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1 Quantifying the diagenetic impact in the late Ediacaran and
2 Early Palaeozoic of the Avalon Peninsula using illite
3 “crystallinity”

4 **Gregor Austermann^{1*}, Melanie Kling¹, Christina Ifrim^{1,2}, Pascale D. Emond¹, and Anne**
5 **Hildenbrand¹**

6 *¹Institut für Geowissenschaften, Universität Heidelberg, Im Neuenheimer Feld 234, 69120*
7 *Heidelberg, Germany*

8 *²Current address: Jura Museum SNSB, Burgstrasse 19, 85072 Eichstätt, Germany*

9 *Corresponding author: gregor.austermann@geow.uni-heidelberg.de
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ABSTRACT

The Avalon Peninsula, Newfoundland, Canada, defined as the type zone of Avalonia is believed to have been impacted by several orogenic and deformation events since the Neoproterozoic. Previous studies determined the lowest degree of metamorphism reached in the successions was of the prehnite-pumpellyite or greenschist facies. We sampled and measured thirteen mainly clastic sedimentary sections ranging from the late Ediacaran to the Early Ordovician and analysed the illite “crystallinity” of 331 samples using the Kübler index. Our results show diagenetic zones occur related to lithology, age and burial depth, respectively, and regional setting. Samples adjacent to the fault zones bounding the Holyrood Horst experienced the highest degree of metamorphism (anchizone) in the study area. The lowest degree of thermal alteration occurs in the high stratigraphic sections at the centre of the horst structure where shallow diagenetic conditions are preserved. Fault zones, at least probably active during the Acadian Orogeny, may have served as potential paths for hot fluids in bounding areas of the horst, whereas the centre of the horst remained almost unaffected by any metamorphic overprint. The thermal impact decreases from the Bonavista Peninsula west of the study area from greenschist facies to anchizonal and diagenetic. The study area experienced lower metamorphic conditions than major regions of Avalonia south of the study area on the mainland of New Brunswick and Maine and eastwards in Europe, but is in part consistent with a few other areas of Avalonia, such as the Mira terrane and the Antigonish Highlands in Nova Scotia.

KEYWORDS

Illite “crystallinity”, Kübler index, Diagenesis, Holyrood Horst, Avalon Peninsula, southeastern Newfoundland

INTRODUCTION

The upper Ediacaran and Lower Palaeozoic rocks of the Avalon Peninsula, Newfoundland have been studied for decades (e.g., Howell 1925; Hutchinson 1962; Fletcher

1972, 2006; Ranger *et al.* 1984; King 1988, 1990; O'Brien *et al.* 2001; Kim *et al.* 2002; Sparkes 2006; Sparkes *et al.* 2007; Harazim and McIlroy 2015; Austermann 2016; Denommee *et al.* 2019; van Staal *et al.* 2020). Nevertheless, we have little knowledge of the diagenetic or metamorphic overprint of its sedimentary successions other than qualitative estimations of the degree of low temperature metamorphic or diagenetic overprint. This is despite the fact that this is the type region for the microcontinent of Avalonia, as defined by Williams (1964). However, the very low grade to low grade metamorphism of Ediacaran to Cambrian successions have been studied elsewhere in Avalonia such as the Mira terrane of SE Cape Breton Island (e.g., McMullin *et al.* 2010; Willner *et al.* 2013; Willner *et al.* 2014). Although there are studies on alteration in conjunction with the mineralization in the study area (Sparkes 2006), Papezik (1974) is the only study providing any quantitative constraints on metamorphism. During the latter one prehnite or pumpellyite limited to Ediacaran rocks were found, but prehnite-pumpellyite facies metamorphism was proposed for the whole study area. He observed these index minerals in magmatic rocks, in infills of cleavages or in restricted parts of sediment successions. We lack in any other related studies, such as organic maturation or clay mineral assemblages, which may provide more constraints. Hence this study is the first ever to estimate the diagenesis and very low-grade metamorphism in the Newfoundland part of Avalonia.

Illite “crystallinity” is a well-developed and the most used method for determining the diagenetic (ranges up to 150–200 °C) and very low-grade metamorphic (200–300 °C) overprint in siliciclastic successions bearing illite and exposed to temperatures <300 °C (Merriman and Kemp 1996; Merriman and Frey 1998; Merriman and Peacor 1998). The Kübler Index (KI; Kübler 1967; Warr and Rice 1994; Warr and Mählmann 2015) provides a measure of the degree of diagenesis and very low-grade metamorphism based on the full-width-at-half-maximum (FWHM) of the illite 001 peak in an X-ray diffractogram. Here we use KI to estimate the degree to which diagenetic and metamorphic processes affected the

Early Palaeozoic successions of eastern Newfoundland in order to compare them with other Avalonian regions with Ediacaran–Ordovician successions. Our study area roughly transects the Avalon Peninsula in SE–NW direction spanning upper Ediacaran–Lower Ordovician successions (Fig. 1).

Regional Geology of the Avalon Peninsula and the Holyrood Horst

Rocks from the former microcontinent or superterrane of Avalonia (e.g., Williams 1964; Hibbard *et al.* 2006; Pollock *et al.* 2012; van Staal *et al.* 2020) crop out on the Avalon Peninsula. Avalonian rocks form a crustal complex consisting of Neoproterozoic plutonic and volcanic rocks with intercalated sedimentary rocks and a cover of Ediacaran–Lower Ordovician clastic, shale-dominated sedimentary rocks (Landing 1992). Avalonian rocks with Ediacaran–Ordovician cover rocks are also exposed in other parts of Avalonia in the Appalachian orogen such as SE Cape Breton Island and northern mainland Nova Scotia, southern New Brunswick, and Boston area in New England (Hibbard *et al.* 2006). Further Avalonian rocks are exposed in eastern New Brunswick, Connecticut, New Hampshire, Maine and Rhode Island as well as in Brunia, the West-Sudets, the Rheno Hercynian Zone in central Europe, and Wales and southeast Ireland in western Europe (e.g., Williams 1979; Barr and Raeside 1989; O’Brien *et al.* 1996; Rabu *et al.* 1996; White and Barr 1996; Hibbard *et al.* 2007; Linnemann *et al.* 2012). Proto-Avalonia developed as a volcanic arc during the Proterozoic (0.8–1.1 Ga; Nance *et al.* 2002; Murphy 2000; Pollock *et al.* 2012). Its Neoproterozoic evolution is characterised by different stages of volcanic-arc and rift development (Nance *et al.* 2002). Avalonia was exposed to different tectonic events, such as the Avalonian (575–565 Ma; van Staal *et al.* 2020) and Acadian (423–395 Ma; Pollock *et al.* 2012) orogeneses.

The Neoproterozoic of the Avalon Peninsula is split into two main parts. (I) The upper Ediacaran sediment consist of mud-, silt-, sandstone and conglomerate intercalated with layers of tuff and other volcanoclastic rocks, and (II) the Holyrood Horst (Fig. 1) consist of

plutonic rocks (e.g., granite, quartz monzonite and quartz diorite–gabbro; Sparkes 2006; Sparkes *et al.* 2007). The youngest rocks on the horst have an age of ca. 622–606 Ma (O'Brien *et al.* 2001). It is delimited on its eastern margin by the Topsail fault and on its western margin by a fault system including the Holyrood and Duffs faults (Rose 1952; King 1988, 1990). Outside the Holyrood Horst, upper Ediacaran strata are folded in large synclinal-anticlinal structures.

The shallow to deep marine Cambrian shale-dominated to locally carbonate-rich rocks disconformably overlie the Neoproterozoic basement. This contact is exposed at the southern rim of the Conception Bay (Hutchinson 1962; King 1988; Landing 2004) and the eastern coast of the Trinity Bay. The top of the Furongian is possibly exposed in the Conception Bay (Fig. 1). The strata on the Holyrood Horst are dipping $\sim 8\text{--}10^\circ$ NNE, whereas the Cambrian strata west of it are folded in large synclinal and anticlinal structures (e.g., Rose 1952; King 1988). Ordovician clastic sedimentary rocks consist of mud-, silt-, and sandstone and are exposed on Kelly's, Little Bell and Bell Island in Conception Bay (Ranger *et al.* 1984). Foliation is observable in the successions outside the Holyrood Horst (Cavendish and Ferryland Head; Table 1). In general, the cleavage in the study area is almost none to moderately developed, whereas other Avalonian areas with Cambrian-Ordovician strata, e.g., the Bonavista Peninsula west of the study area (Mills *et al.* 2016), southern New Brunswick (White and Barr 1996) and Southern England (e.g., Verniers *et al.* 2002) show a well-developed cleavage and foliation. A detailed lithostratigraphy of the study area is given in Fig. 2.

