DR2011098

GSA Data Repository

for

"Fluvial response to paleo-equatorial climate fluctuations during the Late Paleozoic Ice Age"

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Data Repository Items:

Documentation for time-space framework (Fig. 3; main article)

Table DR1 – Climate sensitive indicators

Time-Space Framework Construction

In order to construct the time-space framework for the Maritimes Basin (Fig. 3, main article), a review of all available biostratigraphic data was conducted in order to constrain the age of each formation as accurately as possible. Absolute age constraints are largely absent within the Maritimes Basin and as a result numerical ages are provided only as a reference. However, all formations are constrained either biostratigraphically or lithostratigraphically and are tied to stage names. The time scale of Menning et al. (2000) has been used for the Carboniferous because it retains the Carboniferous European stages not used in the latest geochronological time scale (Davydov et al., 2004). All biostratigraphic data within Atlantic Canada is referenced to the original European stages of the Carboniferous and as a result the stages derived from Russia cannot be recognized within the study area. Therefore, all formation ages are referenced to European stages with the corresponding global chronostratigraphic nomenclature in parentheses. The Permian section of our framework uses the latest timescale (Wardlaw et al., 2004).

Paleoclimatic indicators were identified from both a thorough review of the literature and extensive fieldwork. These data (Table DR1) provide the basis for the paleoclimatic interpretions made in this study. A variety of lithologies and facies relationships have been recognized as climate-sensitive indicators (see review in Tabor and Poulsen, 2008) and have been incorporated into this study. These include: coal, evaporites, eolianites, paleosol type, vegetation patterns, stratigraphic stacking patterns, and fluvial style. The utility of each of these criteria as paleoclimate indicators has been

previously addressed by a variety of authors (Lotts and Ziegler, 1994; Kendall, 1992; Retallack, 1994; Gastaldo et al., 1996; Cecil et al., 2003; Tabor and Poulsen, 2008) and is outside of the scope of this paper, with the exception of fluvial style. The recognition of distinct fluvial styles and their temporal and spatial patterns is one of the main criteria we use for interpreting periods of strongly seasonal paleoclimate (see main article for details).

The Windsor Group was not studied during the current project; however, details regarding the upper strata of the Windsor Group have been included within Table DR1 as well as for the time-space framework. The age of the upper strata of the Windsor Group varies across the basin; however, all Windsor strata are no younger than Brigantian in age (Utting, 1980; 1987; and others).

RISTIGOUCHE BASIN AND NORTHWEST NEW BRUNSWICK PLATFORM

The stratigraphy of the Ristigouche Basin and Northwest New Brunswick Platform (also referred to as the Central Basin) is taken from Jutras et al. (2007b).

PERCÉ GROUP

BONAVENTURE FORMATION

The late Visean (?Asbian to Brigantian) Bonaventure Formation is loosely constrained on the basis of stratigraphic relationships (Jutras and Prichonnet, 2005; 2007a,b), where it conformably overlies the Visean (?Asbian) Poodiac Formation and is conformably to disconformably overlain by the Pointe Sawyer Formation (Justras et al., 2001).

MABOU GROUP

POIINTE SAWYER FORMATION, CHEMIN-DES-PÊCHEURS FORMATION

The Pointe Sawyer Formation contains microfloral assemblages assigned to the *Schopfipollenites acadiensis-Knoxisporites triradiatus* and *Grandispora spinosa-Ibrahimispores magnifus* Concurrent Range Zones (Jutras et al., 2001). The Chemin-des-Pêcheurs Formation is constrained based on its conformable basal contact with the Pointe Sawyer Formation. The upper contact is not observed. Jutras et al., 2001 assigned a Namurian (Serpukhovian) age to the formation.

CUMBERLAND GROUP

RED PINE BROOK FORMATION

The Yeadonian to Langsettian (Bashkirian) Red Pine Brook Formation is constrained by palynofloral assemblages containing abundant *Lycospora*, as well as *Florinites*, *Schopfipollenites ellipsoids*, *Potonieisporites elegans*, and *Endosporites globiformis* indicating a Bashkirian age (Jutras et al., 2007a).

CLIFTON FORMATION, MEMBER A, B

Member A of the Clifton Formation is loosely constrained within the northern portion of the Central Basin and is assigned a Langsettian (Bashkirian) age based on its lithostratigraphic position below Member B of the Clifton Formation (Jutras et al., 2005). Member B contains a typical Westphalian spore assemblage. The presence of *Endosporites globiformis* suggests a basal age of late Langsettian with an upper age of Bolsovian to ?Asturian (Moscovian; Ball et al., 1981; Jutras et al., 2005; 2007a).

PICTOU GROUP

CLIFTON FORMATION, MEMBER C

Member C of the Clifton Formation is poorly constrained. The base of the formation is Bolsovian to ?Asturian (Moscovian) based on the conformable nature of the contact with the underlying Member B (Ball et al., 1981), however, the upper part of the formation has not been dated.

CENTRAL AND SOUTHEAST NEW BRUNSWICK PLATFORM

The stratigraphy of the Central Basin is taken from St. Peter (1997) and St. Peter and Johnson (1997).

MABOU GROUP

NEWCASTLE CREEK FORMATION, CUMBERLAND HILL FORMATION, HARDWOOD RIDGE BASALT, SHIN FORMATION

The stratigraphic position of the Newcastle Creek Formation, conformably overlain by the Cumberland Hill Formation, suggests a Visean age for the formation. A U-Pb zircon age of 335 +/- 2 Ma from rhyolites of the Cumberland Hill Formation indicates a Visean (Asbian) age for the formation (S. C. Johnson, pers. comm., 2009). Both the Cumberland Hill Formation and Hardwood Ridge Basalt conformably overlie the Newcastle Creek Formation, and are, in part, time-equivalent. The Hardwood Ridge

Basalt is also stratigraphically equivalent with the Visean to ?Serpukhovian Royal Road Basalt (St. Peter, 2000).

The Shin Formation conformably overlies the Windsor Group and is overlain in areas by the Royal Road Basalt which indicates a Visean to Suerpukhovian age for the formation (St. Peter 2000). This is supported by its lithostratigraphic similarity with the Newcastle Creek Formation on the central portion of the New Brunswick Platform and the Wanamaker, Scoodic Brook, and Hopewell Cape formations in southeastern New Brunswick.

CUMBERLAND GROUP

BOSS POINT FORMATION

The Kinderscoutian to early Duckmantian (Bashkirian) Boss Point Formation is constrained by both micro- and macrofloral assemblages. Within the New Brunswick basins, the formation is separated into two members, the Breau Creek and Cole Point members. The Breau Creek Member contains miospore assemblages that indicate a ?Kinderscoutian to early Langsettian age (Bashkirian; Dolby in St. Peter and Johnson, 2005). Assemblages near the base of the formation contain *Florinites* spp., *Schopfipollenites* spp., and *Raistrickia fulva* which indicate an age no older than Kinderscoutian, while assemblages near the top of the member contain the biostratigraphically significant *Spelaeotriletes arenaceus* (Dolby in St. Peter and Johnson, 2005). The Cole Point Member is dated as late Yeadonian to ?early Duckmantian (Bashkirian) based on microfloral assemblages. The base of the member is mostly Langsettian in age, however, Namurian elements such as *Florinites mediapudens* and *Vestispora costata* indicate a Yeadonian age (Dolby and Utting in St. Peter and Johnson, 2005) suggesting a diachronous boundary with the underlying Breau Creek Member. Striate, bisaccate pollen, *Florinites florinii*, *Wilsonites* spp., and *Raistrickia fulva* all indicate a mid-Langsettian to early Duckmantian age for the upper Cole Point Member (Dolby in St. Peter and Johnson, 2005).

PICTOU GROUP

MINTO FORMATION

The Minto Formation is constrained on the basis of both micro- and macrofloral assemblages. The formation contains a *Vestispora* zone miospore assemblage indicating

an early Bolsovian (Moscovian) age (Hacquebard, 1972; Kalkreuth et al., 2000). Kalkreuth et al. (2000) suggested that the microfloral assemblage from the Minto coal seam in the upper part of the formation could be correlated with the *Torispora securis*-*T. laevigata* zone of western Europe (Clayton et al., 1977) and the *T. securis*-*Vestispora fenestrata* zone of the Illinois Basin (Peppers, 1996). Macrofloral assemblages support a Bolsovian age (Bell in Muller, 1950; Bell, 1962).

HURLEY CREEK FORMATION, SUNBURY CREEK FORMATION

The Hurley Creek Formation is constrained lithostratigraphically. The formation displays a gradational contact with the underlying Minto Formation and a conformable contact with the overlying Sunbury Creek Formation, and is therefore Bolsovian in age (Ball et al., 1981). Miospore assemblages from the Sunbury Creek Formation indicate a late Bolsovian age (Ball et al., 1981). St. Peter (1997) has proposed that the lithologically similar Minto and Sunbury Creek formations be amalgamated into a single Minto Formation, and that the geographically isolated Hurley Creek Formation be downgraded to member status. While this proposal has gained wide acceptance, the Hurley Creek and Sunbury Creek formations have not yet been formally abandoned and as a result, their usage is retained.

SALISBURY FORMATION, RICHIBUCTO FORMATION

The Salisbury Formation contains a typical Duckmantian to Bolsovian transitional assemblage, with *Vestispora magna* and *V. pseudoreticulata* indicating a late Duckmantian age, and *Illinites unicus*, *Vestispora foveata*, and *Knoxisporites triradiatus* yielding an early Bolsovian age (Dolby in St. Peter and Johnson, 2005). The depositional hiatus between the Salisbury Formation and the Cole Point Member of the Boss Point Formation is not considered to be significant (St Peter and Johnson, *in press*).

The Richibucto Formation is constrained by palynofloral assemblages from the *Potonieisporites* zone (Dolby in St. Peter and Johnson, 2005). The presence of *Illinites unicus* and *Punctatosporites granifer* indicates a mid-Bolsovian age and suggests a diachronous contact with the underlying Salisbury Formation in southeast New Brunswick (Johnson, 1995). The upper age of the formation may be as young as Stephanian C (Gzhelian) based on the abundance of striate pollen and presence of *Granulatisporites elegans* (Dolby in St. Peter and Johnson, 2005).

MONCTON BASIN AND WESTMORELAND UPLIFT

Stratigraphy for the Moncton Basin and Westmoreland Uplift is largely taken from St. Peter and Johnson (1997).

MABOU GROUP

WANAMAKER FORMATION, SCOODIC BROOK FORMATION, HOPEWELL CAPE FORMATION

The stratigraphic position of both the Wanamaker and Scoodic Brook formations suggest a Visean to Serpukhovian age. Additionally, these and other previously undivided rocks assigned to the Mabou Group have recently been reassigned to the Bonaventure Formation by Jutras et al. (2007). While these units are all lithologically similar and stratigraphically equivalent, St. Peter and Johnson (in press), however, do not recognize the Bonaventure Formation in southeastern New Brunswick and retain the usage of the Wanamkaer and Scoodic Brook formations.

