeo intrusive suite intruding across a shape fabric in conglomeratic schist but itself displaying inclined folds and foliation of the same generation.*

Silurian diabase dykes and gabbro bosses, which are variably foliated, intrude the La Poile Group and parts of the

Burgeo and La Poile intrusive suites. On a regional scale, this mafic magmatism was most voluminous along major fault zones, such as those that bound the La Poile subbasins.

SETTING AND CONTROL OF GOLD MINERALIZATION

The Hope Brook Gold Mine is located immediately southeast of the La Poile Group, near the trace of the Cinq Cerf Fault Zone (Figure 1). Economic mineralization and related alteration are restricted to the sub-La Poile Group basement (O'Brien, 1989a), which locally includes rocks correlated with the Upper Precambrian Roti Granite (Dunning and O'Brien, 1989). Therefore, the gold mine occurs in the hanging wall of the Cinq Cerf Fault Zone. The main alteration zone was deformed prior to the intrusion of the Devonian Chetwynd Granite (McKenzie, 1986), although the absolute age of alteration is as yet undetermined. At the mine-site, timing of alteration is broadly bracketed by the age of deformation (pre-Devonian) and the age of the youngest host rock (Late Precambrian). Local and regional field relationships indicate that the deformation associated with basement reactivation along the Cinq Cerf Fault Zone is Silurian (O'Brien, 1989a; O'Brien *et al.*, 1989; O'Brien and O'Brien, 1990), thus, accommodating a hypothesis of Silurian alteration and deformation. However, pre-Silurian rocks and structures have been recognized in the hanging-wall block (O'Brien, 1989a; Dunning and O'Brien, 1989), thus, a pre-Silurian age for the main alteration and mineralization cannot be readily discounted.

The Peter Snout gold–base-metals prospect occurs near the Cinq Cerf Fault Zone approximately 25 km to the northeast of the Hope Brook Gold Mine (Figure 1). At Peter Snout, the mineralization and alteration is hosted by dated Silurian rocks of the La Poile cover sequence. Alteration postdates structural inversion, granite injection and localized amphibolite-facies metamorphism of La Poile Group volcanic and sedimentary rocks. The Peter Snout prospect, therefore, occurs in the footwall of the Cinq Cerf Fault Zone, and demonstrates that some of the deformed mineralization associated with this structure is Silurian. A potentially significant difference between the Hope Brook mine and the Peter Snout prospect is the age of crosscutting plutons. The former was truncated by posttectonic high-level Devonian granite, the latter by late syntectonic Silurian granite. In neither the Peter Snout nor the Hope Brook deposit, is there evidence to support the existence of significant epithermal systems developed in association with high-level, subvolcanic magmatism of Ordovician or Silurian age. Instead, where mineralization can be documented as Silurian, it was associated with igneous activity genetically related to mid-Paleozoic, synmetamorphic folding and thrusting (cf., O'Brien, 1989b). More specifically, gold mineralization along the Cinq Cerf Fault Zone, where Precambrian crystalline rocks were reactivated during the deformation of Silurian strata, exemplifies a larger class of deposit characteristically localized near the basement/cover interface in the orogenic suprastructure.

Gold mineralization and alteration occur within the La Poile Group in, and adjacent to, the mylonites of the Bay d'Est Fault Zone (see O'Brien, 1988) and deformed mineralization of this type is also found within adjacent platey to mylonitic Ordovician rocks. Later gold mineralization in the fault zone (e.g., Walker, 1985) is associated with brittle faults that offset the main northwest-trending body of the Devonian Chetwynd Granite (Unit 8, Figure 1). However, several northeast-trending Chetwynd Granite dykes intruded along these faults, thus, implying an overall synchroneity of Devonian plutonism, brittle faulting and mineralization. Gold occurrences along the Bay d'Est Fault Zone are an example of a larger group of mineral deposits sited in the transitional area between suprastructure and infrastructure. In the case of the Bay d'Est Fault Zone, Precambrian basement was remobilized with high-grade Ordovician rocks, thrust imbricated with Silurian cover, and displaced by Devonian normal faults.

In places, the basement/cover interface is situated in the infrastructure and a gradation can exist between the two settings of gold deposits. In both types of regional settings, however, the tightly braided mylonite zones are major lineaments that record evidence of a protracted history of displacement and recurrent magmatism (O'Brien, 1989b). The recognition of such a history, which predates, overlaps and postdates Silurian magmatism, is of fundamental importance in establishing exploration philosophies and selecting regions for initial exploration. These processes were operative in a variety of environments, not only within the La Poile Group, but also in many of the rock units of the Hermitage Flexure, which range in age from Late Precambrian to Early Carboniferous.

SUMMARY AND DISCUSSION

The Silurian La Poile Group forms a thick succession of generally low-grade, subaerial felsic volcanic and fluvial clastic rocks that occupy two fault-bounded subbasins at the southern boundary of the Dunnage Zone in southwest Newfoundland. Sedimentation and volcanism were tectonically controlled by faults sited along the subbasin margins and further influenced by the physiography of the volcanic centres. In the La Poile subbasins, accumulation of up to 5 km of strata occurred within approximately 10 Ma, indicating rapid subsidence and related, continuous uplift; the erosion of surrounding ranges resulted in a juvenile Silurian topography.