Sample localities

The mineral assemblage of all samples is given in Table 2.

Cavendish

The section at Cavendish is located in a small cove at the eastern coast of Trinity Bay (47.725786, -53.498129; WGS 84; Fig. 1A). The succession comprises the lower Cambrian

Bonavista, Smith Point and Brigus formations (Figs. 2, 3). The base of the Smith Point Formation conformably overlies the red mudstone of the Bonavista Formation. The Smith Point Formation is characterised by biostromal limestone with abundant oncoids and microbialites. It is conformably overlain by the red mudstone of the Brigus Formation (~11.50 m thickness), which hosts reef debris and disarticulated trilobites within the basal ~1.50 m. Towards its top at Cavendish the formation hosts numerous coquina beds with disarticulated trilobite fragments. The top of the formation is not exposed in the section. The thin to medium bedded strata dip ca. 75° W, and are moderately cleaved perpendicular to the bedding (Table 1). Cleavages are usually filled with calcite, quartz occurs occasionally. Foliation is well developed at Cavendish (Table 1).

Bacon Cove

The section near Bacon Cove is situated in a little cove (Lower Cove) at the southwestern coast of Conception Bay (47.4857242, -53.166310; WGS 84; Fig. 1A). A ~5–15 mm thick red basal conglomerate marks the onlap of the Cambrian Bonavista Formation (Fig. 3). Thin conglomerate and limestone layers, intercalated with coarse red sandstone, siltstone, and mudstone with in situ stromatolites (Edhorn and Anderson 1977; Anderson 1987, Hildenbrand *et al.* 2021a) characterise the lowermost ~2.20 m of the Bonavista Formation. Upsection, a ~4.20 m thick red mudstone unconformably underlies the ~3.50 m thick biostromal limestone of the Smith Point Formation. The Bonavista Formation is interpreted as a shallow marine depositional onlap resulting from a NW–SE transgression (Landing 1992). The contact with the overlying Brigus Formation is conformable and marked by the transition from biostromal limestone to mudstone (Anderson 1987). The Brigus Formation consists of red mudstone and is ~2.10 m thick at Bacon Cove. The thin to medium bedded strata dip 8–10° NW, as typical on the Holyrood Horst, and are weakly cleaved perpendicular to the bedding (Table 1). Cleavages are usually filled with calcite, quartz occurs occasionally.

Duffs

Cambrian rocks at Duffs are exposed along a ~200 m long beach section, situated on the southern coast of Conception Bay (47.445587, -53.10509; WGS 84; Fig. 1A). The section comprises a mudstone dominated succession with intercalated limestones, which is assigned to the lower Cambrian Brigus Formation (Anderson 1987). It overlies nonconformably a Precambrian granoporphyr (Hughes 1971; Anderson 1987). The strata in the ~15.00 m thick succession are red to grey-green. The thin bedded strata dip 8–10° NW, as typical on the Holyrood Horst. Cleavage is very little at this locality (Table 1).

Red Bridge Road (Kelligrews 1–3)

The outcrops at Kelligrews (1–3; Fig. 1B), Conception Bay South, are situated in a series of partially abandoned quarries (47.480155, -53.007567; 47.483461, -53.007434; 47.486722, -53.009824; WGS 84; Fig. 1B). A clastic succession ranging from the lower to the middle Cambrian, composed by the Brigus, Chamberlain's Brook, and Manuels River formations (King 1988) is exposed there. Kelligrews 1 hosts the ~8.70 m thick Brigus Formation disconformably overlying the Precambrian basement of the Holyrood Horst. It consists of red to green mudstone with scattered disarticulated trilobite fragments. The formation is conformably overlain by green to grey-green fossiliferous mainly mud- and siltstone of the Chamberlain's Brook Formation (Kelligrews 2 and 3). The trilobite dominated fauna indicates a Cambrian Series 2 to Miaolingian age for the deposition of the whole formation (Landing 1992). The formation is ~7.4 m thick in total at Kelligrews 2 and 3 and is conformably overlain by the basal bentonite of the Manuels River Formation. At Kelligrews 3, the Manuels River Formation comprises only ~6.90 m of grey and black shales as it is erosionally cut by Holocene sands. It is highly fossiliferous, dominated by well-preserved trilobites. The thin bedded strata dip 8–10° NW, as typical on the Holyrood Horst. Cleavage is very little at this locality (Table 1). Small manganese nodules occur in parts of the Brigus Formation, but were not sampled.

Ochre Cove

Ochre Cove is located at the northwestern coast behind the airfield on Bell Island, in Conception Bay (47.633872, -52.986369; WGS 84). The ~43.5 m thick siliciclastic succession is assigned to the Lower Ordovician Powers Steps Formation (Ranger *et al.* 1984; Denommee *et al.* 2019). The base of the Powers Steps Formation is defined as a sharp and disconformable contact between the underlying haematitic oolite of the Dominion Formation and dark grey phosphatic shell particles and ~0.1–0.5 cm thick mudstone pebble conglomerate [sic] (Ranger *et al.* 1984). The lowermost ~6.00 m, of the Powers Steps Formation comprises interbedded dark grey mud- and siltstone, green phosphatic and brass-yellow pyritic oolites (Ranger *et al.* 1984). The overlying ~36.00 m comprise fissile dark mudstone, which are to the top increasingly interbedded with rippled silt- and sandstone (Ranger *et al.* 1984). Acritarchs have been used as biostratigraphic markers and have assigned the formation to the Arenig, Florian, late Early Ordovician (Bergström 1976; Dean and Martin 1978; Pickerill and Fillion 1983; Ranger *et al.* 1984; Williams 1990), ca. 477.7–470.0 Ma (Cooper and Sadler 2012). The depositional environment has been interpreted as shallow marine (Denommee *et al.* 2019). The thin to thick bedded strata dip 8–10° NW, as typical on the Holyrood Horst. Small local normal faults occur within the outcrop. However, cleavage is very weak at this locality (Table 1).

Upper Grebes Nest Point

Upper Grebes Nest Point is situated at the northwestern coast of Bell Island, in the Conception Bay (47.641336, -52.978611; WGS 84). It lies northwest of the airfield and ~900 m NE of Ochre Cove. The siliciclastic succession has been assigned to the uppermost ~30.15 m of the Lower Ordovician Powers Steps Formation (Ranger *et al.* 1984). The succession comprises fissile mudstone, which are increasingly substituted by silt- and sandstone (Ranger *et al.* 1984). The top is defined as a sharp and conformable contact with the haematitic oolite of the Scotia Formation (Ranger *et al.* 1984). The formation is fossiliferous (e.g., Bergström 1976; Dean and Martin 1978; Ranger *et al.* 1984). The depositional environment was

interpreted as shallow subtidal to intertidal (Ranger *et al.* 1984). The thin to thick bedded strata dip 8–10° NW, as typical on the Holyrood Horst. Cleavage is very little at this locality (Table 1).

Lance Cove

Lance Cove is situated at the southern coast of Bell Island, with the section exposed at a ~50 m long beach west of the marina (47.601769, -52.974838; WGS 84). The base of the examined succession is marked by an erosional unconformity above an ~2.50 m thick sandstone layer. The succession is assigned to the ~440-m-thick Lower Ordovician Beach Formation and consists of micaceous, grey to red-brown mud-, silt-, and fine-grained sandstone. Sedimentary structures include cross-, wavy and lenticular bedding of shallow marine environment, as described by Ranger *et al.* (1984), in addition to which we found symmetric wave and micro-ripples. The succession is ichnofossiliferous and includes horizontal and vertical trace fossils. The basal contact of the formation with the underlying Little Bell Island Formation is unknown because it is submerged in Conception Bay (Ranger *et al.* 1984). The top of the ~6 m thick succession at Lance Cove is cut by Holocene sands. The formation is reported to have been deposited in a shallow marine setting (Ranger *et al.* 1984), here suspected to represent a deltaic environment. The thin to thick bedded strata dip 8–10° NW, as typical on the Holyrood Horst. Cleavage is very little at this locality (Table 1).