The Hopewell Cape Formation is loosely constrained by stratigraphic relationships within the Moncton Basin and Westmoreland Uplift, however, it has been dated within the Sackville Basin as Visean in age (Utting, 1987; Dolby in St. Peter and Johnson, 1997). Within the Moncton Basin, the formation is Pendleian to ?Arnsbergian (Bashkirian; St. Peter and Johnson, 1997).

CUMBERLAND GROUP

BOSS POINT FORMATION

Details on the age justification for the Boss Point Formation can be found in the section on the stratigraphy of the central and southeastern New Brunswick Platform.

PICTOU GROUP

SALISBURY FORMATION, RICHIBUCTO FORMATION, TORMENTINE FORMATION

The age justification for the Salisbury and Richibucto formations is given in the section on the stratigraphy of the central and southeastern New Brunswick Platform. The Tormentine Formation is loosely constrained based on lithostratigraphic relationships. The formation conformably overlies the Richibucto Formation (Johnson, 1995) and is therefore Stephanian (Kasimovian) in age, although it may be as young as early Permian.

SACKVILLE BASIN

The stratigraphy for the Sackville Basin is taken from St. Peter and Johnson (1997).

MABOU GROUP

HOPEWELL CAPE FORMATION, MARINGOUIN FORMATION

The Brigantian to ?Arnsbergian (late Visean to Serpukhovian) Hopewell Cape Formation has been dated within the Sackville Basin based on miospore assemblages. The basal part of the formation contains an *acadiensis-triradiatus* zone spore assemblage (Dolby in St. Peter and Johnson, 1997), although Utting (1987) reported assemblages from the *Knoxisporites stephanophorus* Concurrent Range Zone which may indicate that the base of the formation is as old as Asbian in age. The top of the formation is constrained on the basis of lithostratigraphic relationships and is assigned a Pendleian to ?Arnsbergian age based on correlations with the Enrage and Claremont formations in the eastern Cumberland Basin (see below).

The Maringouin Formation has been dated in the eastern Cumberland Basin as late Visean.

CUMBERLAND GROUP

BOSS POINT FORMATION

Details on the age justification for the Cumberland Group can be found in the section on the stratigraphy of the central and southeastern New Brunswick Platform.

PICTOU GROUP

SALISBURY FORMATION, RICHIBUCTO FORMATION, BALFRON FORMATION

The age justification for the Salisbury and Richibucto formations is given in the section on the stratigraphy of the central and southeastern New Brunswick Platform, while the age justification for the Balfron Formation can be found in the section on the Cumberland Basin stratigraphy.

HASTINGS UPLIFT AND EASTERN CUMBERLAND BASIN

Stratigraphy for the Hastings Uplift and eastern Cumberland Basin is taken from St. Peter and Johnson (1997) and Ryan et al. (1991).

MABOU GROUP

HOPEWELL CAPE FORMATION, MARINGOUIN FORMATION, SHEPODY FORMATION, ENRAGE FORMATION

The age justification for the Hopewell Cape Formation can be found in the above section on the Sackville Basin stratigraphy. The Maringouin Formation contains miospore assemblages assigned to the *acadiensis-triradiatus* zone (Dolby in St. Peter and Johnson, 2005). The large number of specimens of *Schopfipollenites acadiensis* suggests that the top of the formation may span the *acadiensis-triradiatus/spinosa-magnifus* zone boundary (Dolby in St. Peter and Johnson, 2005).

The Shepody Formation contains an *acadiensis-triradiatus* palynofloral assemblage in the lower part of the formation and a *spinosa-magnifus* assemblage in the upper part (Dolby in St. Peter and Johnson, 2005; Utting et al., 2005). The overlying Enrage Formation has yielded samples too poor for a confident age assessment, however the presence of *Cingulizonates* cf. *bialatus* suggests an age no younger than Namurian (Dolby in St. Peter and Johnson, 2005).

CUMBERLAND GROUP

BOSS POINT FORMATION, GRANDE ANSE FORMATION, MALAGASH FORMATION

The Boss Point Formation displays a high degree of diachroneity across New Brunswick from the west to the east, and in the eastern Cumberland Basin the formation is Yeadonian to Langsettian (Bashkirian) in age based on miospore assemblages (Dolby in St. Peter and Johnson, 2005) and would be placed within the newly recognized *Raistrickia saetosa* assemblage zone of Utting et al. (in press).

The Grande Anse Formation is constrained on the basis of miospore assemblages, however the date of the formation has been called into question. Miospores indicate a late Namurian (?Yeadonian) to early/middle Langsettian (Bashkirian) age (Dolby in St. Peter and Johnson, 2005). The assemblage contains *Florinites florinii, Wilsonites* spp. and *Cananoropollis mehtae* which suggest an age no older than early to middle Langsettian, while the absence of *Punctatosporites* spp., *Vestispora tortuosa* and *F. junior* indicates the section is no younger than Langsettian (Dolby in St. Peter and Johnson, 2005). Keighley et al. (2008) cautioned that a late Namurian to Langsettian age for the Grande Anse Formation may not be justified on the basis of the complex

stratigraphic/structural relationships of the Maringouin Peninsula in addition to the possibility of reworked spore assemblages. However, based on the available data, a tentative late Namurian to Langsettian age is proposed for the formation (c.f. Falcon-Lang et al., 2007; Falcon-Lang and Benton, 2008).

The age justification for the Malagash Formation is given in the section on the stratigraphy of the Cumberland Basin.

PICTOU GROUP

BALFRON FORMATION, TATAMAGOUCHE FORMATION, CAPE JOHN FORMATION

Details on the age justification for the Pictou Group can be found in the section on the stratigraphy of the Cumberland Basin.

CUMBERLAND BASIN

Stratigraphy of the Cumberland Basin is taken from Ryan et al. (1991).

MABOU GROUP

MIDDLEBOROUGH FORMATION, SHEPODY FORMATION, CLAREMONT FORMATION

Microfloral assemblages of the Middleborough Formation contain a high proportion of recycled Windsor Group material and have been assigned to the *acadiensis-triradiatus* zone (Dolby, 1988a). The base of the formation is believed to be time-equivalent with the underlying Windsor Group (Lime-kiln Brook Formation) based on lithostratigraphic relationships (Bell, 1944; Ryan and Boehner, 1994).

The Brigantian to Pendleian (late Visean to Serpukhovian) Shepody Formation contains an *acadiensis-triradiatus* zone palynofloral assemblage in the lower part of the formation and a *spinosa-magnifus* zone assemblage in the upper part (Utting et al., 2005). The overlying Claremont Formation also contains a *spinosa-magnifus* zone assemblage within the lowest portion of the formation (Utting et al., 2005), however, the top of the formation is not well constrained. An unconformity between the Claremont and overlying Boss Point Formation has been inferred by numerous authors (Calder, 1998; Waldron and Rygel, 2005; Utting et al., in press) and an age no younger than Arnsbergian has been suggested for the top of the formation (Calder, 1998; Utting et al., in press).

CUMBERLAND GROUP

BOSS POINT FORMATION

The Boss Point Formation within the Cumberland Basin contains miospores that have been assigned a Yeadonian to earliest Langsettian age (Bashkirian; Dolby, 1991; Utting et al., in press). These assemblages have recently been assigned to a new palynologic zone, the *Raistrickia saetosa* assemblage zone by Utting et al. (in press). Dolby (1991) placed the formation entirely within the Langsettian based on the presence of *Dictyotriletes reticulocingulum* and *D. castanaeformis* and the absence of *Florinites* spp. However, Namurian elements were recognized by both Dolby (1991) and Utting et al. (in press), and a Yeadonian age is likely for part of the formation. The presence of *Apiculatasporis spinosaetosa* near the base of the formation suggests an age close to the Yeadonian/Langsettian boundary (Utting et al., in press). Rare macrofloral remains within the Boss Point Formation support a Langsettian age assignment (Utting and Wagner, 2005).

LITTLE RIVER FORMATION

The ?Yeadonian to Langsettian (Bashkirian) Little River Formation is constrained by a low diversity microfloral assemblage dominated by *Lycospora pusilla*, *Potonieisporites*/*Florinites* complex, and *Schopfipollenites ellipsoides* which is characteristic of a *R. saetosa* zone assemblage (Utting et al., 2005; in press). The base of the Little River Formation is problematic. The formation has been dated as either Marsdenian to Yeadonian (Utting in Calder et al., 2005) or earliest Langsettian (Dolby 1991; 2003). The Little River Formation contains a palynoflora typical of upper Boss Point-lower Joggins miospore assemblages. A single specimen of *Cananoropollis mehtae* was used to assign a basal Langsettian age to the formation (Dolby, 2003). However, based on the persistence of Namurian floral elements that emphasized the proximity of the Little River to the Namurian-Westphalian boundary, and due to the limitations of the data, the base of the Little River was cited by Calder et al. (2005) as latest Namurian (Yeadonian). Based on the stratigraphic position with the underlying Boss Point Formation as well as the available biostratigraphic data, the base of the Little River Formation is most likely Langsettian.

JOGGINS FORMATION

The Joggins Formation is constrained biostratigraphically on the basis of both micro- and macrofloral assemblages. Miospore assemblages indicate a Langsettian (late Bashkirian) age (Dolby, 1991; Utting et al., 2005). The miospore assemblages for the Joggins (as well as for the overlying Springhill Mines and lower Ragged Reef formations) are similar to the underlying Boss Point and Little River formations; however, these assemblages also contain small monolete spores (Utting et al., 2005). Utting et al. (in press) have recently proposed a new palynological zone for this assemblage, the *R. fulva* assemblage zone. Macroflora (most significantly *Neuralethopteris schlehanii* and *Karinopteris acuta*) from the *Lyginopteris hoeninghausi-Neuralethopteris schlehani* macrofloral zone of Wagner (1984), support a Langesttian age (Utting and Wagner, 2005). Although, Namurian floral elements have been recognized within the basal Joggins Formation (Utting and Wagner, 2005; Calder et al., 2006), the bottom of the formation is placed within the Langsettian based on its stratigraphic position overlying the ?Yeadonian to Langsettian Little River Formation (Calder et al., 2005).

SPRINGHILL MINES FORMATION, POLLY BROOK FORMATION

The Langsettian Springhill Mines Formation is constrained by both micro- and macrofloral assemblages (Dolby, 1986; 1987; 1991; Utting et al., 2005; Utting and Wagner, 2005). The formation contains a *R. fulva* miospore assemblage (Utting et al., in press). Macrofloral assemblages are very similar to those in the underlying Joggins Formation and were assigned a late Langsettian age by Utting and Wagner (2005).

The Polly Brook Formation is constrained on the basis of lithostratigraphic relationships. The formation is laterally equivalent to the Little River, Joggins, and Springhill Mines formations and is given a Langsettian (Bashkirian) age. Recent subsurface evidence has suggested that the upper part of the Polly Brook Formation may be correlative with the lower Ragged Reef Formation (J. Waldron pers. comm., 2008), however, this would still yield a Langsettian age for the Polly Brook Formation.