Silurian strata were originally deposited as a cover sequence on upper Precambrian to lower Ordovician basement. Unconformities between Silurian and Precambrian rocks are preserved on both margins of the La Poile Group, implying that the Precambrian basement originally extended under the Silurian subbasins. The La Poile subbasins were inverted during the earliest regional phase of folding and thrusting in the Silurian, shortly after deposition of the group. An upright–recumbent structural transition in the La Poile Group is associated with northward translation of the cover sequence and its basement, so that Silurian strata now occupy a 5-km-thick, parautochthonous thrust sheet. Syntectonic intrusions were emplaced into the La Poile Group during and after inversion of the subbasins. The oldest granitic intrusions were preferentially injected into the marginal thrust zones as southeast-dipping sheets, which metamorphically upgraded and mimetically recrystallized inverted members of the La Poile Group. The youngest intrusions crosscut the early folds and thrusts in the cover and the basement, as well as the older syntectonic granites.

Remobilization of the sub-La Poile basement with its cover was one of several processes that occurred during the regional Silurian tectonothermal event (cf., Dunning *et al.*, *in press*) in southern Newfoundland. This basement of upper Precambrian to lowest Ordovician gneissic, plutonic and sedimentary rocks comprises part of a more extensive domain, which is presently recognized to be most widespread south of the Ordovician stratified rocks of the Dunnage Zone. A fragmented belt of these distinctive basement rocks extends eastward for at least 130 km to the south-central portion of the Hermitage Flexure (Dunning and O'Brien, 1989). The presence of the basement block in the south, and its interaction with Ordovician and Silurian strata to the north, are fundamental controls on the structural style, regional metamorphic patterns and magmatic character of the Hermitage Flexure (O'Brien and O'Brien, *in preparation*).

The regional geological setting of the La Poile Group is fundamentally different than rocks of the same age and facies, which are found in the Botwood Group (Williams, 1967) in the Exploits Subzone (cf. Williams *et al.*, 1988). Most of the fill in this Dunnage Zone basin is interpreted to stratigraphically overlie lower Silurian flysch deposits and to define a shoaling upward, marine to terrestrial regression (Williams, 1967). In contrast, the La Poile Group is exclusively terrestrial and deposited upon crystalline basement, without any intervening Ordovician strata. In this respect, its tectonic setting is generally more comparable with the Silurian cover sequences in the Notre Dame Subzone of the Dunnage Zone, which unconformably overlie various Ordovician units. The structural style of La Poile Group rocks, thrust to the north above the Middle Ordovician Bay du Nord Group, themselves overthrust by southerly belts of mainly Precambrian rocks and the total assemblage backthrust to the south, contrasts with the setting of other Silurian belts in Newfoundland. However, the contact between the Rogerson Lake Conglomerate, of presumed Silurian age, and the Upper Precambrian Valentine Lake granite, which crops out adjacent to the Victoria Lake Group farther north in the Exploits subzone (Evans *et al.*, *this volume*), may be analogous to the thrust-reactivated unconformity between the La Poile Group and the Upper Precambrian Roti Granite. Examples of the tectonic style that characterizes the Exploits subzone of the Hermitage Flexure, where a regionally extensive basement massif was involved in Silurian tectonism, are recognized as far north as the Victoria Lake Group in central Newfoundland. The fundamental differences in the effects of the Silurian tectonothermal event in the Dunnage Zone may be directly related to degree of basement involvement at this time, which was profound in the south, but insignificant or absent in the north, where the sub-La Poile basement may lie at greater depth.

The distinctive upper Precambrian tonalitic to granodioritic plutons of the Hermitage Flexure basement, intrude not only high-grade amphibolitic gneiss, but also low-grade sedimentary and tuffaceous strata. The age and preservation of these low-grade Precambrian rocks (Whittle Hill–Third Pond succession of O'Brien, 1989a), coupled with their relationship to upper Precambrian granite, invite correlation with sedimentary and volcanic facies beneath the upper Precambrian sub-Musgravetown unconformity in the Avalon Zone, which lies to the southeast (Dunning and O'Brien, 1989; O'Brien *et al.*, *in press*). The relationships amongst low-grade Precambrian and Silurian, and high-grade Precambrian rocks in the Hermitage Flexure are directly comparable to relationships along the northwest margin of the Avalon Composite Terrane of southern New Brunswick (e.g., McCutcheon, 1981).

A major tectonostratigraphic boundary, similar to the one in southern New Brunswick, may lie immediately northwest of the La Poile Group (Figure 3). This boundary is between the Dunnage Zone and a newly recognized upper Precambrian composite terrane, which is the fundamental and most extensive component of the sub-La Poile basement block. This terrane, taken together with the Avalon Zone in southeast Newfoundland, constitutes the extension of the Avalon Composite Terrane of Maritime Canada (cf., Keppie, 1988). Its oldest diagnostic constituent is the Grey River–Cinq Cerf gneiss of O'Brien and O'Brien (1990), which was juxtaposed with low-grade sedimentary rocks prior to intrusion of both units by upper Precambrian granite (O'Brien, 1989a).