Manuels River

The outcrops of Manuels River (1–3, Fig. 1C) are located in the valley of the Manuels River, within the city limits of Conception Bay South, ~20 km west of St. John's (47.525171, -52.951331; 47.525835, -52.952200; 47.530663, -52.954665; WGS 84). The clastic succession in general disconformably overlies the Precambrian basement of the Holyrood Horst and spans the lower to upper Cambrian. The localities at Manuels River host a middle to upper Cambrian succession, which is composed of the Manuels River and Elliot Cove formations. The base of the Manuels River Formation (Manuels River 1) is marked by a

regionally traceable bentonite horizon (Hutchinson 1962; Fletcher 2006; Austermann 2016). The formation consists of mainly grey to black mudstones interbedded with minor limestone. It is highly fossiliferous and hosts a well-preserved trilobite-dominated fauna (Howell 1925; Hutchinson 1962; Martin and Dean 1988; Hildenbrand 2016, Hildenbrand *et al.* 2021b). Agnostids, polymerid trilobites and acritarchs have been used as biostratigraphic markers and have proven a Drumian age of the formation (Hutchinson 1962; Martin and Dean 1988; Hildenbrand 2016, Hildenbrand *et al.* 2021b). The formation is ~19 m thick at its type locality, with the top marked by a thin, unconformably overlying sandstone to conglomerate (Austermann 2016), interpreted to have formed on an outer shelf depositional environment (Fletcher 2006).

The overlying Elliot Cove formation (Manuels River 1–3) is dominated by black shales with an increasing grain size towards the top. It is of Guzhangian to Furongian age (Martin and Dean 1988) and less fossiliferous compared to the Manuels River Formation. A major part of the formation is covered by glacial till or trees. We have sampled ~29.05 m of the succession. The top of the Elliot Cove formation is not exposed at Manuels River. It was deposited in a marine shelf environment and shows a shallowing upward trend towards its top (Hutchinson 1962). The valley of Manuels River, including all outcrops and fossils, is under governmental protection by the Newfoundland and Labrador law, Regulation 67/11 “Palaeontological Resource Regulations under the Historic Resources Act”. The thin bedded strata dip 8–10° NW, as typical on the Holyrood Horst. Cleavage decreases from the bottom of the Manuels River Formation (Manuels River 1) to its top from weak to very little. In Manuels River 2 and 3 the cleavage is very little (Table 1). Trilobite fossils at Manuels River 2 and 3 are usually elongated. Two local normal faults exist between Manuels River 2 and 3 and a normal fault with an offset of ca. 20 m is aligned with the middle of the river valley. All faults in the outcrop area are aligned with the main Topsail Fault system bounding the east of

the Holyrood Horst. Limestone concretions occur within all formations scattered in different sizes, ranging from less than a cm up to several dm.

Ferryland Head

Ferryland Head is a small peninsula situated at the east coast of the Avalon Peninsula, ~77 km south of St. John's. The section is located at the coastline (47.016287, -52.854991; WGS 84) and hosts an ~71.10 m thick upper Ediacaran clastic succession, which is assigned to the Ferryland Head Formation (Williams and King 1979). The base of the formation is conformably overlying the Fermeuse Formation (Fig. 2), the top is not exposed. The formation is characterised by steeply east dipping grey-green-reddish sand-silt-mudstone alternations and is interpreted to represent a shallow marine to subaerial (youngest part) depositional environment (King 1990). The thin to thick bedded strata dip steeply ca. 75° NW. Cleavage is perpendicular to the bedding and moderately developed (Table 1), whereas foliation is strong in the outcrop. In particular in the sandstone small local normal faults occur here. Cleavages and fault surfaces are filled with quartz.

MATERIALS AND METHODS

We sampled thirteen different sections ranging from the upper Ediacaran to the lower Ordovician between 2016 and 2019 and collected a total of 331 samples. The samples were prepared for X-ray diffraction analysis after Moore and Reynolds (1997) and measured in a Bruker D8 advanced eco diffractometer with a range of 5–70 °2 θ . The resulting XRD patterns were analysed using Bruker Diffraction.Suite EVA software to determine the mineral composition. Subsequently, the full width at half maximum of the illite/mica 001 (FWHM illite, Kübler Index) and the full width at half maximum of the chlorite 001 (FWHM chlorite, Árkai Index) peaks with more than 2000 cps were obtained using Fityk's (Wojdyr 2010) Split Pearson VII function (Warr 2018). As the main purpose of this study is to estimate the highest very-low to low-grade metamorphic impact, we do not distinguish between authigenic and detrital illite. We used the “pure” illite peak at 9.00±0.18 °2 θ , which shows the lowest

FWHM values and indicates the highest ordered illite present in the samples and thus the highest impact. This may only lead to an overestimation of the metamorphic impact in samples with a high amount of detrital illite, affected by higher metamorphic grades than the authigenic ones. We used the Árkai Index to support and control the Kübler Index in all applicable samples. All measured FWHM values were corrected with the Crystallinity Index Standards (CIS), using data from Warr and Rice (1994) and Warr (2018). Correction is given by the equation:

$$\text{FWHM}_{\text{corrected}} = 0.9736 * \text{FWHM}_{\text{measured}} + 0.1974. (1)$$

Zone boundaries are from Árkai (1991), Merriman and Kemp (1996), Merriman and Frey (1998), and Warr and Máhlmann (2015, Fig. 1, CIS scale)¹. All statistical analyses were undertaken with R (R Core Team 2020).

RESULTS

The FWHM illite values of the lower Cambrian Cavendish succession range from deepest diagenetic to lower anchizonal (~0.33 to 0.58°2θ; Table 2), with a median in the upper anchizone (~0.48°2θ; Table 1; Fig. 4). The values of the lowest ~4 m, which are assigned to the limestones of the Smith Point Formation, are lower anchizonal (~0.33 to 0.39°2θ), whereas the values for the Brigus Formation (upsection) are mainly upper anchizonal (increased by ~0.2°2θ). The median chlorite FWHM chlorite values (Árkai index) at Cavendish indicate uppermost epizone conditions (limestone) and uppermost anchizone conditions (mudstone; tables 1–2).

At Bacon Cove (lower Cambrian), the FWHM illite values are lower and upper anchizonal (~0.33 to 0.48°2θ; Table 2), with a median close to the transition in between (~0.41°2θ; Table 1). Specifically, the FWHM illite values of the Bonavista Formation scatter around the transition of lower and upper anchizone (~0.39 to 0.44°2θ). The FWHM illite

¹ The standard measurements are given in Table S1 and the best fit straight line for correction is given in Fig. S1.

values of the Smith Point Formation are mainly lower anchizonal (~ 0.33 to $0.42^\circ 2\theta$). The FWHM illite values of the Brigus Formation range from ~ 0.35 to $0.46^\circ 2\theta$. The FWHM illite is roughly constant throughout both successions. The median $\bar{A}$ rkai indices at Bacon Cove indicate uppermost epizone conditions (limestone) and uppermost anchizone conditions (mudstone; tables 1–2).

At Duffs (lower Cambrian) and Kelligrews (lower–middle Cambrian), the FWHM illite values plot scattered in the diagenetic zone (0.57 to $0.77^\circ 2\theta$; Table 2), with a median of $0.65^\circ 2\theta$ at Duffs (Table 1; Fig. 4). At Kelligrews, the FWHM illite values range from 0.56 to $0.88^\circ 2\theta$. Specifically, at Kelligrews 1 (lower Cambrian) the FWHM illite ranges from $\sim 0.56^\circ 2\theta$ close to the base of the Brigus Formation to $\sim 0.73^\circ 2\theta$ towards the top, with a median of $0.67^\circ 2\theta$. The FWHM illite more or less constantly decreases towards the top of the formation. The FWHM illite values of the middle Cambrian Chamberlain's Brook Formation at Kelligrews 2 range from $0.56^\circ 2\theta$ to $0.75^\circ 2\theta$ with a median of $0.70^\circ 2\theta$. It is constant throughout the section. At Kelligrews 3 (middle Cambrian), the FWHM illite values plot scattered as point cloud from 0.61° to $0.88^\circ 2\theta$, with a median of $0.75^\circ 2\theta$. The median $\bar{A}$ rkai indices at Duffs and Kelligrews 1–3 indicate diagenetic conditions (tables 1–2).

The FWHM illite values at Ochre Cove (lower Ordovician) on Bell Island plot scattered in the diagenetic zone (~ 0.56 to $0.79^\circ 2\theta$; Table 2) with a median at $\sim 0.63^\circ 2\theta$ (Table 1; Fig. 4). The median $\bar{A}$ rkai indices at Ochre Cove indicate uppermost epizone conditions (sandstone) and diagenetic conditions (mud- and siltstone; tables 1–2). At Upper Grebes Nest Point, the FWHM illite is distributed from ~ 0.41 to $1.01^\circ 2\theta$ with a median at $\sim 0.84^\circ 2\theta$. At Lance Cove, the FWHM illite scatters from 0.35 to $1.24^\circ 2\theta$ with a median at $0.90^\circ 2\theta$. The median $\bar{A}$ rkai indices at Upper Grebes Nest Point indicate diagenetic conditions for mud-, silt-, and sandstone (tables 1–2).