RAGGED REEF FORMATION, MALAGASH FORMATION

Miospore assemblages contained within the Ragged Reef Formation were previously interpreted as middle Duckmantian to early Bolsovian age (Bashkirian to

Moscovian; Dolby, 1987, 1989, 1991). Recently, Utting et al. (in press) have re-evaluated the miospore assemblages and recognize a *R. fulva* zone assemblage within the lower portion of the Ragged Reef where the formation crops out at the Joggins section (near Two Rivers). At Spicer's Cove, strata assigned to the Ragged Reef formation contain spore assemblages from the *Vestispora magna* assemblage zone which indicate a late Duckmantian (early Moscovian) age (Utting et al., in press). Megafloral assemblages containing *Sphenopteris coemansii* within the upper part of the formation support a Duckmantian to Bolsovian age (Utting and Wagner, 2005). On the palynologic data, Utting et al. (in press) postulated that a hiatus may occur within the Ragged Reef Formation between strata at the top of the Joggins section and strata at Spicer's Cove. These authors also stated that this apparent hiatus may be the result of beds not being sampled due to lack of exposure and complex stratigraphic and structural relationships within this part of the section (Utting et al., in press).

Previous studies have noted that the stratigraphic context of the Ragged Reef Formation at Spicer's Cove is uncertain due to faulting (Ryan et al., 1991; Ryan and Boehner, 1994). The upper Ragged Reef Formation (Spicers Cove Member; Ryan et al., 1991; 'Spicers Cove Formation;' Utting et al., in press) was observed to be in fault contact with basin margin fanglomerates of uncertain age (Devonian to Carboniferous; Ryan et al., 1990). However, the current study asserts that the upper part of the Ragged Reef Formation and underlying fanglomerate facies is not in fault contact and is instead a continuous stratigraphic succession. This is observed only on the intertidal shoreface at low tide, where conglomerates dipping at the same orientation as the fanglomerate facies are interbedded with rocks assigned to the Ragged Reef Formation. This interpretation implies that the upper Ragged Reef (Spicers Cove Member) at Spicers Cove is a basin marginal facies that is observed to transition into more distal facies to the north. This suggests that the Ragged Reef Formation is a continuous stratigraphic section without any significant hiatus. Until further biostratigraphic work can be conducted on the middle portion of the formation from Shulie to Spicers Cove, the age of the Ragged Reef remains tentative.

The Malagash Formation has been assigned a Bolsovian to Asturian (Moscovian) age (Dolby, 1986; 1987) based on the presence of *Vestispora* sp. *Torispora* sp., and *Thymospora* sp.

PICTOU GROUP

BALFRON FORMATION, TATAMAGOUCHE FORMATION

The Pictou Group within the Cumberland Basin is constrained biostratigraphically based on miospore assemblages. The Asturian to Stephanian (Moscovian to Kasimovian) Balfron Formation contains an assemblage characteristic of the *Potonieisporites* zone and contains Stephanian markers such as *Centonites symmetricus*. However, the base of the formation contains *Lophotriletes microsaetosus* which indicates an Asturian age (Dolby, 1986; 1987). The Tatamagouche Formation contains a *Potonieisporites* zone miospore assemblage (Dolby, 1987).

CAPE JOHN FORMATION

The Stephanian to ?early Permian Cape John Formation contains *Potonieisporites* and *Vittatina* zone assemblages (Dolby, 1986; 1987). It is interesting to note that samples from Cape John yield an Asturian palynofloral assemblage containing *Lycospora* spp., *Reticulatisporites reticulatus*, and *Vestispora* aff. *Pseudoreticulata* (Dolby, 1987). One explanation for this apparent discrepancy in age may be due to the location where these samples were collected. Samples were collected near a structurally disturbed (faulted and folded) area (Ryan and Boehner, 1990), whereas samples from other areas yield a definitively Stephanian age. An early Permian age for the formation is supported by the tetrapod trace fossil assemblage within the world's only walchian conifer forest preserved at Brule (van Allen et al., 2005). The ichnofauna includes *Batrachichnus*, *Limnopus*, *Amphisauropus*, *Varanopus*, *Dromopus*, and *Dimetropus*, which is consistent with the Wolfcampian of the southwestern U.S. and the Lower Rotliegend of Europe (Calder, 2000; Hunt et al., 2005)

MINAS BASIN

MABOU GROUP

WEST BAY FORMATION

The Brigantian to Arnsbergian (late Visean to Serpukhovian) West Bay Formation is loosely constrained on the basis of miospore assemblages. Miospore

assemblages that could be assigned to the *acadiensis-triradiatus* and *spinosa-magnificus* zones have been reported from the formation (Barss in Carroll et al., 1975; Dolby in Naylor and Kennedy, 1997). The formation is lithologically similar to the Hastings and lower Pomquet formations which lends support to a Brigantian to Arnsbergian age assignment.

CUMBERLAND GROUP

BOSS POINT FORMATION, PARRSBORO FORMATION, FOWLER HEAD FORMATION

The age of the Boss Point Formation within Nova Scotia is detailed in the Cumberland Basin section. Palynofloral assemblages of the Parrsboro Formation have been assigned to the latest Namurian (?Yeadonian) to early Langsettian (Bashkirian; Barss in D'Orsay, 1986; Dolby in Naylor and Kennedy, 1997). A predominantly Langsettian age is supported by the macrofloral and faunal assemblages (Bell, 1944), as well as by the tetrapod trace fossil assemblage (Hunt et al., 2004).

The Fowler Head Formation contains a late Duckmantian to early Bolsovian miospore assemblage (Donohoe and Wallace, 1982).

PICTOU GROUP

SCOTCH VILLAGE FORMATION

The Scotch Village Formation is loosely constrained by a *Thymospora* zone miospore assemblage (Barss and Haquebard, 1967). The top of the formation is not observed, however, the upper part of the formation may be as young as Stephanian.

NEW GLASGOW AND STELLARTON GAP

The stratigraphy from the New Glasgow and Stellarton Gap areas comes from Chandler et al. (1997).

MABOU GROUP

HOLLOW CONGLOMERATE

The Hollow Conglomerate is loosely constrained on the basis of lithostratigraphic relationships. Chandler et al. (1997) noted that the contact with the apparently overlying Lismore Formation was uncertain, however, Fralick and Schenk (1981) observed that the Hollow Conglomerate is interbedded with and grades into the Lismore Formation. The Hollow Conglomerate has been interpreted as an alluvial fan deposit (Fralick and Schenk,

1981) and based on the above relationships is, in part, time equivalent with the overlying more distal strata of the Lismore Formation. Based on this information a tentative Brigantian to Pendleian (latest Visean to Serpukhovian) age is suggested for the unit.

LISMORE FORMATION, CLAREMONT FORMATION

The basal Lismore Formation contains an *acadiensis-triradiatus* zone palynoflora (Utting, 1987), while Namurian assemblages have been recognized farther upsection (Chandler, 1997). The top of the formation has been placed within the Namurian (Pendleian to ?earliest Arnsbergian). While Chandler (1997) reports that younger, Alportian-Kinderscoutian spores have been recovered from the formation, the assignment of these spores to the Bashkirian was speculative. Based on patterns of sedimentation in adjacent basins and within the Maritimes as a whole, a Serpukhovian age seems more likely.

The age of the Claremont Formation is detailed within the section on the Cumberland Basin stratigraphy.

CUMBERLAND GROUP

BOSS POINT FORMATION, NEW GLASGOW FORMATION, MALAGASH FORMATION

In the New Glasgow area, miospore assemblages assigned to the latest Namurian (?Yeadonian) to the early Langsettian (Bashkirian) have been recovered from the Boss Point Formation (Chandler, 1997).

The Langsettian to ?Duckmantian (Bashkirian) New Glasgow Formation contains an early Langsettian spore assemblage along with late Namurian palynofloral elements (Chandler, 1998). The conformable relationship with the underlying Boss Point Formation supports a basal Langsettian age. The upper part of the formation is loosely constrained based on lithostratigraphic relationships. The New Glasgow Formation has been correlated with the Little River, Joggins, and Polly Brook formations within the Cumberland Basin, and contains a similar proximal to distal facies succession (Chandler, 1998; Buchan and Chandler, 1999).

The age constraints for the Malagash Formation are detailed within the section concerning Cumberland Basin stratigraphy.

PICTOU GROUP

The Pictou Group has not been differentiated into separate formations within the New Glasgow area. Miospore assemblages from the *Thymospora* and *Potonieisporites* zones were recovered from the base of the Pictou Group (Dolby in Chandler et al, 1997). The contact with the underlying Malagash Formation was observed to be conformable in a nearby core (Chandler et al., 1997), however, only 750 meters of the basal Pictou Group was recovered and an upper age range is not available.

STELLARTON BASIN

Stratigraphy of the Stellarton Basin is taken from Waldron et al., (1999) and Waldron (2004).

MABOU GROUP

The Mabou Group is loosely constrained within the Stellarton Basin and has been assigned a late Visean to Pendleian (Serpukhovian) age (Chandler et al., 1997; Waldron et al., 1999).

CUMBERLAND GROUP

STELLARTON FORMATION

The Langsettian to Asturian (Bashkirian to Moscovian) Stellarton Formation is subdivided into 7 members that are constrained predominantly on the basis of microfloral assemblages. The Middle River Member and base of the Skinner Brook Member contain Langsettian spore assemblages (Waldron, 2004). The upper part of the Skinner Brook Member contains a *Vestispora* assemblage (Waldron, 2004). Waldron et al. (1999) and Waldron (2004) speculated that the Duckmantian within the Stellarton Basin is either condensed or missing within the Skinner Brook Member.

The Westville, Albion, and Coal Brook Members are dated as Bolsovian in age based on miospores assigned to the *Vestispora* and *Torispora* zones (Waldron, 2004). The Acadia seam within the Westville Member was assigned an early Bolsovian age, while the Foord seam at the top of the Albion Member was assigned a late Bolsovian age (Yeo et al., 1988). A *Paripteris linguaefolia* macrofloral zone assemblage also indicates a Bolsovian age for these members (Bell, 1940). The Plymouth Member is constrained lithostratigraphically to the Bolsovian, based on its lateral equivalence with the top of the Westville, Albion, and base of the Coal Brook Members (Waldron et al., 1999).

Miospores at the base of the Thornburn Member have been assigned to the *Torispora* zone (Waldron, 2004), while the upper and lower MacKay seams near the top of the member were dated as Asturian based on the presence of *Thymospora pseudothiesseni* (Yeo et al., 1988).

ANTIGONISH BASIN

The stratigraphy of the Antigonish Basin is taken from Boehner and Giles (1993).

MABOU GROUP

HASTINGS FORMATION

Spores recovered from the reference section of the Hastings Formation in Pomquet River were dated as late Visean to earliest Namurian (?Pendleian) by Neves and Belt (1970). This age assignment was supported by Utting (1980) who reported that the assemblage was characteristic of the *spinosa-magnificus* zone. The occurrence of *Potonieisporites elegans* may indicate a late Pendleian age which agrees with the intertonguing nature of the Hastings and Pomquet formations.