In the region southeast of the Bay d'Est Fault Zone, field relationships indicate that neither Gander nor Dunnage zone rocks were ever deposited on sub-La Poile basement, where Ordovician strata do not intervene between Precambrian and Silurian rocks. The syndepositional faults that delimit the La Poile subbasins were developed in a pre-Silurian fault zone sited near the southern limit of the Dunnage Zone. The basement massif of the Grey River–Cinq Cerf gneiss is interpreted to have been an emergent upland (Figure 3), whose northern boundary coincided with the southern limit of Dunnage Zone rocks in mid-Ordovician time. However, the larger, upper Precambrian composite terrane extends at depth northward under the Dunnage Zone. The pre-Silurian tectonostratigraphic boundary that is coincident with the Bay d'Est Fault Zone, was reactivated during subsequent Silurian folding and thrusting, regional metamorphism, syntectonic intrusion and wrench faulting (cf., Hutton and Murphy, 1987; O'Brien and O'Brien, 1990).

Regional goldfields that consist mainly of mesothermal deposits are commonly located near major terrane boundaries (cf., Wyman and Kerrich, 1988) that have undergone a history of protracted crustal remobilization, such as that described above. The Hope Brook mine and Peter Snout prospect, which are, herein, also interpreted as mesothermal deposits, are now shown to be sited near a fundamental Appalachian tectonostratigraphic boundary. Along this boundary, and elsewhere in this part of the Hermitage Flexure, gold mineralization, regardless of age, was fundamentally

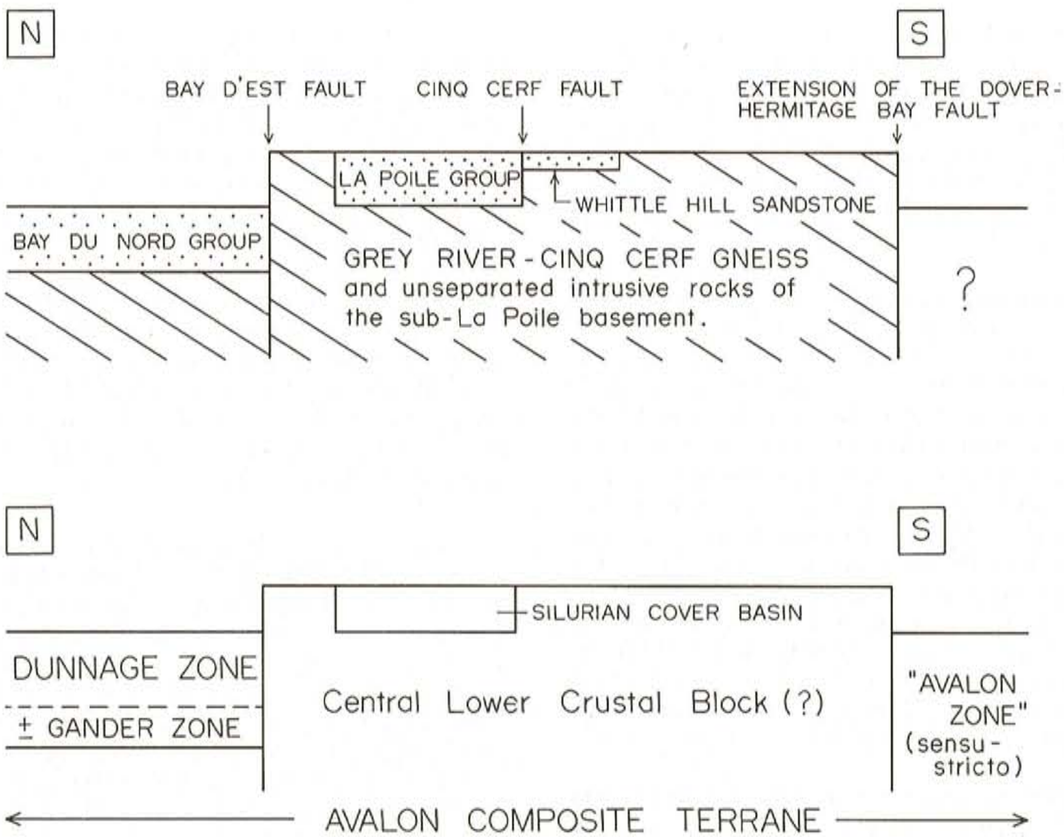

Figure 3. *Schematic block diagram showing (A) the relative location of major rock units and bounding structures in the southwestern Hermitage Flexure (the extension of the Dover–Hermitage Bay Fault occurs offshore), and (B) their tectonostratigraphic affiliation and possible relationship to the Central (lower crustal) Block of Marillier* et al. *(1989).*

controlled by, and was a consequence of events related to protracted basement-cover interaction.

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