The FWHM illite values for the middle–upper Cambrian Manuels River localities range from deepest diagenetic to lower anchizonal ~ 0.35 to $0.65^\circ 2\theta$ (Table 2; Fig. 4).

Specifically, at Manuels River 1 (middle–upper Cambrian) the FWHM illite ranges from ~ 0.35 to $0.65^\circ 2\theta$, with a median of $\sim 0.41^\circ 2\theta$. The FWHM illite decreases within the lowest part of this succession. At Manuels River 2 (upper Cambrian) it ranges from ~ 0.37 to $0.56^\circ 2\theta$, with a median of $\sim 0.44^\circ 2\theta$. At Manuels River 3 (upper Cambrian) it ranges from ~ 0.35 to $0.58^\circ 2\theta$, with a median of $\sim 0.44^\circ 2\theta$. The FWHM illite is more or less constant in the upper 10 m of Manuels River 1 and in the whole successions of Manuels River 2 und 3. The median Árkai index at Manuels River 1 indicates lowermost diagenetic conditions (tables 1–2). At Manuels River 2 anchizone conditions are indicated by the Árkai index. The Árkai indices of both, mud- and sandstone at Manuels River 3 indicate anchizonal thermal impact.

The FWHM illite values at Ferryland Head (upper Ediacaran) are roughly constant throughout the succession and are anchizonal to uppermost epizonal (~ 0.31 to $\sim 0.40^\circ 2\theta$; Table 2), with a median in the anchizone ($\sim 0.34^\circ 2\theta$; Table 1; Fig. 4). The median Árkai index at Ferryland Head indicates uppermost epizone conditions (tables 1–2).

DISCUSSION AND INTERPRETATION

Illite FWHM values from the Cavendish section indicate exposure of the succession to deep diagenesis to the upper anchizones. Since the contact between the Smith Point and Brigus formations is concordant and the only known hiatus is intra-Smith Point, a significant difference of the illite measurements due to a potentially eroded and not preserved deposition between these two formations is unlikely. A potential constant decrease in diagenetic impact due to decreasing burial depth would be minimal and probably not visible within the small thickness of the section. In addition to temperature, illite “crystallinity”-controlling factors are (a) sediment composition, (b) fluid composition, and (c) the amount of detrital mica and authigenic illite, which are dependent on (d) porosity and permeability (Kisch 1980; Roberson and Lahann 1981; Colten-Bradley 1987; Frey 1987; Pytte and Reynolds 1989; Hartmann *et al.* 1999). Hence the difference observed here can be accounted to different rock textures of mud- and limestone or differences in the amounts of detrital and authigenic mica.

At Bacon Cove, the results indicate lower and upper anchizonal grades of metamorphism were reached, in contrast to the diagenetic conditions that would be expected the higher location of these rocks in the stratigraphic record. This difference is probably due to the textural differences between the two different rock types (limestone and mudstone) and their different composition, this might have an impact on the illite “crystallinity” as shown by Roberts *et al.* (1991).

The results of the Cambrian successions at Duffs and Kelligrews (Brigus–Manuels River Formation) indicate a deep diagenesis. This is a significantly lower diagenetic impact compared to the similar and even younger aged rocks in the Manuels River localities (Fig. 4–6). These successions are also mudstone-dominated and formed in palaeogeographically related depositional environments, so coherence of the offset in illite “crystallinity” with lithology or composition is unlikely. Though their geographic proximity, the localities of Manuels River are in direct relation to the fault system connected with the boundaries of the Holyrood Horst, whereas the localities of Kelligrews and Duffs are situated close to the centre of the horst. The geological position of the sediments exposed at Duffs and Kelligrews prevented a higher impact of any post-depositional event, such as the deformation related to the Acadian orogeny, on the successions.

At Ochre Cove, our results point to the shallow–deep diagenetic zone with one value in the lower anchizone. The decreasing trend in the lowermost 15 m indicates a deep diagenetic grade and is independent of the lithologies (Figs. 4, 5). This may suggest a mainly external influence of the illite “crystallinity”, such as conduction. The higher permeability of the underlying, 6-m-thick hematized oolite of the Dominion Formation (Fig. 3²) might have served as an ideal path for hot fluids, what may have led to higher temperatures above the oolite. Another cause for the trend could be the amount of detrital material from the same or

² Fig. S2

different sources of a higher diagenetic grade buried in the sandstones, but additional data e.g. on smectite-illite percentage and illite polytypes would be required to test this hypothesis in more detail.

At Upper Grebes Nest Point, our results point to the shallow–deep diagenetic zones (Fig. 4) and one value plots in the upper and one in the lower anchizone. The range of the measurements is unusual since the diagenetic impact is expected to remain stable in such a short succession (Kübler 1967) and indicates local additional factors. The mudstones in the upper 8 m of the succession have a roughly constant diagenetic grade close to the shallow–deep diagenesis boundary. Temperature is the main controlling factor of illite “crystallinity” (Kübler 1967), and the whole succession should have experienced these minimal conditions, so the lowest grades can be assumed to be the result of burial diagenesis and thus the burial depth.

The results from Lance Cove plot largely in the shallow to deep diagenetic zone, except one value in the upper anchizone. The diagenetic impact of the measured mudstone sample is within the expected range, as Lance Cove is situated close to the centre of the Holyrood Horst. The lowest FWHM values can be attributed to higher amounts of detrital illites in sandstone lithologies.

The results of the Manuels River localities (1–3) indicate deep diagenetic to lower anchizone grades. Particularly the lower 5–10 m of the Manuels River Formation at Manuels River 1 are lower influenced (deep diagenesis) whereas the rest of the succession shows clear evidence of anchizonal influence. The lower diagenesis of sandstone in Manuels River 3 can be explained by the different lithology and thus by different composition, porosity and permeability. The low diagenetic grade at the base of the Manuels River Formation is puzzling, as such grades should be expected rather at the top of the succession due to decreasing burial depth if even. However, these values parallel those of the uppermost samples from Kelligrews 3, which are also from the lower Manuels River Formation. It is

evident, that the lower part of Manuels River 1 was impacted as low as Kelligrews 3. Further data points in the lower part of Manuels River 1 plot within the anchizone. Possibly, that the clay mineral composition, porosity or permeability of the mudstones from the Manuels River Formation change rapidly within the lower part of the succession (Austermann 2016). Austermann (2016) argues with a secondary diagenetic event, that affected only the upper part, but this is highly speculative and is rejected here in the light of the other measurements from Kelligrews and Manuels River. Although the Árkai index correlates well ($R^2 = 0.59$) with the median Kübler index (Fig. 6; Table 2; Table 1) at all localities, the mudstone of Manuels River 1 and 3 are exemptions. Here, the Kübler index clearly indicates mid-anchizonal influence, whereas the Árkai index indicates deepest diagenetic conditions at Manuels River 1 and 3. Due to this and the changes in the mineral composition (Austermann 2016), it is more likely that the mixture of detrital and authigenic illite changed and caused the illite “crystallinity” shift, but ultimately the cause for the much lower diagenetic grade remains unknown.

The results from Ferryland Head indicate the transition zone from the higher anchi- to epizone. This is in the expected range compared to the Cavendish location also outside the Holyrood Horst. The difference between the Cavendish and the Ferryland Head samples is insignificant and explained by different lithologies, i.e. mudstone/limestone vs. siltstone. It is thus hard to determine whether this difference is a result of different orogenic influences, such as Avalonian and Acadian orogeneses or the higher burial depth of the Ferryland Head samples. Despite this, the consistency of the Ferryland Head results is remarkable considering the siltstone lithology. This is possibly also indicated by the better developed cleavage in the area of the outcrop, compared to the other outcrops.

Illite FWHM values indicate shallow diagenetic to epizone (Figs. 4–6). At least for the Cambrian–Ordovician successions exposed on the centre of the Holyrood Horst, our results contrast the prehnite-pumpellyite facies metamorphic overprint in general proposed by

Papezik (1974) and cited in van Staal *et al.* (2020). Papezik (1974) carried out his study in very restricted parts of Ediacaran successions, magmatic rocks on the Holyrood Horst or infills in cleavages, but not in sedimentary successions. Aside of some volcanic occurrences, he reported prehnite from two different localities: In the Signal Hill Formation, it occurs in veins in patches of a fine-grained sandstone and associated with quartz, calcite and chlorite and in the Harbour Main Group it is found within sandstones and conglomerates, also associated in veins with quartz and calcite. The Harbour Main Group is composed mainly of magmatic rocks, constantly intruding during the Cryogenian and the lower Ediacaran (King 1990; Sparkes 2006, *et al.* 2007) and increasing temperatures during the deposition of similar or even younger aged sediments. Thus, it is evident, that these occurrences are induced by syn- or post-sedimentary local fluid intrusions or higher temperatures in a limited area of the succession, but do not represent the general diagenetic overprint. Aside, the samples from the Harbour Main Group of Papezik (1974) occur stratigraphically lower than those of the present study. This has most likely led to a higher burial depth and thus higher metamorphic grades.