POMQUET FORMATION

The basal Pomquet Formation is constrained by a *spinosa-magnificus* zone miospore assemblage. The upper age limit of the formation is problematic. Poorly preserved palynofloras resembling a *Reticulatisporites carnosus* assemblage zone have been recovered from the Pomquet Formation (Hamblin, 2001; Utting and Giles, 2004; 2008). Based on this, these authors assigned a Pendleian to Arnsbergian age to the formation. However, Neves and Belt (1971) suggested that the Arnsbergian-Chokierian (Serpukhovian-Bashkirian) boundary occurs within the Pomquet Formation. Furthermore, a Langsettian age spore assemblage was recovered from a coaly horizon near the contact with the Port Hood Formation (Belt, 1965). The contact with the overlying Port Hood Formation was inferred to be conformable by Belt (1965). Based on stratigraphic information and the most recent biostratigraphic work, however, an Arnsbergian age for the upper Pomquet Formation is likely.

CUMBERLAND GROUP

PORT HOOD FORMATION

Spore assemblages have not been recovered from the Port Hood within the Antigonish Basin, however, based on lithostratigraphic relationships with the underlying

Pomquet Formation and spore assemblages recovered from West Cape Breton, the Port Hood is assigned a Bashkirian age (Boehner and Giles, 1993).

PRINCE EDWARD ISLAND

The stratigraphy of Prince Edward Island is taken from van de Poll (1989).

PICTOU GROUP (PRINCE EDWARD ISLAND GROUP; informal)

MIMINEGASH FORMATION, EGMONT BAY FORMATION

The strata of Prince Edward Island are all constrained biostratigraphically based principally on miospore assemblages. Many of the palynological data come from assemblages identified from units within the subsurface (Barss et al., 1963; Barss and Hacquebard, 1967) which have been related to surface units on Prince Edward Island (van de Poll, 1989).

The top of the Miminegash Formation is assigned a Stephanian (Kasimovian) age based mainly on macroflora and miospore assemblages. The macrofloral assemblage was assigned a Stephanian age by Darrah (1936) and a Permian age by Holden (1913). Miospore assemblages from the *Potonieisporites* assemblage zone are found within strata of the Shediac area of New Brunswick. When projected into the subsurface, the strata correlate with beds of the Miminegash Formation (van de Poll, 1989). Additionally, the presence of the bivalve *Carbonita inflata*, a Carboniferous species, supports a Stephanian (Kasimovian) age (Copeland, 1957).

Miospores of the *Potonieisporites* assemblage zone are found within subsurface strata assigned to the Egmont Bay Formation which indicates a Stephanian (Kasimovian-?Gzhelian) age (Barss et al., 1963; Barss and Hacquebard, 1967). The macrofloral assemblage which consists of *Pecopteris, Alethopteris*, *Neuropteris*, *Cordaites*, *Calamites, Arborescens*, and *Walchia* has been described as identical to floral assemblages occurring within coal measures of latest Pennsylvanian age from Nova Scotia and New Brunswick (Dawson and Harrington, 1871) and support a Stephanian (Kasimovian-?Gzhelian) age for the formation.

KILDARE CAPES FORMATION

The age of the Kildare Capes Formation is loosely constrained on the basis of miospore and vertebrate assemblages. Miospore assemblages assigned to the *Vittatina* assemblage zone indicate a Sakmarian age (Barss et al., 1963; Barss and Hacquebard,

1967). Macrofloral assemblages have also been interpreted as early Permian in age (Dawson and Harrington, 1871; Ziegler et al., 2002). An early Permian age is also indicated by vertebrate assemblages consisting of *Eryops megacephalus*, *Xenacanthus*, and *Diadictes* (Langston, 1963). Mossman and Pace (1989) assigned vertebrate trackways found near Gallas Point to *Amplisauropus latus*, *Gilmoreichnus kablikae*, and possibly *Ichniotherium willsi* which indicate an early Permian (?Asselian) age. These authors compared the ichnofauna with European equivalents from late Autunian strata. On the basis of both floral and faunal evidence, an early Permian (Asselian-Sakmarian) age for the Kildare Capes Formation is justified. van de Poll (1989) has suggested that the Carboniferous-Permian boundary is located at or near the base of this formation.

HILLSBOROUGH RIVER FORMATION, ORBY HEAD FORMATION (not shown in Fig. 3; main article)

The base of the Hillsborough River Formation is largely constrained on the basis of stratigraphic relationships. Strata of the Malpeque and Woods Islands Members of the Hillsborough River Formation are recorded to be conformable with the underlying Kildare Capes Formation and suggests an age no older than Asselian-Sakmarian (van de Poll, 1989). A vertebrate assemblage from the Spring Valley area was assigned an Artinskian age by Langston (1963). The faunal assemblage is consistent with the land-vertebrate faunachron C of Lucas (2002) confirming an early Permian age (Calder et al.; 2004). Calder et al. (2004) identified tetrapod trackways at Malpeque Bay and assigned them to the ichnogenera *Notalacerta* and *Gilmoreichnus*. These authors assign a late Stephanian age to the strata at Malpeque Bay (Malpeque Member) and suggest that the rocks young northward.

The Orby Head Formation is assigned an Artinskian age based on miospore and vertebrate assemblages. Miospore assemblages suggest either an early Permian or Stephanian to early Permian age (van de Poll, 1989). Vertebrate fossils, most notably the type specimen of the mammal-like reptile *Bathygnathus borealis*, have been assigned an early Artinskian age (Langston, 1963).

PRINCE EDWARD ISLAND SUBSURACE AND GULF OF ST. LAWRENCE

The stratigraphy and biostratigraphy from the subsurface of Prince Edward Island and adjacent Gulf of St. Lawrence is taken from Giles and Utting (1999).

MABOU GROUP

SHEPODY FORMATION, HASTINGS FORMATION, POMQUET FORMATION

No pollen samples were taken from strata assigned to the Shepody Formation in the subsurface of Prince Edward Island. However, age justifications for the Shepody Formation can be found under the section detailing with the stratigraphy of the Cumberland Basin. Similarly, age constraints for both the Hastings and Pomquet formations can be found under the section on West Cape Breton stratigraphy. The Shepody Formation has been correlated by Giles and Utting (1999) as laterally equivalent to the Hastings Formation (Brigantian to Pendleian) and conformably overlain by the Pomquet Formation (Pendleian to Arnsbergian), which suggests that the age of the upper part of the Shepody Formatioin is diachronous from where it crops out in the Cumberland Basin in comparison with the subsurface.

CUMBERLAND GROUP

PORT HOOD FORMATION

The Port Hood formation is described in the section detailing the stratigraphy of the West Cape Breton Basin. It is interesting to note that within the subsurface the Port Hood has been interpreted to have experienced significant erosion such that the entire Colindale Member and upper part of the Margaree Member has been removed (Giles and Utting, 1999).

PICTOU GROUP

BRADELLE FORMATION, GREEN GABLES FORMATION, CABLE HEAD FORMATION, NAUFRAGE FORMATION

The entire Pictou Group is constrained on the basis of miospore assemblages. Age assessment for these units is still preliminary, and as a result, individual units have not been assigned to established spore zones. However, the preliminary age assignments given by Giles and Utting (1999) are presented herein.

The base of the Bradelle Formation is diachronous and ranges from late Duckmantian (Moscovian) in the Tyrone #1 well of south-central Prince Edward Island to Asturian in the Gulf of St. Lawrence. The top of the formation is Asturian to ?Stephanian (Moscovian to ?Kasimovian). The base of the Green Gables Formation is also diachronous ranging in age from Bolsovian to Asturian/?Stephanian (Moscovian).

The top of the formation is Stephanian (Kasimovian) in age. The Cable Head Formation is entirely Stephanian in age. The Naufrage Formation is predominantly Stephanian (Kasimovian to Gzhelian); however, based on correlations with strata of the Kildare Capes Formation on Prince Edward Island, Giles and Utting (1999) tentatively placed the Carboniferous-Permian boundary within the upper part of the Naufrage Formation.

Unnamed redbeds overlie the Naufrage Formation in a number of wells; however, no samples were taken for biostratigraphic analysis.

WEST CAPE BRETON BASIN

Stratigraphy of the West Cape Breton Basin is taken from Giles et al. (1997a,b).

MABOU GROUP

HASTINGS FORMATION, POMQUET FORMATION

The Brigantian to Pendleian (latest Visean to Serpukhovian) Hastings Formation contains a miospore assemblage assigned to the *spinosa-magnifus* zone (Hamblin, 2001). The Pomquet Formation contains a palynoflora that spans the *spinosa-magnifus* and *carnosus* zones (Hamblin, 2001; Utting and Giles, 2008) and is assigned a latest Pendleian to Arnsbergian (Serpukhovian) age.

CUMBERLAND GROUP

PORT HOOD FORMATION, HENRY ISLAND FORMATION

The Port Hood Formation contains spores that span the *Reticulatisporites saetosa* and R. *polygonalis* assemblage zones (Dolby in Allen, 1999; Utting and Giles, 2008) and is assigned a Yeadonian to Langsettian (Bashkirian) age. The upper Colindale Member of the Port Hood Formation lies entirely within the Langsettian (Barss and Hacquebard, 1967; P.S. Giles, pers. comm., 2008). A Langsettian age for the Colindale Member is supported by the megafloral assemblage that is characterized by *Neuropteris schlehani* and *Mariopteris acuta* indicative of the *hoeninghausi-schlehani* macrofloral zone (Bell, 1944).

The Duckmantian to Bolsovian (Bashkirian to Moscovian) Henry Island Formation is loosely constrained by miospore assemblages. Near the base of the formation, Duckmantian spores have been recovered (P.S. Giles, pers. comm., 2008). The contact between the Henry Island Formation and the underlying Port Hood Formation is observed only in core and the nature of this contact is uncertain as

summarized by Allen (1999). Due to the problematic nature of the contact between the Port Hood and the Henry Island formations, a Duckmantian age is assigned to the base of the Henry Island Formation with an unconformable contact with the underlying Langsettian Port Hood Formation. The upper part of the formation contains a *Torispora* zone palynoflora (P.S. Giles, pers. comm., 2008) indicating a late Bolsovian age.

INVERNESS FORMATION

The Inverness Formation contains miospore assemblages spanning the *Torispora* to *Potonieisporites* assemblage zones (Barss and Haquebard, 1967; Dolby in Brown, 1998) yielding an age of Bolsovian to Stephanian (Moscovian to Kasimovian). Macrofloral assemblages recovered from the Mabou Mines Coal Mine Point section contain flora from the *Lonchopteris* and *Linopteris oblique* floral zones of Bell (1938) that were established for the Sydney coalfield, and were assigned a Bolsovian to Asturian age (Zodrow and Vasey, 1986).

The exact nature of the boundary between the Inverness Formation and the underlying Henry Island Formation is not observed at outcrop. The contact has been recognized, however, within seisimic profiles where it has been observed to be conformable to locally unconformable (Brown, 1998). The contact may also be diachronous in nature. The top of the Henry Island Formation contains thin coals and other facies similar to the basal Inverness Formation, and based on the palynofloral assemblages, the upper Henry Island and lower Inverness formations are age equivalent (Dolby in Brown, 1998; P.S. Giles, pers. comm., 2008).

The top of the formation is loosely constrained to the earliest Stephanian (?Cantabrian to Barruelian) based on the presence of large amounts of striate pollen such as *Striatoabietes*. However, the top of the formation may be significantly younger based on specimens resembling *Vittania* sp. (Dolby in Brown, 1998).

PICTOU GROUP

BROAD COVE FORMATION

The Broad Cove Formation is loosely constrained by lithostratigraphic relationships. The formation conformably overlies the Inverness Formation and is no older than Stephanian (Kasimovian). Some authors have suggested an early Permian age for the formation (Giles et al., 1997a, b).

LOCH LOMOND BASIN AND GLENGARRY HALF GRABEN

The stratigraphy for the Loch Lomond Basin and Glengarry Half Graben comes from Boehner and Prime (1985; 1993).

MABOU GROUP

MACKEIGAN LAKE FORMATION

The MacKeigan Lake Formation is dated as latest Brigantian to Pendleian (latest Visean to Serpukhovian) based on a *spinosa-magnifus* palynoflora (Boehner and Prime, 1993). The formation was divided into three to four informal units by Boehner and Prime (1993). The top unit consists of red mudstone, sandstone, and conglomerate with abundant mottling and calcrete nodules and may correlate with the Pomquet Formation based on the similar lithofacies.

CUMBERLAND GROUP

SILVER MINE FORMATION, BIG BARREN FORMATION, GLENGARRY VALLEY FORMATION

The Silver Lake Formation is loosely constrained by palynomorphs assigned to the late Namurian to Langsettian. The Big Barren Formation has not yielded any dateable spore assemblages; however, it is constrained lithostratigraphically by the underlying Silver Lake Formation and the overlying Glengarry Valley Formation. Both the lower and upper contacts are conformable and gradational. The Bolsovian to Asturian (Moscovian) Glengarry Valley Formation contains both *Torispora* and *Thymospora* zone spore assemblages (Boehner and Prime, 1993).

SYDNEY BASIN

Stratigraphy of the Sydney Basin is from Boehner and Giles (1986; 2008).

MABOU GROUP

CAPE DAUPHIN FORMATION, POINT EDWARD FORMATION

The Cape Dauphin Formation contains well-preserved miospore assemblages assigned to the *spinosa-magnifus* zone (Hamblin, 2001). The Point Edward Formation contains a palynoflora that spans the *spinosa-magnifus* and *carnosus* zones (Hamblin, 2001; Utting and Giles, 2008) and is assigned a latest Pendleian to Arnsbergian (Serpukhovian) age. It is in part laterally equivalent with the underlying Cape Dauphin Formation with an intertonguing relationship (Boehner and Giles, 2008).

MORIEN GROUP

SOUTH BAR FORMATION, WADDENS COVE FORMATION

The South Bar Formation is dated as Duckmantian to Asturian (latest Bashkirian to Moscovian) based on miospore assemblages (Dolby, 1988c; 1989b). Dolby (1988c) recognized several palynological events which he separated into three zones. Zone 1 corresponds to the *Vestispora* zone of Barss and Haquebard (1967), while Zones 2 and 3 correspond to the *Torispora* zone (Dolby, 1988c). Within the type section of the South Bar Formation at Victoria Mines, Dolby (1989b) placed the Bolsovian-Asturian boundary at 506 meters from the bottom of the formation based on the presence of *Thymospora* spp.

The Bolsovian (Moscovian) Waddens Cove Formation is taken from Dolby (1988c). Miospore assemblages from the lower half of the formation were assigned to Zone 1 which corresponds to the *Vestispora* zone. The upper half of the formation is constrained on the basis of lithostratigraphic relationships. The formation displays a conformable, gradational boundary with the overlying Sydney Mines Formation in the eastern portion of the basin (Boehner and Giles, 2008).

SYDNEY MINES FORMATION

The Sydney Mines Formation is well constrained by both mega- and microfloral assemblages. Megafloral assemblages from the *Linopteris obliqua* and *Ptychocarpus unitus* zones of Bell (1938) yield a Bolsovian to Asturian age which was confirmed and extended into the Cantabrian by Zodrow and Cleal (1985). Palynomorph assemblages suggest an age of latest Bolsovian to Cantabrian (Moscovian to earliest Kasimovian) and contain spores from the *Torispora, Thymospora*, and *Potonieisporites* assemblage zones (Barss and Haquebard, 1967; Dolby, 1988c; 1989b). The base of the Sydney Mines Formation is diachronous across the basin, and based on palynofloral assemblages it is Asturian in the central part of the basin where it overlies the South Bar Formation and is latest Bolsovian in the eastern part of the basin where it overlies the Waddens Cove Formation (Dolby, 1988c; Boehner and Giles, 2008). Dolby (1988c) placed the Asturian-Cantabrian boundary, 25.3 meters above the Hub Seam at the Bras d'Or section based on the presence of *Angulisporites splendidus, Savitrisporites hoffmeisterii*, and *Columinisporities* c.f. *ovalis*. This is in broad agreement with macrofloral data that

suggest that the Asturian-Cantabrian boundary lies below the Lloyd Cove Seam (Zodrow and Cleal, 1985).

PICTOU GROUP

Biostratigraphic dating of the overlying redbeds assigned to the Pictou Group has not been conducted to date. The Pictou Group conformably overlies the Sydney Mines Formation and is assigned a Cantabrian (Kasimovian) age at the base of the formation. The top of the formation is not constrained although some authors have suggested an earliest Permian age (Boehner and Giles, 2008).

BAY ST. GEORGE BASIN

CODROY GROUP

ROBINSONS RIVER FORMATION, WOODY CAPE FORMATION

The Holkerian to Brigantian (Visean) Robinsons River Formation is constrained by miospore assemblages. The lower part of the Robinsons River Formation contains palynoflora from the *Lycospora pusilla-Densosporites columbaris* Concurrent Range Zone and *stephanephorus* assemblage zone, while the upper part of the formation contains assemblages from the *acadiensis-triradiatus* zone (Utting and Giles, 2004). The Woody Cape Formation also contains an *acadiensis-triradiatus* zone miospore assemblage (Utting and Giles, 2004).

BARACHOIS GROUP

SEARSTON FORMATION, UNNAMED COAL MEASURES

The Searston Formation contains miospore assemblages of the *carnosus* assemblage zone (Utting and Giles, 2008). The "unnamed coal measures" of the upper part of the Barachois were previously assigned a Langsettian age (Hyde et al., 1991), however, this age assessment was based on poorly preserved specimens that were assigned to *Endosporites globiformis*, which have been reinterpreted as *Auroraspora solisorta*, a species that ranges from Asbian to Langsettian. A Langsettian age for the Searston Formation was also given by Bell (1948) on the basis of a macrofloral assemblage containing the biostratigraphically significant species *Lyginopteris hoeninghausii*. Utting and Giles (2008) note that a Langsettian age for the "unnamed coal measures" in the upper part of the Barachois Group is problematic, because it suggests a ~4 m.y. hiatus between these beds and the underlying Searston Formation.

However, the contact between these two units has been observed as gradational in nature. On this basis, Utting and Giles (2008) correlate the "unnamed coal measures" with the upper part of the Searston Formation. Lithostratigraphically, the Searston Formation contains a very similar succession with other late Namurian to Langsettian units throughout the Maritimes Basin (Knight, 1983).

PICTOU GROUP

BLANCHE BROOK COAL MEASURES

The Bolsovian (Moscovian) Blanche Brook coal measures contain *Vestispora* and *Torispora* zone miospore assemblages (Hyde et al., 1991). Macrofloral assemblages support a Bolsovian age (Bashforth, 2005).

DEER LAKE BASIN

The stratigraphy of the Deer Lake Basin comes from Hyde et al. (1991)

DEER LAKE GROUP

NORTH BROOK FORMATION, ROCKY BROOK FORMATION, HUMBER FALLS FORMATION, LITTLE POND BROOK FORMATION

The North Brook Formation is loosely constrained on the basis of lithostratigraphic relationships. The formation is equivalent with the upper Codroy and Windsor Groups and is assigned a Brigantian (Visean) age (Utting and Giles, 2008). The latest Brigantian to Pendleian (Visean to Serpukovian) Rocky Brook Formation contains miospore assemblages of the *spinosa-magnifus* zone (Hamblin et al., 1997). The basal portion of the Rocky Brook Formation is interpreted to be equivalent in age to the underlying North Brook Formation in some areas based on lithologic similarity (Hyde, 1995). The Humber Falls Formation is assigned a latest Pendleian to Arnsbergian age based on lithologic similarity with the Searston Formation (Hyde, 1983; Utting and Giles, 2008). The Little Pond Brook Formation contains a Visean to Namurian spore assemblage and are considered correlative with the Humber Falls Formation (Hyde, 1995).

HOWLEY FORMATION

The age of the Howley Formation is not entirely certain. The formation has been dated as Langsettian (Bashkirian) on the basis of miospore assemblages (Haquebard et al., 1960). However, Utting and Giles (2008) correlate the formation with the

lithologically similar “unnamed coal measures” of the upper Searston Formation which has recently undergone a palynofloral revision, and assign a late Arnsbergian (Serpukhovian) age to the formation.

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Table DR1 - Compilation of climate-sensitive features found within the Maritimes Basin. Abbreviations: Fm.=Formation; Grp.=Group, PDB=Peedee belemnite.

Basin/Unit Name	*Age*	*Climatically Sensitive Indicators*	*Climatic Interpretations*	*Reference(s)*
RISTIGOUCHE & NW NEW BRUNSWICK PLATFORM				
Bonaventure Fm.	late Visean (Asbian to Brigantian)	Laterally variable and chaotically bedded conglomerates interpreted as distal alluvial fan facies associated with abundant nodular pedogenic calcretes and oxidation haloes.	***Arid.*** Deposition of sudden, ephemeral flash floods and debris flows on an arid alluvial fan.	Jutras et al. (2001)
Pointe Sawyer Fm.	Brigantian to Pendleian	***Vegetation***. Carbonized plant remains.	***Semiarid***. Plant remains, lack of pedogenic calcrete, and trilete spores (*Schopfites claviger* and *Colatisporites decorus*) indicate an arid climate, but relatively more humid than underlying (Bonaventure) and overlying (Chemin-des-Pêcheurs) units.	Jutras et al. (2001)
Clifton Fm, Member B (lower succession)	Langsettian to ?Asturian	***Paleosols***. Alternating successions of pedogenically altered red mudstones with deep desiccation cracks, carbonate nodules, and calcretes (Stage III) overlain by thin laterally continuous coals/carbonaceous shales	***Subhumid, seasonal***. Cycles produced by fluctuating water table caused by either climatic or autocyclic processes.	Legun & Rust (1982); Rust & Legun (1983)
Clifton Fm., Member B (upper succession)	Langsettian to ?Asturian	***Vegetation, fluvial style.*** Abundant plant debris and detrital coal fragments within braided fluvial sandstones.	***?(sub)Humid.*** Increase in fluvial competence due to either greater rainfall or tectonic rejuvenation (or both). Abundance of plant debris and coal fragments (interpreted as peat rafts) indicate a vegetated floodplain.	Legun & Rust (1982); Rust & Legun (1983)
NEW BRUNSWICK PLATFORM				
New Castle Creek Fm.	Asbian	***Paleosols.*** Abundant pedogenic carbonate.	***Semiarid.***	St. Peter (1997)
Shin Fm.	Visean	***Paleosols.*** Abundant pedogenic carbonate (scattered and concentrated horizons), desert varnish.	***(semi)Arid.***	St. Peter (2000)
Minto Fm.	early Bolsovian	***Coal.*** Seams up to 90 cm thick.	***Humid.***	Kalkreuth et al. (2000)
Sunbury Creek Fm.	late Bolsovian	***Coal.***	***Humid.***	Muller (1951)
Sunbury Creek Fm.	late Bolsovian	***Fluvial style.*** Middle member (informal) dominated by medium-grained planar bedded plant-bearing sandstones.	***?Seasonal.***	Muller (1951)
MONCTON & SACKVILLE BASINS				