Pumpellyite was only found in magmatic rocks (Papezik 1974). A very low and very restricted metamorphic overprint of the Ediacaran sediments is evident from Papezik (1974), but the usage of zones or interpretation of widespread overprint from his study are challenged by our results. The Cambrian–Ordovician succession has a generally lower level of diagenesis than the fluid-overprinted and partly volcanic low metamorphic rocks studied by Papezik (1974).

Our results show very well that the position of the successions, (1) outside the Holyrood Horst, (2) inside but proximal to the boundaries and fault zones, and (3) inside and close to the centre (figs. 5, 7; Table 1), is reflected very well by the illite “crystallinity” of mud- and limestones, with significantly lower diagenetic grades proximal to the centre of the horst (Fig. 4, 5). Several studies have indicated late Silurian to early Devonian ages for the collision of Avalonia with the leading edge of Laurentia (e.g., White *et al.* 2006; van Staal *et*

448 *al.* 2009; van Staal and Barr 2012; Willner *et al.* 2014). Subsequent deformation seems to
449 have had a low influence onto the diagenetic grade of the successions on the Holyrood Horst,
450 as already noted superficially by Williams (1993), whereas the rocks outside the Holyrood
451 Horst are folded in large synclinal-anticlinal structures and indicate anchizonal to uppermost
452 epizonal thermal influence. The very-low to low-grade metamorphic conditions outside the
453 horst are roughly concordant with the Cambrian–Ordovician succession of the Mira terrane in
454 SE Cape Breton Island, Nova Scotia (McMullin *et al.* 2010; Willner *et al.* 2013; Willner *et al.*
455 2014), Antigonish Highlands, Nova Scotia (Abad *et al.* 2012) and the Welsh basin (Verniers
456 *et al.* 2002). Willner *et al.* (2013) have calculated temperatures of 280 ± 30 °C for their
457 samples from the Mira terrane, proving a terminal anchizonal to epizonal influence. Such very
458 low to low-grade metamorphism during the Acadian orogeny was attributed to the foreland
459 position of the terrane during the collision. Hence, the Mira terrane escaped a pervasive
460 overprint during the deformation (Willner *et al.* 2014). Likewise, the study area probably
461 escaped overprinting, as it was situated proximal to the similar Mira terrane (Barr *et al.* 1998)
462 and positioned in the foreland of the collision (Willner *et al.* 2014). The study area, the Mira
463 terrane, the Antigonish Highlands and the Midlands Microcraton in England are in general the
464 lowest metamorphosed areas of Avalonia. The Bonavista Peninsula west of the study area is
465 considered of greenschist facies (Mills *et al.* 2016), although quantitative data is missing.
466 Metamorphism in the Avalonian part of Southern New Brunswick is usually greenschist
467 facies (White and Barr 1996) but may locally reach granulite facies (high-pressure, low-
468 temperature metamorphism at 430–580 °C, 9–12.4 kbar; White *et al.* 2001). Rocks of
469 Avalonian origin from Maine have experienced peak temperatures of 550–600°C and 3–4
470 kbar (West Jr *et al.* 2003). Other areas of Avalonia in Europe, such as eastern England
471 (greenschist facies; Pharaoh *et al.* 1987; Merriman *et al.* 1993; Verniers *et al.* 2002), the
472 Stavelot-Venn Inlier (400–450 °C, 1–3 kbar; Fielitz and Mansy 1999), the Rocroi-Serpont
473 Inlier (500 °C, 2–3 kbar; Fielitz and Mansy 1999) were exposed to higher metamorphic

grades than the study area. The shallow to deep diagenetic results from the inner Holyrood Horst are inconsistent with most other areas of Avalonia, but represent among the lowest conditions reported from Avalonia, similar to the Midlands microcraton (Merriman *et al.* 1993). It is likely, that the fault systems bounding the horst, in conjunction with the crystalline basement, have prevented a higher thermal overprint and also the faulting in large anticlinal-synclinal structures of the successions. Instead, all successions on the horst only slightly dip with 8–10° NW.

Our results indicate a remarkable homogenous mineralogy over all sampled successions. All samples basically consist of white mica, albite, quartz $\pm$ chlorite $\pm$ kaolinite $\pm$ calcite $\pm$ Fe- $\pm$ Ti-accessories (Table 2). The carbonate content is mainly controlled by the depositional environment and the occurrence of reefs in the study area (Cavendish and Bacon Cove). Minor changes in the mineralogy occur locally and are temporally restricted. This suggests a constant and proximal source area for all successions in the study area, possibly the Holyrood Horst. It is impossible to finally determine the sediment source for the deposited rocks with the present data, but future studies will probably focus on this topic.

The range of the illite “crystallinity” of the siltstone samples from the upper Ediacaran Ferryland Head locality is low (Figs. 4, 5), the measurements are constant throughout this part of the succession and thus can be taken as an indicator for the diagenetic overprint of the succession here. The minor difference in the samples from the two localities outside the horst (Ferryland Head and Cavendish) can be explained by lithological differences of siltstone (Ferryland Head) and limestone or mudstone (Cavendish), respectively. In addition, a higher burial depth in Ferryland Head might have caused the slightly higher diagenetic grade (Fig. 7). This, in turn, would indicate that all post-depositional events had a lower influence on the successions than the burial depth on the Avalon Peninsula. Influence of the Avalonian Orogeny (Landing 1992; Myrow 1995; van Staal *et al.* 2020) on the upper Ediacaran rocks can neither be proven nor excluded here.

Higher metamorphic grades are observed in all lithologies close to the boundaries (Bacon Cove and Manuels River). These successions are coeval to some of those in the centre, an age-related and thus burial depth-related distinction is thus unlikely (Fig. 7) and a simple lithology-related difference to the centre of the horst is absent. The proximity to the fault systems bounding the Holyrood Horst seem to have caused the anchizonal grades (Fig. 7). The tectonic development of the Holyrood Horst was completed prior to deposition (Krogh *et al.* 1988; Sparkes 2006; Sparkes *et al.* 2007). Most probably these fault systems were reactivated during postdepositional events, such as the Acadian Orogeny. Possibly, these fault systems also led to a higher fluid potential, causing the increased diagenetic grade. This is indicated by Papezik (1974), as his samples are from postdepositional veins within cleavage infills, showing even an increased diagenetic impact. Such scenarios are well known from other Host-Graben systems, e.g., in the north German Rotliegendes (Zwingmann *et al.* 1998).

A positive age-diagenetic grade correlation can be interpreted within the mudstones (Fig. 7) in the sections in the centre of the Horst (Grebes Nest Point, Lance Cove, Ochre Cove, Duffs and Kelligrews). The Kübler index as “stand-alone” is not accepted as a geothermometer, but instead serves as an indicator of the general very low-grade metamorphism in a region. For reliable results, more temperature constraints are needed. On the other hand, to the present study we lack totally in knowledge on the burial depths and metamorphism in the type area of Avalonia. In order to get a first simplified model and a principle overview, we use the Kübler index in conjunction with the Árkai index to roughly estimate burial temperatures. With given mudstone FWHM median values of $\sim 0.90^\circ 2\theta$ at Grebes Nest Point and $\sim 0.67^\circ 2\theta$ at Kelligrews a difference of $\sim 30\text{--}40\text{ K}$ (e.g. Merriman and Kemp 1996) can be estimated. Considering a normal thermal gradient of $\sim 30\text{ K}\cdot\text{km}^{-1}$, this is equivalent to $\sim 1000\text{ m}$ of deposition and roughly fits the thickness of the Cambro-Ordovician succession deposited between Kelligrews and Grebes Nest Point (e.g., Ranger *et al.* 1984; Hutchinson 1962).

Another correlation seems to exist between the increasing variability of the FWHM illite and the increased sample grain size in the coarser grained sediments of the Lower Ordovician succession (Figs. 4, 5). Coarser clastic sediments tend to be composed of heterogeneous detrital material (Aldega and Eberl 2005) and increasing amounts of detrital illite or muscovite from sources with higher diagenetic overprint might play a role here. This is also likely as Pollock *et al.* (2009) proved a change in the provenance from Avalonia and Amazonia during the Ediacarian and Cambrian to more Baltica and Laurentia dominated within the Ordovician Bell Island sediments based on zircon provenance analysis. Such detritus was not reordered during the relatively low diagenetic conditions impacting the Bell Island successions. The resulting FWHM composition within coarse grained rocks is thus more variable, and does not only reflect the diagenetic overprint of the Lower Ordovician sediments.