Windsor Grp. (Lime-kiln Brook Fm.)	Brigantian	***Evaporites***. Interstratified marginal marine carbonates (limestones, dolostones) and nonmarine redbeds associated with evaporites (gypsum, salt, anhydrite).	***Arid.*** Shallow water marginal marine environments associated with sabkha and saline mudflat/playa deposits.	St. Peter and Johnson (1997)
Wanamaker Fm.	late Visean to ?Serpukhovian	***Paleosols.*** Abundant pedogenic carbonate.	***Semiarid.***	Anderle, et al. (1979)
Scoodic Brook Fm.	Pendleian to ?Arnsbergian	***Paleosols.*** Abundant pedogenic carbonate.	***Semiarid.***	Anderle, et al. (1979)
Hopewell Cape Fm.	Brigantian to ?Arnsbergian	***Paleosols***. Proximal to distal alluvial fan/braidplain succession with abundant calcisols and nodular calcretes (Stage III).	***Semiarid, seasonal***. Alluvial fan deposits with abundant pedogenic carbonate in the distal portions indicate deposition in a tropical climate with a pronounced dry season. Lack of plant material and gleyed horizons suggests a semiarid climate.	van de Poll & Sutherland (1976); this study.
Tynemouth Creek Fm.	Yeadonian to Langsettian	***Paleosols***. Red/green mottled vertisols abundant carbonate nodules within proximal/distal alluvial plain deposits.	***Seasonal***. Seasonally dry conditions.	Plint & van de Poll (1982; 1984)
Tynemouth Creek Fm.	Yeadonian to Langsettian	***Vegetation***. Low- to medium-diversity assemblages dominated by cordaitaleans, locally preserved charcoal. Rare lycopsids.	***Subhumid, seasonal***. Upland/dryland vegetation experiencing periodic drought and wildfires. Rare lycopsids (*Sigillaria* and *Lepidodendron*) suggest a subhumid to humid climate.	Falcon-Lang (2006b)
Salisbury Fm.	Duckmantian to Bolsovian	***Coal, other paleosols***. Locally narrow seams of coal and black shale interbedded with red shale, siltstone, and fluvial sandstones. Locally abundant siliceous paleosols (ganisters).	***Subhumid.***	St. Peter (1993); Johnson (1995); St. Peter and Johnson (1997)
Richibucto Fm.	Asturian to Stephanian	***Coal***. Thin (<8 cm), discontinuous coals associated with red mudstone intervals, bases of sandstone bodies have abundant coalified plant material and logs. Pedogenic red mudstones increase in abundance upsection.	***Humid to subhumid/semiarid***. Presence of coals and abundant plant debris within channel sandstones indicate vegetated swamps/floodplains formed in humid to subhumid conditions. Humid conditions decrease upsection.	van de Poll (1973); Johnson (1995)
Tormentine Fm.	Stephanian to ?early Permian	***Paleosols.*** Pedogenically altered red mudstones with ball and pillow horizons and calcretes (Stage I/II)	***Semiarid***.	van de Poll (1973); Johnson (1995)
CUMBERLAND BASIN				
Windsor Grp. (Lime-kiln Brook Fm.)	Brigantian	***Evaporites***. Interstratified marginal marine carbonates (limestones, dolostones) and nonmarine redbeds associated with evaporites (gypsum, salt, anhydrite).	***Arid.*** Shallow water marginal marine environments associated with sabkha and saline mudflat/playa deposits.	Ryan & Boehner (1994)

Maringouin/ Middleborouogh Fm.	Brigantian	***Paleosols.*** Calcic entisols and alfisols, associated with gypsum casts and pedogenic carbonate nodules.	***Arid to semi-arid.***	McCabe & Schenk (1982); This study.
Shepody Fm.	Brigantian to early Pendleian	***Paleosols.*** Calcic entisols and alfisols, associated with pedogenic carbonate nodules.	***Semiarid.***	This study.
Shepody Fm.	Brigantian to early Pendleian	***Fluvial style.*** Fluvial sandbodies dominated by upper flow regime sedimentary structures.	***Strongly seasonal.***	McCabe & Schenk (1982); this study.
Claremont Fm.	Pendleian to ?Arnsbergian	***Paleosols.*** Calcic entisols, vertisols, calcisols, nodular calcretes (Stage I-III).	***Semiarid, seasonal.***	McCabe & Schenk (1982); Hamblin (2001); this study.
Boss Point Fm.	Yeadonian to Langsettian	***Paleosols.*** Several types of paleosols are found within the fine-grained facies association including thin coals, gleysols, and abundant vertisols (calcic and gleyed). Stage II/III nodular calcretes.	***Semiarid/subhumid, strongly seasonal.*** Abundance of vertisols suggests a seasonal climate with pronounced wet and dry periods in a subarid climate. The presence of coals and other hydromorphic paleosols (gleysols) indicate humid/subhumid conditions as well.	Browne & Kingston (1993); Plint & Browne (1994)
Boss Point Fm.	Yeadonian to Langsettian	***Paleosols.*** 100+ m interval in the upper part of the formation containing calcic vertisols/calcisols and pedogenic mud aggregates.	***Semiarid, strongly seasonal.***	Gardiner & Gibling (2005); this study.
Boss Point Fm.	Yeadonian to Langsettian	***Fluvial style.*** Rill marks on mudstone intraclasts and muddy channel floors.	***Strongly seasonal.*** Presence of rills suggests pronounced fluctuations in flood stage.	Plint (1986); Browne & Plint (1994)
Boss Point Fm.	Yeadonian to Langsettian	***Fluvial style.*** Fluvial sandbodies in the upper half of the formation are dominated by upper flow regime sedimentary structures	***Strongly seasonal.***	This study.
Boss Point Fm.	Yeadonian to Langsettian	***Stratigraphic stacking patterns***. Alternations (megacycles) of sandy braided-fluvial deposits up to 90 m thick and fine-grained floodplain-lacustrine deposits with minor coal, limestone, and paleosols.	***Oscillations between strongly seaonal wet/dry (?semiarid) climate with humid, seasonal climate***. Megacycles due to rapid subsidence along basin bounding faults associated with climatically or tectonically induced variations in sediment supply.	Plint & Browne (1994)
Grande Anse Fm.	?Yeadonian to middle Langsettian	***Paleosols.*** Succession is dominated by weakly developed entisols, alfisols, and calcic alfisols.	***Semiarid.***	Falcon-Lang et al. (2007); this study.
Grande Anse Fm.	?Yeadonian to middle Langsettian	***Fluvial style.*** Fluvial sandbodies dominated by upper flow regime sedimentary structures	***Strongly seasonal.***	This study.

Little River Fm.	early Langsettian	***Paleosols***. Succession is dominated by weakly developed entisols, alfisols, and calcic alfisols (with StageI-III calcretes)	***Semiarid-arid, seasonal drying***. Paleosols with well-developed calcic (Bk) horizons indicate xeric conditions in a semiarid to arid climate with seasonal drying. Topographic effects may have enhanced drainage. Gleyed horizons indicate periods of wetting or ponding.	Calder et al. (2005); this study.
Little River Fm.	early Langsettian	***Fluvial style***. Fluvial sandbodies dominated by upper flow regime sedimentary structures	***Strongly seasonal***.	This study.
Joggins Fm.	Langsettian	***Paleosols***. Coals, gleysols, immature alfisols and entisols.	***Warm, humid, seasonally dry***.	Smith (1991)
Joggins Fm.	Langsettian	***Fluvial style, vegetation, fauna***. Anastomosing channels associated with well-drained floodplains with alfisols and inclined heterolithic sediment (IHS) channel fills that suggest erratic low stage flow and ponding (raindrop impressions, desiccation cracks, adhesion ripples). Abundant, low diversity flora and fauna associated with IHS channel fills.	***Humid, seasonally dry***. Perennial waterhole deposit within an anastomosing channel environment. IHS channel fill displays evidence of partial subaerial exposure during periods of drought and evidence of low flow during periods of flooding when connected to active channels.	Falcon-Lang (2003a); Hebert & Calder (2004); Falcon-Lang et al. (2004)
Joggins Fm.	Langsettian	***Stratigraphic stacking patterns***. 14 rhythms of open-water (brackish) deposits of thin coal and limestone overlain by mouth-bar and delta lobe sandstone deposits, overlain by poorly-drained floodplain deposits with drab mudstones, coals, and channel bodies, overlain by well-drained floodplain deposits consisting of fixed and meandering channel sands and red cumulative paleosols.	***Humid, seasonal***. Rhythms are interpreted as stacked parasequence sets produced by glacio-eustatic fluctuations modulated by rapid subsidence caused by faults and halokinesis. Evidence from paleosols, channel, and floodplain deposits indicate a generally humid but seasonal climate.	Davies & Gibling (2003); Rygel & Gibling (2008)
Joggins Fm.	Langsettian	***Charcoal***. Detrital charcoal fragments crushed into a single block (charcoal mat) found within the hollowed base of 15 sigillarian stumps within an ephermal peat swamp.	***Humid, seasonal***. Rhythmic banding within charred sigillarian stumps suggests trees experienced periodic water stress. Periodic droughts, potentially related to climate seasonality, may have been the trigger for wildfires.	Falcon-Lang (1999)
Joggins Fm.	Langsettian	***Vegetation, fauna***. Transgressive/regressive cycles of lycopsid-dominated lowland vegetation within coastal plain and mire facies associated with rising baselevel, with gymnosperm and tree fern dominated assemblages, charred wood, and calcic vertisols, associated with falling baselevel.	***Humid to subhumid/semiarid fluctuations***. "Highstand" deposits represent the most humid conditions, while "lowstand" deposits represent the most arid conditions. Two explanations for these alternations are changes in ocean proximity or glacial-interglacial climate changes.	Falcon-Lang (2003b); Falcon-Lang et al. (2005)