The largest illite FWHM values were detected in the Ordovician mudstones ($\sim 0.7^\circ 2\theta$; Powers Steps Formation); they indicate a maximum temperature of $\sim 120^\circ\text{C}$ (e.g. Merriman and Kemp 1996). This enables an estimation of the primary burial depth. Willner *et al.* (2013) have estimated a very low thermal gradient of $20\text{--}25^\circ\text{K}$ for the proximal Avalonian Mira terrane. Under the assumption of a slightly higher normal thermal gradient of $30^\circ\text{K}\cdot\text{km}^{-1}$ the primordial overlying succession was ~ 4 km thick (Fig. 7). Such thermal gradient is supported by our Cambrian results ($\sim 0.65^\circ 2\theta$; $\sim 150^\circ\text{C}$; Kelligrews 1 and Duffs) from the centre of the Horst, because these fit into the expected range with the given thickness of the succession in between (Figs. 2, 7). A higher thermal gradient would contradict the reported succession thickness ranges of e.g., Hutchinson (1962), Ranger *et al.* (1984), and Fletcher (2006). The FWHM from the lower Cambrian of the east coast of Trinity Bay (Cavendish; $\sim 0.60^\circ 2\theta$; $\sim 170^\circ\text{C}$) also fit into our model (Fig. 7). Landing (1992) and Fletcher (2006) already noted the lowest thicknesses observed in all formations in our study area there. Higher thicknesses of the successions in between would have caused higher diagenetic impact, or an unusually low

thermal gradient would have existed. Also, the results from the Ferryland Head Formation fit into our model.

SUMMARY

The upper Ediacaran to Lower Ordovician strata exposed on the Avalon Peninsula show evidence of diagenesis to very low-grade metamorphism depending on age, lithology and regional geological setting. Our study shows that the lowest diagenetic impact was onto sediments on the Holyrood Horst (shallow to deep diagenesis), whereas sediments adjacent to the fault zones bounding the horst and outside the horst are stronger overprinted (anchizone). Sediments on the horst show a clear correlation between age, i.e. burial depth and degree of diagenesis, which suggests that the basement of the horst prevented a higher tectonic impact onto the sedimentary successions. The fault systems bounding the horst have possibly been reactivated during postdepositional events, leading to a higher fluid impact. Subjection to prehnite-pumpellyite-facies impact for the whole sediment succession exposed on the Avalon Peninsula as previously proposed is rejected here. Our results indicate diagenetic conditions for the centre of the Holyrood Horst, a major part of the eastern Avalon Peninsula. However, the thermal impact in the successions outside the Holyrood Horst, is consistent with a few other areas of Avalonia, such as the Mira terrane and the Antigonish Highlands in Nova Scotia and the Midland Microcraton in England. The metamorphic impact decreases from the Bonavista Peninsula west of the study area from greenschist facies to anchizonal and diagenetic. Major regions of Avalonia south of the study area on the mainland of New Brunswick and Maine and eastwards in Europe have experienced higher metamorphic conditions. The low diagenetic overprint indicates a normal temperature gradient of ~ 30 K*km⁻¹ for the whole succession, similar to the Mira terrane (20–25 °C). The influence of syn- or postsedimentary orogeneses (e.g., Avalonian and Acadian) on all sedimentary successions was only minor, if even noticeable.

AUTHOR STATEMENTS

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Author Contributions

The study was designed by GA and AH and is based on field work carried out by GA, AH and MK. Analyses were carried out by GA, MK and PE. Sedimentological interpretations and implications developed from discussions with CI, AH and MK. The manuscript was prepared with input from all co-authors.

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881 FIGURES

Figure 1: Sample localities on the eastern Avalon Peninsula. A) Simplified geological map of the eastern Avalon Peninsula (based on King 1988, available at <https://www.gov.nl.ca/iet/files/88-01.pdf>, compiled with Adobe Illustrator; Adobe Inc. 2020). BACO: Bacon Cove; BGNP: Bell Island, Upper Grebes Nest Point; BILC: Bell Island, Lance Cove; BOCC: Bell Island, Ochre Cove; CAVD: Cavendish; DUFS: Duffs; FEHE: Ferryland Head; KG01–03: Kelligrews 1–3, MR01–03: Manuels River 1–3. B) Detailed map of localities Kelligrews 1–3. Compiled with Adobe Illustrator (Adobe Inc. 2020), base map from Government of Newfoundland (2021a), available at <https://www.gov.nl.ca>. C) Detailed map of localities Manuels River 1–3. Compiled with Adobe Illustrator (Adobe Inc. 2020), base map from Government of Newfoundland (2021b), available at <https://www.gov.nl.ca>.

Figure 2: Lithostratigraphy of the upper Ediacaran to Lower Ordovician rocks of the Avalon Peninsula based on Hutchinson (1962), King (1988) and Ranger *et al.* (1984). Black bars correspond with the sampled segments of the formations.

Figure 3: Simplified sections of the sampled localities. Black arrows correspond with sample horizon. Please see Fig. 2 for lithostratigraphy of the Avalon Peninsula. BACO: Bacon Cove; BGNP: Bell Island, Upper Grebes Nest Point; BILC: Bell Island, Lance Cove; BOCC: Bell Island, Ochre Cove; CAVD: Cavendish; DUFS: Duffs; FEHE: Ferryland Head; KG01–03: Kelligrews 1–3, MR01–03: Manuels River 1–3; DF: Dominion Formation³.

Figure 4: Scatterplot of the illite “crystallinity” values against the stratigraphical height in each succession. Outcrops are in temporal order. Lance Cove, Ochre Cove and Upper Grebes Nest Point are on Bell Island. DZ: Diagenetic zone; AZ: Anchizone; EP: Epizone. Zone

³ Detailed information is available in Fig. S2.

boundaries are from Merriman and Kemp (1996), Merriman and Frey (1998), and Warr and Mählmann (2015, fig. 1, CIS scale).

Figure 5: Boxplots of the illite “crystallinity” (values) against their outcrop’s latitude with a subdivision by lithology. Note the positive correlation of FWHM illite with the relative age of the succession close to the centre of the Holyrood Horst. Upper Ediacaran: Ferryland Head; lower Cambrian: Cavendish, Bacon Cove Duffs and Kelligrews 1; middle Cambrian: Kelligrews 2–3; upper Cambrian: Manuels River 1–3; Lower Ordovician: Bell Island outcrops. Diagenetic zone boundaries as in Fig. 4.

Figure 6: Crossplot of the illite and chlorite “crystallinities” (Kübler and Árkai indices) which correlate with an $R^2=0.59$.

Figure 7: Scatterplot of the illite “crystallinity” values against the overall succession thickness on the Avalon Peninsula. Note the positive correlation of FWHM illite with the relative age of the succession close to the centre of the Holyrood Horst. Our model fits a roughly normal temperature gradient of $\sim 30 \text{ K} \cdot \text{km}^{-1}$ (right y-axis). Successions adjacent to the fault zones bounding the horst (BACO and MR01–03) show lower FWHM illite values than expected from the burial depth. These successions have been impacted by the fault zones. The eastern fault zone is aligned SSW–NNE towards the Ordovician Bell Island sections. Succession thickness data from Hutchinson (1962), Ranger *et al.* (1984), King (1990), Fletcher (2006) and the present study. BACO: Bacon Cove; BGNP: Bell Island, Upper Grebes Nest Point; BILC: Bell Island, Lance Cove; BOCC: Bell Island, Ochre Cove; CAVD: Cavendish; DUFFS: Duffs; FEHE: Ferryland Head; KG01–03: Kelligrews 1–3, MR01–03: Manuels River 1–3.

931 Table 1: Summary of all data presented here. Abbreviations: nc: not cleaved, mc: moderately
932 cleaved, wc: well cleaved; nf: not foliated, sf: strongly foliated.

933

934 Table 2: Measurement data and mineralogical assemblage based on XRD of each sample.

935 XRD measurement was conducted at 5–70 °2 θ . Abbreviations (Whitney and Evans 2010):

936 Ab: albite, Ant: anatase, Cal: calcite, Chm: chamosite, Gth: goethite, Hem: hematite, Ilt: illite,

937 Kln: kaolinite, Mnt: montmorillonite, Qz: quartz, Py: pyrite.

Draft

System	East coast of Trinity Bay	Holyrood Horst	East coast of Avalon Peninsula
Ordovician		Gravel Head Fm.	
		Gull Island Fm.	
		Grebes Nest Point Fm.	
		Scotia Fm.	
		Powers Steps Fm.	
		Dominion Fm.	
		Ochre Cove Fm.	
		Redmans Fm.	
		Beach Fm.	
		Little Bell Island Fm.	
		Kelly's Island Fm.	
		Elliot Cove fm.	
		Manuels River Fm.	
Cambrian		Chamberlain's Brook Fm.	
	Brigus Fm.	Brigus Fm.	
	Smith Point Fm.	Smith Point Fm.	
	Bonavista Fm.	Bonavista Fm.	
	Random Fm.		
Ediacaran	Musgravetown Gp.		Blackhead Fm.
			Cuckold Fm.
			Quidi Vidi Fm.
			Gibett Hill Fm.
			Ferryland Head Fm.
			St. John's Gp.
		Drook Fm.	Conception Gp.
		Holyrood Intrusive Suite

FWHM Illite [$^{\circ}2\theta$]

Chronostratigraphy

- Lower Ordovician
- Upper Cambrian
- Middle Cambrian
- Lower Cambrian
- Upper Ediacaran

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Latitude

Kübler Index

0.8

0.6

0.4

0.2

0.4

0.6

Årkai Index

 $R^2 = 0.5903$

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Locality

- Bacon Cove
- Bell Island, Lance Cove
- △ Bell Island, Ochre Cove
- + Bell Island, Upper Grebes Nest Point
- × Cavendish
- ◇ Duffs
- ▽ Ferryland Head
- ▣ Kelligrews 1
- * Kelligrews 2
- ◊ Kelligrews 3
- ⊕ Manuels River 1
- ⊗ Manuels River 2
- ▤ Manuels River 3

Lithology

- limestone
- mudstone
- sandstone
- siltstone

Locality	Lithology	Age	Median FWHM illite	Kübler index
Bacon Cove	limestone	Lower Cambrian	0.373	anchizone
Bacon Cove	mudstone	Lower Cambrian	0.408	anchizone
Bell Island, Lance Cove	mudstone	Lower Ordovician	0.634	diagenetic zone
Bell Island, Lance Cove	sandstone	Lower Ordovician	0.719	diagenetic zone
Bell Island, Lance Cove	siltstone	Lower Ordovician	0.855	diagenetic zone
Bell Island, Ochre Cove	mudstone	Lower Ordovician	0.611	diagenetic zone
Bell Island, Ochre Cove	sandstone	Lower Ordovician	0.634	diagenetic zone
Bell Island, Ochre Cove	siltstone	Lower Ordovician	0.785	diagenetic zone
Bell Island, Upper Grebes Nest Point	mudstone	Lower Ordovician	0.872	diagenetic zone
Bell Island, Upper Grebes Nest Point	sandstone	Lower Ordovician	0.805	diagenetic zone
Bell Island, Upper Grebes Nest Point	siltstone	Lower Ordovician	0.682	diagenetic zone
Cavendish	limestone	Lower Cambrian	0.363	anchizone
Cavendish	mudstone	Lower Cambrian	0.503	diagenetic zone
Duffs	mudstone	Lower Cambrian	0.660	diagenetic zone
Ferryland Head	siltstone	Upper Ediacaran	0.346	anchizone
Kelligrews 1	mudstone	Lower Cambrian	0.657	diagenetic zone
Kelligrews 2	mudstone	Middle Cambrian	0.680	diagenetic zone
Kelligrews 3	mudstone	Middle Cambrian	0.764	diagenetic zone
Manuels River 1	mudstone	Upper Cambrian	0.438	diagenetic zone
Manuels River 2	mudstone	Upper Cambrian	0.442	diagenetic zone
Manuels River 3	mudstone	Upper Cambrian	0.423	diagenetic zone
Manuels River 3	sandstone	Upper Cambrian	0.539	diagenetic zone

Median FWHM chlorite	Árkai index	Position relative to the Horst	Deformation
0.245	epizone	boundary / fault zone (2)	wc, nf
0.351	anchizone	boundary / fault zone (2)	wc, nf
0.501	diagenetic zone centre (3)		nc, nf
0.517	diagenetic zone centre (3)		nc, nf
0.482	diagenetic zone centre (3)		nc, nf
0.429	diagenetic zone centre (3)		nc, nf
0.216	epizone	centre (3)	nc, nf
0.368	diagenetic zone centre (3)		nc, nf
0.532	diagenetic zone centre (3)		nc, nf
0.491	diagenetic zone centre (3)		nc, nf
0.469	diagenetic zone centre (3)		nc, nf
0.257	epizone	outside (1)	mc, sf
0.351	anchizone	outside (1)	mc, sf
0.410	diagenetic zone centre (3)		nc, nf
0.213	epizone	outside (1)	mc, sf
0.411	diagenetic zone centre (3)		nc, nf
0.405	diagenetic zone centre (3)		nc, nf
0.448	diagenetic zone centre (3)		nc, nf
0.356	diagenetic zone boundary / fault zone (2)		mc, sf
0.301	anchizone	boundary / fault zone (2)	nc, nf
0.363	diagenetic zone boundary / fault zone (2)		nc, nf
0.373	diagenetic zone boundary / fault zone (2)		wc, nf

Sample	Locality	Age	Lithology	WHM illit	übler inde	VHM chlori	Árkai index	Illt
0117-CAVC	Cavendish	Lower Cam	limestone	0.368081	anchizone	0.216364	epizone	x
0216-CAVC	Cavendish	Lower Cam	limestone	0.330151	anchizone	0.216364	epizone	x
0247-CAVC	Cavendish	Lower Cam	limestone	0.349115	anchizone	0.330146	anchizone	x
0248-CAVC	Cavendish	Lower Cam	limestone	0.368081	anchizone	0.330146	anchizone	x
0092-CAVC	Cavendish	Lower Cam	limestone	0.349116	anchizone	0.216364	epizone	x
0123-CAVC	Cavendish	Lower Cam	limestone	0.368081	anchizone	0.216364	epizone	x
0122-CAVC	Cavendish	Lower Cam	limestone	0.368081	anchizone	0.216364	epizone	x
0124-CAVC	Cavendish	Lower Cam	limestone	0.36808	anchizone	0.311183	anchizone	x
0121-CAVC	Cavendish	Lower Cam	limestone	0.387046	anchizone	0.311183	anchizone	x
0060-CAVC	Cavendish	Lower Cam	limestone	0.387046	anchizone			x
0005-CAVC	Cavendish	Lower Cam	mudstone	0.481867	diagenetic	0.387038	diagenetic	x
0017-CAVC	Cavendish	Lower Cam	mudstone	0.500832	diagenetic	0.406002	diagenetic	x
0203-CAVC	Cavendish	Lower Cam	mudstone	0.481867	diagenetic	0.216364	epizone	x
0059-CAVC	Cavendish	Lower Cam	limestone	0.387045	anchizone	0.330146	anchizone	x
0020-CAVC	Cavendish	Lower Cam	mudstone	0.557725	diagenetic	0.424965	diagenetic	x
0201-CAVC	Cavendish	Lower Cam	mudstone	0.519796	diagenetic	0.424965	diagenetic	x
0054-CAVC	Cavendish	Lower Cam	mudstone	0.481867	diagenetic	0.216364	epizone	x
0037-CAVC	Cavendish	Lower Cam	mudstone	0.500832	diagenetic	0.387038	diagenetic	x
0217-CAVC	Cavendish	Lower Cam	mudstone	0.500832	diagenetic	0.406002	diagenetic	x
0824-CAVC	Cavendish	Lower Cam	mudstone	0.443939	diagenetic	0.216364	epizone	x
0825-CAVC	Cavendish	Lower Cam	mudstone	0.519797	diagenetic	0.424965	diagenetic	x
0215-CAVC	Cavendish	Lower Cam	mudstone	0.519797	diagenetic	0.368074	diagenetic	x
0826-CAVC	Cavendish	Lower Cam	mudstone	0.519796	diagenetic	0.387038	diagenetic	x
0014-CAVC	Cavendish	Lower Cam	mudstone	0.519797	diagenetic	0.387038	diagenetic	x
0206-CAVC	Cavendish	Lower Cam	mudstone	0.538761	diagenetic	0.424965	diagenetic	x
0221-CAVC	Cavendish	Lower Cam	mudstone	0.500832	diagenetic	0.387038	diagenetic	x
0119-CAVC	Cavendish	Lower Cam	mudstone	0.500832	diagenetic	0.34911	anchizone	x
0242-CAVC	Cavendish	Lower Cam	mudstone	0.519797	diagenetic	0.406002	diagenetic	x
0220-CAVC	Cavendish	Lower Cam	mudstone	0.519796	diagenetic	0.216364	epizone	x
0073-CAVC	Cavendish	Lower Cam	mudstone	0.500832	diagenetic	0.424965	diagenetic	x
0046-CAVC	Cavendish	Lower Cam	mudstone	0.519797	diagenetic	0.387038	diagenetic	x
0048-CAVC	Cavendish	Lower Cam	mudstone	0.481867	diagenetic	0.368074	diagenetic	x
0214-CAVC	Cavendish	Lower Cam	mudstone	0.443939	diagenetic	0.216364	epizone	x
0018-CAVC	Cavendish	Lower Cam	mudstone	0.500831	diagenetic	0.387038	diagenetic	x
0207-CAVC	Cavendish	Lower Cam	limestone	0.330151	anchizone	0.387038	diagenetic	x
0074-CAVC	Cavendish	Lower Cam	mudstone	0.424974	diagenetic	0.34911	anchizone	x
0053-CAVC	Cavendish	Lower Cam	mudstone	0.57669	diagenetic	0.216364	epizone	x
0177-BAC1	Bacon Cove	Lower Cam	mudstone	0.40601	anchizone	0.330146	anchizone	x
0174-BAC1	Bacon Cove	Lower Cam	mudstone	0.387045	anchizone	0.368074	diagenetic	x
0180-BAC1	Bacon Cove	Lower Cam	mudstone	0.387045	anchizone	0.34911	anchizone	x
0175-BAC1	Bacon Cove	Lower Cam	mudstone	0.424974	diagenetic	0.387038	diagenetic	x
0173-BAC1	Bacon Cove	Lower Cam	mudstone	0.406009	anchizone	0.34911	anchizone	x
0181-BAC1	Bacon Cove	Lower Cam	mudstone	0.443939	diagenetic	0.424965	diagenetic	x
0169-BAC2	Bacon Cove	Lower Cam	limestone	0.424974	diagenetic	0.216364	epizone	x
0170-BAC2	Bacon Cove	Lower Cam	limestone	0.349116	anchizone	0.216364	epizone	x
0167-BAC2	Bacon Cove	Lower Cam	limestone	0.387045	anchizone	0.330146	anchizone	x
0171-BAC2	Bacon Cove	Lower Cam	limestone	0.330151	anchizone	0.216364	epizone	x
0172-BAC2	Bacon Cove	Lower Cam	mudstone	0.462903	diagenetic	0.387038	diagenetic	x
0188-BAC2	Bacon Cove	Lower Cam	mudstone	0.349116	anchizone	0.216364	epizone	x