Joggins Fm.	Langsettian	***Isotopes***. Geochemistry of *Naiadites* bivalve shells indicate a continental, eutrophic habitat. $\delta^{13}C$ (2.11-2.24‰ PDB), $\delta^{18}O$ (-5.83- -5.72‰ PDB), and $^{87}Sr/^{86}Sr$ (>0.7093).	***Humid, ?monsoonal precipitation***. Stable isotopes Indicate an equatorial position with air temperatures of 17-35° C and water temperatures of 18-30° C. $^{87}Sr/^{86}Sr$ suggests lakes received water from hinterland areas as a result of monsoonal meteoric precipitation.	Brand (1994)
Springhill Mines Fm.	Langsettian to early Duckmantian	***Coal***. Thick (up to 4.3 m) coals, toward the top of the formation; coals decrease to zero and reddened intervals increase.	***Humid, seasonal.*** Coals interpreted as rheotrophic mires fed by groundwater discharge from correlative alluvial fan deposits (Polly Brook Formation) indicate short-term dry seasons. Fusain also indicates wildfires indicative of periodic dryness.	Calder (1994)
Springhill Mines Fm.	Langsettian to early Duckmantian	***Vegetation***. Rheotrophic paleomire (No. 3 seam) dominated by arborescent lycopsids (*Lepidodendron*, *Anabathra*) throughout the life of the mire.	***Humid, seasonal***. Mire vegetation required nutrient-rich freshwater (provided by groundwater seepage at the toes of alluvial fans), clastic influx, and seasonal dryness. Mire hydrology may have been influenced by precessional climate change.	Calder (1993)
Malagash Fm.	Bolsovian to Asturian	***Paleosols***. Floodplain intervals dominated by reddened mudrocks containing vertisols and calcic vertisols. Several 1+ m thick calcretes (Stage III). Thin coals occur at the base of the formation.	***Subhumid/semiarid, strongly seasonal***. Subhumid conditions becoming increasingly semiarid with strong seasonality.	Chandler (1997); Naylor et al. (1999); this study.
Malagash Fm.	Bolsovian to Asturian	***Fluvial style***. Fluvial sandbodies in the upper portion of the formation are dominated by upper flow regime sedimentary structures	***Strongly seasonal***.	This study.
Pictou Group	Stephanian to early Permian	***Paleosols***. Calcic vertisols, calcretes.	***Semiarid/arid, seasonal***.	Ryan & Boehner (1994)
Cape John Fm.	late Stephanian to early Permian	***Flora, fauna, fluvial style***. *Walchia* forest associated with tetrapod trackways, paleopterid wings, numerous invertebrates within mud-draped, desiccated, planar-bedded sandstone.	***Semiarid, monsoonal***. Abandoned dryland channel experiencing ephemeral flooding.	Calder et al. (1998); van Allen et al. (2008)
Cape John Fm.	late Stephanian to early Permian	***Paleosols.*** Calcic vertisols, calcisols, nodular calcrete (Stage II/III) horizons.	***Semiarid/arid, strongly seasonal***.	This study.
Cape John Fm.	late Stephanian to early Permian	***Fluvial style***. Single storey channel bodies dominated by upper flow regime structures, abundant mud-filled channels.	***Arid, strongly seasonal***.Ephemeral channels associated with calcic floodplains.	This study.
MINAS BASIN				
Windsor Grp.	Brigantian	Marginal marine carbonates interbedded with algal laminites.	***Arid.*** Marginal marine, intra-supratidal environments.	Giles (1980); D'Orsay (1986)

West Bay Formation	Brigantian to Arnsbergian	Shallow and marginal lacustrine deposits with pervasive desiccation and tetrapod tracks	***Warm, arid-semiarid***. Playa or ephemeral lacustrine deposits. West Bay facies may represent the peripheral margin of a perennial West Bay-Hastings lake complex.	McCarty (1980)
Parrsboro Formation	Langsettian	***Paleosols***. Thin, impure coals, gleysols, immature alfisols and entisols.	***Humid, seasonally dry.*** Vertical, gradational nature of poorly-drained floodplain paleosols into well-drained floodplain paleosols indicate lowering of the watertable.	Pluim (1980); D'Orsay 1986); Naylor & Kennedy (1998)
Fowler Head Formation	late Duckmantian to Bolsovian	***Coal***. Seams up to 6 cm thick.	***Humid***.	D'Orsay and van de Poll (1984)
Fowler Head Formation	late Duckmantian to Bolsovian	***Grain Textures***. Quartz grains exhibiting surface textures such as solution pits, etched V patterns, weathering hollows, scaling, silica globules, etc.	***Hot, humid***. Quartz grain textures resemble textures observed within modern surficial diagenetic tropical environments.	D'Orsay and van de Poll (1984)
NEW GLASGOW & STELLARTON GAP				
New Glasgow Fm.	Langsettian to ?Duckmantian	***Paleosols***. Lower conglomeratic portion of the formation contains hematite coated grains and groundwater calcretes. Upper part of the formation consists of reddened mudstones with desiccation cracks, calcrete nodules (stage II), tetrapod footprints,and associated calcic and gleyed paleosols. Minor drab intervals.	***Tropical, seasonal with pronounced dry seasons***. Alluvial fan deposits with abundant pedogenic carbonate and vertisols in the distal portions of the fan point to deposition in a tropical climate with a pronounced dry season.	Chandler (1998)
Stellarton Basin				
Stellarton Fm.	Langsettian to Asturian	***Coal***. Thick coal seams (up to 13.4 m) occur throughout the formation, but are concentrated in the upper part of the succession, from the Westville Member upward. Formation is dominated by lacustrine, lake-margin, and mire facies.	***Humid***.	Naylor et al. (1989)
Stellarton Fm.	Langsettian to Asturian	Rhythmic alternation of siliciclastic and organic-rich laminae	***Humid, seasonal*.**	Kalkreuth et al. (1990)
Upper Stellarton Fm. Westville-Thorburn Members	Bolsovian to Asturian	***Coal***. Coal petrology of several seams (Acadia, Foord, and MacKay) show that the relationships between different coal macerals vary throughout individual seams.	***Humid***.Coal facies variations suggest alternating limnic and swampy conditions occur through coal seams. The Foord seam records up to 6 episodes of peat accumulation.	Yeo (1988); Lyons et al. (1997)
Upper Stellarton Fm. Albion Member	Bolsovian	***Fusain***. Fusain clasts occur throughout the entire 13.4 m of the Foord seam.	***Humid, seasonal***. Charcoal indicates a humid climate with a pronounced dry season with recurring wild fires.	Calder (1979)
Upper Stellarton Fm. Thorburn Member	latest Bolsovian to Asturian	***Vegetation***. *In situ*, upright lycopsids within fluvial channel deposits.	***Humid, strongly seasonal*.** *In situ* plant colonization of active channel deposits requires significant exposure of the channel bed (extended periods of low or no flow) in order to allow tree growth.	This study.

PRINCE EDWARD ISLAND				
Pictou (Prince Edward Island) Group	Stephanian to Artinskian	***Paleosols, redbeds***. 25% of the PEI group consists of orange-red to dark-red silts and claystones that are calcareous and exhibit desiccation, hackley fracture (?calcic vertisols to vertic calcisols).	***Semiarid-arid*.**	van de Poll (1983)
Kildare Capes, Orby Head Fms.	Asselian to Artinskian	***Vegetation*.** Fossil assemblages dominated by xeromorphic conifers such as *Walchia* and *Tylodendron*. Associated with pedogenic carbonate.	***Semiarid, seasonally dry***. A review of worldwide phytogeographical occurences of *Walchia* combined with climate models suggest a tropical to subtropical biome with a seasonally dry climate.	Ziegler et al. (2002)
SUBSURFACE PRINCE EDWARD ISLAND & GULF OF ST. LAWRENCE				
Bradelle Fm.	late Duckmantian to ?Stephanian	***Coal***.	***Humid***.	Giles & Utting (1999)
Naufrage Fm.	Stephanian	Abundant pedogenic carbonate	***Subhumid-semiarid***.	Giles & Utting (1999)
ANTIGONISH & WEST CAPE BRETON BASINS				
Upper Windsor Grp. (Hood Island Fm.)		***Evaporites***. Interstratified redbeds (dominantly mudstones with minor sandstones and conglomerates), carbonates (oolitic algal and micritic argillaceous limestone), and evaporites (nodular gypsum and anhydrite).	***Arid***. Shallow water marginal marine environments associated with sabkha and saline mudflat/playa deposits.	Boehner & Giles (1993)
Hastings Fm.	Brigantian to Pendleian	***Stratigraphic stacking patterns***. Transgressive-regressive shallowing-upward sequences of predominantly black, laminated shales coarsening upwards into bioturbated mudstones, sandstones, and limestones.	***Warm, semiarid, seasonal***. Black laminated mudstones at sequence bases suggest anoxic, stagnant conditions typical of warm climates. Basin-margin deposits (red siltstones and sandstones associated with vertisols) suggest prolonged periods of exposure in a warm, semiarid environment.	Crawford (1995); Hamblin (2001)
Pomquet Fm.	latest Pendleian to Arnsbergian	***Paleosols***. Succession is dominated by red mudstones (vertisols and calcisols) with color mottling, desiccation cracks, evaporite crystal moulds, and pedogenic carbonate along with minor gray mudstones, sandstones, and conglomerates.	***Warm, (semi)arid, highly seasonal***. Pedogenically altered playa, mudflat, and overbank environments indicate a (semi) arid, seasonally dry climate with some wetting (gray mudrocks imply minor sustained standing water).	Hamblin (2001)
Port Hood Fm., Margaree Member	Yeadonian to Langsettian	***Fluvial style, paleosols***. Basal fluvial sandstone bodies dominated by upper flow regime structures and associated with calcic and gleyed vertisols. Coalified plant debris is common at the bases of sandstone bodies.	***Subhumid, strongly seasonal*.**	This study

Port Hood Fm., Colindale Member	Langsettian	***Coals, other paleosols***. Repetitive stratigraphic cycles of lacustrine limestones, coals, and carbonaceous shales overlain by coastal plain deposits that are capped by reddened mudstone intervals (calcic vertisols). Coals are thicker and more numerous upsection.	***Humid, seasonal***. Abundance of coals and carbonaceous mudstones (?gleysols) suggest humid conditions, however vertisols (gleyed and calcic) indicate some degree of seasonality. Cycles may be the result of eustatic or climatic variation with autocyclic overprinting.	Allen (1999)
Inverness Fm.	Bolsovian to earliest Stephanian (?Cantabrian-Barruelian)	***Coals, other paleosols***. Thick coal seams, up to ~4 m thick occur throughout the formation. Intervals of reddened mudstones associated with calcic vertisols and calcretes along with fluvial sandbodies (see below) occur as well.	***Humid, (strongly) seasonal***. Abundance of thick coals, lacustrine limestones, gleysols suggest deposition within humid conditions. Upper portion of the formation records increasing evidence (calcic vertisols, calcisols) for seasonal to strongly seasonal conditions.	This study
Inverness Fm.	Bolsovian to earliest Stephanian (?Cantabrian-Barruelian)	***Fluvial style***. Fluvial sandstone bodies dominated by upper flow regime structures. Abundant peat raft breccias occur at the base of most sandstone bodies.	***Subhumid, strongly seasonal***.	This study
Broad Cove Fm.	Stephanian to ?early Permian	***Fluvial style, paleosols***. Fluvial sandstone bodies dominated by upper flow regime structures, associated with calcic paleosols.	***Semiarid, strongly seasonal***.	This study
LOCH LOMOND BASIN				
Upper Windsor Grp. (Uist Fm.)	Brigantian	***Evaporites***. Interstratified redbeds (dominantly mudstones with minor sandstones and conglomerates), carbonates (oolitic algal and micritic argillaceous limestone), and evaporites (nodular gypsum and anhydrite).	***Arid***. Shallow water marine transgressions and regressions that produced cyclic alternations of fossiliferous micritic oolitic and algal carbonate, nodular gypsum and anhydrite (sabkha facies) and red continental siltstone and shale (saline mudflats).	Boehner & Prime (1993)
MacKeigan Lake Fm.	latest Brigantian to Pendleian	***Evaporites, paleosols*.** Basal part of the unit consists of interbedded shale, gypsum, and limestones that pass upward into reddened siltstone with minor sandstone and conglomerate associated with color mottling and calcrete nodules. Minor coals have been observed. Formation is commonly capped by a calcrete horizon.	***Arid to semiard, strongly seasonal***. Base records the transition from mixed marine continental deposition of the underlying Windsor Group to restricted, saline lacustrine deposition in arid climatic conditions. Evaporites are interpreted to represent waning and terminal-phase marine environments that are transitional into continental playa lake environments. The top of the formation represents deposition on a floodplain characterized by a highly seasonal, semiarid climate with fluctuating groundwater levels.	Boehner & Prime (1993)

Silver Mines Fm.	late Namurian to Langsettian	***Coal***. Thin coals occur within the middle portion of the unit, however, coalified plant debris is observed throughout the formation.	***(sub)Humid***. Abundance of coaly material suggests that deposition took place during a period of moderate climate with sufficient precipitation to permit the development of peat mires.	Boehner & Prime (1993)
Glengarry Valley Fm.	Bolsovian to Asturian	***Coal, other paleosols***. Thin coal seams and coaly shales occur throughout the fine-grained formation although they are concentrated in the basal part. Mudstones display reddening, color mottling, and carbonate nodules. Nodular calcretes have also been observed.	***Humid, seasonal***. Fine-grained intervals with possible vertisols and nodular calcretes represent a seasonal climate with dry periods, however, coal seams indicate that conditions were locally conducive to allow for peat development.	Boehner & Prime (1993)
SYDNEY BASIN				
Upper Windsor Grp. (Woodbine Road Formation)	Brigantian	***Evaporites***. Interstratified redbeds (dominantly mudstones with minor sandstones and conglomerates), carbonates (oolitic algal and micritic argillaceous limestone), and evaporites (nodular gypsum and anhydrite).	***Arid***. Shallow water marine transgressions and regressions that produced cyclic alternations of fossiliferous micritic oolitic and algal carbonate, nodular gypsum and anhydrite (sabkha facies) and red continental siltstone and shale (saline mudflats).	Boehner & Giles (2008)
Cape Dauphin Fm.	Brigantian to Pendleian	***Evaporites***. Gypsum and anhydrite occur in the lower portion of the unit (only from subsurface core). Gray mudrocks and minor limestones (algal stromatolites) dominate the remainder of the succession.	***Arid***. Base of the formation records the transition from mixed marine continental deposition of the underlying Windsor Group to restricted, saline lacustrine deposition in arid climatic conditions. Strata without evaporites potentially represent climate moderation and the evolution of a saline evaporitic basin within a continental lacustrine environment.	Boehner & Giles (2008)
Point Edward Fm.	Pendleian to Arnsbergian	***Paleosols***. Succession is dominated by red mudstones with color mottling, pedogenic carbonate with minor gray mudstones, sandstones, and conglomerates.	***(semi)Arid, highly seasonal***. Pedogenically altered playa, mudflat, and overbank environments characterized by vertisols with minor calcisols indicate a (semi) arid, seasonally dry climate with some wetting (gray mudrocks imply minor sustained standing water).	Hamblin (2001); Boehner & Giles (2008)
South Bar Fm.	Duckmantian to Asturian	***Coal***. Seams up to 2 m thick.	***Humid***.	Rust & Gibling (1990a); Tibert & Gibling (1999)
South Bar Fm.	Duckmantian to Asturian	***Fluvial style***. Fluvial sandbodies dominated by upper flow regime sedimentary structures are ubiquitous within the upper half (late Bolsovian to Asturian) of the formation.	***Strongly seasonal***.	Rust & Gibling (1990a, b); this study.

Waddens Cove Fm.	Bolsovian	***Paleosols, fluvial style***. Coals at the base of the formation, become progressively thinner with an increase in desiccated mudrock intervals (?vertisols) upsection. Sandstone bodies deeply incised into floodplain/overbank deposits.	***Humid, strongly seasonal***. Heterolithic and episodically prograding accretion sets, abundant in situ vegetation within channel sandstones, and association with mudrocks containing pseudo-anticlines (?vertisols) indicate fluctuating flow strength due to a strongly seasonal climate. Alternations of grey, coal-bearing intervals with red, siliceous duricrust-rich zones attributed to water-table fluctuations in response to base-level (?sea-level) changes.	Gibling & Rust (1990; 1992)
Sydney Mines Fm.	latest Bolsovian to Cantabrian	***Coals, other paleosols***. Systematic alternations of coals and other hydromorphic paleosols (gleysols) with calcretes (stage II/III) and calcic vertisols within cyclothemic deposits (20-30 m).	***Humid to subarid fluctuations***. Significant shifts in seasonality and total precipitation associated with sea-level fluctuations. Semi-arid pedogenesis linked with sea-level falls.	Tandon & Gibling (1994; 1997)
Sydney Mines Fm.	latest Bolsovian to Cantabrian	***Fluvial style***. Fluvial sandbodies dominated by upper flow regime sedimentary structures and *in situ* trees commonly overlie reddened intervals associated with calcic vertisols, and underlie thick coals.	***Strongly seasonal***.	Batson & Gibling (2005); this study
Sydney Mines Fm.	latest Bolsovian to Cantabrian	***Stratigraphic stacking patterns***. Thin (~19 m) and thick (~55 m) sequences characterized by a calcrete overlying the sequence boundary passing into vertic mudstones overlain by thick coals and dark limestones/shales (MFS) overlain by coastal plain deposits (HST).	Stratigraphic (sequence/cyclothem) architecture controlled by high accommodation events of relative sea level (RSL) that is an expression of glacioeustatic events. Thin sequences estimated at 105 k.y. within Milankovitch band, thick sequences estimated at 0.3-0.5 m.y.	Gibling & Bird (1994); Gibling et al. (2004)
Sydney Mines Fm.	latest Bolsovian to Cantabrian	***Vegetation***. Alternations of lycopsid-dominated lowland vegetation associated with coastal plain/bayfill facies and coals, with gymnosperm and tree fern dominated assemblages with rare charred wood associated with calcretes and calcic vertisols.	***Humid to semiarid fluctuations***. Peat-forming plant assemblages are found within TST and HST (interglacial; warm, humid) deposits, gymnosperms and tree ferns dominate LST (glacial, cool, dry) deposits. Vegetation responded to glacial/interglacial cycles by contracting and expanding respectively.	Falcon-Lang (2004)
Sydney Mines Fm.	latest Bolsovian to Cantabrian	***Vegetation***. Systematic changes in the floral compositions of lowland mire environments from lycopsid-dominated mires in the lower portion of the formation to tree-fern dominated mires in the uppermost portion.	***Humid, seasonal drying***. Large-scale floral change resulting from global perturbation resulting from icehouse-greenhouse transition (c.f. Gastaldo et al., 1996).	White et al. (1994); Calder et al. (1996); Zodrow (2002); Falcon-Lang (2006a)
Sydney Mines Fm.	latest Bolsovian to Cantabrian	***Stomatal density***. Cuticles of *Neuropters ovata* (medullosalean pteridosperm) display marked decreases in stomatal density and index in the earliest Cantabrian.	Stomatal density decrease is the result of increasing pCO_2. Potentially associated with an interval of global warming during most of the Stephanian.	Cleal et al. (1999)

BAY ST. GEORGE BASIN				
Robinsons River Fm., Jeffereys Village Mbr.	Brigantian	***Evaporites.*** Anhydrite, gypsum, halite, carnallite, sylvite, and polynalite deposits interstratified with marginal marine carbonates and continental siliciclastics.	***Arid.*** Shallow water marginal marine environments associated with sabkha and saline mudflat/playa deposits.	Knight (1983)
Robinsons River Fm., Upper Jeffereys Village Mbr.	Brigantian	***Paleosols.*** Red mudstones with abundant carbonate nodules (?calcisols), desiccation cracks, halite pseudomorphs, and gypsum layers associated with planar bedded sandstones. Intercalated with marginal marine carbonate units.	***Arid-semiarid.*** Saline mudflats and playa environments interfingering with sabkha facies.	Knight (1983)
Robinsons River Fm., Mollichignick Mbr.	Brigantian	***Paleosols.*** Red mudstones with abundant carbonate nodules (Stage I-III). ?calcisols.	***Semiarid.***	Knight (1983)
Robinsons River Fm., Mollichignick Mbr.	Brigantian	***Fluvial Style.*** Fluvial sandbodies are predominantly planar bedded with parting lineation, climbing ripple cross-stratification and minor amounts of trough cross-bedding.	***Semiarid, strongly seasonal.***	Knight (1983)
Searston Fm.	Arnsbergian	***Coal, other paleosols***. Red mudstones associated with mudcracks and pedogenic carbonate nodules characterized the lower 1600 m, while coals up to 1.15 m thick, carbonaceous shales, and gleysols are characteristic of the upper 900 of the formation.	***Semiarid/subhumid to humid***. Humidity increases upsection.	Knight (1983); Utting & Giles (2008)
Blanche Brook CM	Bolsovian	***Coal.***	***Humid.***	Knight (1983); Hyde et al., 1993
DEER LAKE BASIN				
North Brook Fm.	Brigantian	***Paleosols***. Distal alluvial fan/braidplain deposits with abundant calcic paleosols.	***Semiarid***.	Hyde (1995)
Rocky Brook Fm.	latest Brigantian to Pendleian	***Paleosols***. Lower portion of the formation contains fluvial deposits with abundant pedogenic carbonates and calcrete horizons.	***Semiarid***. Presence of spores including *Crassipora trychera* and *Rugospora minuta* indicate arid climates.	Hamblin et al. (1997)
Little Pond Brook Fm.	Pendleian to Arnsbergian	***Fluvial style, vegetation***. Fluvial sandstones are very micaceous and dominated by parallel lamination. Interbedded red and grey mudstones, plant-bearing sandstones, and carbonaceous mudstones.	***Semiarid/subhumid, (?strongly) seasonal***.	Hyde (1995)
Howley Fm.	Arnsbergian or Langsettian	***Coal***.	***Humid***.	Hyde (1995)