0807-DUFS Duffs	Lower Cam mudstone	0.766335 diagenetic	0.462893 diagenetic	x
0806-DUFS Duffs	Lower Cam mudstone	0.671513 diagenetic	0.387038 diagenetic	x
0805-DUFS Duffs	Lower Cam mudstone	0.633584 diagenetic	0.406002 diagenetic	x
0229-DUFS Duffs	Lower Cam mudstone	0.671513 diagenetic	0.406002 diagenetic	x
0786-DUFS Duffs	Lower Cam mudstone	0.633584 diagenetic	0.368074 diagenetic	x
0025-DUFS Duffs	Lower Cam mudstone	0.690477 diagenetic	0.406002 diagenetic	x
0028-DUFS Duffs	Lower Cam mudstone	0.709442 diagenetic	0.424965 diagenetic	x
0029-DUFS Duffs	Lower Cam mudstone	0.633584 diagenetic	0.424965 diagenetic	x
0843-DUFS Duffs	Lower Cam mudstone	0.61462 diagenetic	0.406002 diagenetic	x
0024-DUFS Duffs	Lower Cam mudstone	0.576689 diagenetic	0.406002 diagenetic	x
0030-KG01 Kelligrews	Middle Car mudstone	0.804264 diagenetic	0.462893 diagenetic	x
0142-KG01 Kelligrews	Middle Car mudstone	0.842193 diagenetic	0.443929 diagenetic	x
0249-KG01 Kelligrews	Middle Car mudstone	0.861158 diagenetic	0.443929 diagenetic	x
0250-KG01 Kelligrews	Middle Car mudstone	0.842193 diagenetic	0.481857 diagenetic	x
0146-KG01 Kelligrews	Middle Car mudstone	0.880122 diagenetic	0.462893 diagenetic	x
0252-KG01 Kelligrews	Middle Car mudstone	0.766335 diagenetic	0.424965 diagenetic	x
0251-KG01 Kelligrews	Middle Car mudstone	0.709442 diagenetic	0.424965 diagenetic	x
0149-KG01 Kelligrews	Middle Car mudstone	0.842194 diagenetic	0.50082 diagenetic	x
0139-KG01 Kelligrews	Middle Car mudstone	0.842193 diagenetic	0.519784 diagenetic	x
0041-KG01 Kelligrews	Middle Car mudstone	0.766335 diagenetic	0.462893 diagenetic	x
0145-KG01 Kelligrews	Middle Car mudstone	0.804264 diagenetic	0.538748 diagenetic	x
0052-KG01 Kelligrews	Middle Car mudstone	0.728405 diagenetic	0.443929 diagenetic	x
0141-KG01 Kelligrews	Middle Car mudstone	0.842194 diagenetic	0.462893 diagenetic	x
0254-KG01 Kelligrews	Middle Car mudstone	0.728405 diagenetic	0.424965 diagenetic	x
0040-KG01 Kelligrews	Middle Car mudstone	0.747371 diagenetic	0.424965 diagenetic	x
0255-KG01 Kelligrews	Middle Car mudstone	0.766335 diagenetic	0.462893 diagenetic	x
0042-KG01 Kelligrews	Middle Car mudstone	0.74737 diagenetic	0.443929 diagenetic	x
0019-KG01 Kelligrews	Middle Car mudstone	0.747371 diagenetic	0.424965 diagenetic	x
0031-KG01 Kelligrews	Middle Car mudstone	0.74737 diagenetic	0.424965 diagenetic	x
0370-KG01 Kelligrews	Middle Car mudstone	0.709442 diagenetic	0.424965 diagenetic	x
0062-KG01 Kelligrews	Middle Car mudstone	0.614619 diagenetic	0.406002 diagenetic	x
0043-KG01 Kelligrews	Middle Car mudstone	0.709442 diagenetic	0.424965 diagenetic	x
0202-KG01 Kelligrews	Middle Car mudstone	0.861158 diagenetic	0.462893 diagenetic	x
0016-KG01 Kelligrews	Middle Car mudstone	0.728406 diagenetic	0.443929 diagenetic	x
0783-KG01 Kelligrews	Middle Car mudstone	0.842194 diagenetic	0.443929 diagenetic	x
0063-KG01 Kelligrews	Middle Car mudstone	0.842193 diagenetic	0.481857 diagenetic	x
0072-KG01 Kelligrews	Middle Car mudstone	0.728406 diagenetic	0.424965 diagenetic	x
0057-KG01 Kelligrews	Middle Car mudstone	0.709442 diagenetic	0.424965 diagenetic	x
0191-KG01 Kelligrews	Middle Car mudstone	0.728406 diagenetic	0.424965 diagenetic	x
0190-KG01 Kelligrews	Middle Car mudstone	0.804264 diagenetic	0.50082 diagenetic	x
0064-KG01 Kelligrews	Middle Car mudstone	0.728406 diagenetic	0.443929 diagenetic	x
0253-KG01 Kelligrews	Middle Car mudstone	0.690477 diagenetic	0.406002 diagenetic	x
0126-KG01 Kelligrews	Middle Car mudstone	0.614619 diagenetic	0.424965 diagenetic	x
0148-KG01 Kelligrews	Middle Car mudstone	0.633584 diagenetic	0.406002 diagenetic	x
0223-KG03 Kelligrews	Lower Cam mudstone	0.709442 diagenetic	0.443929 diagenetic	x
0039-KG03 Kelligrews	Lower Cam mudstone	0.614619 diagenetic	0.216364 epizone	x
0038-KG03 Kelligrews	Lower Cam mudstone	0.709442 diagenetic	0.424965 diagenetic	x
0226-KG03 Kelligrews	Lower Cam mudstone	0.671513 diagenetic	0.443929 diagenetic	x
0224-KG03 Kelligrews	Lower Cam mudstone	0.728405 diagenetic	0.481857 diagenetic	x
0010-KG03 Kelligrews	Lower Cam mudstone	0.709442 diagenetic	0.235328 epizone	x

0194-KG03Kelligrews	Lower Cam mudstone	0.671512	diagenetic	0.462893	diagenetic	x
0071-KG03Kelligrews	Lower Cam mudstone	0.728406	diagenetic	0.481857	diagenetic	x
0007-KG03Kelligrews	Lower Cam mudstone	0.709442	diagenetic	0.462893	diagenetic	x
0198-KG03Kelligrews	Lower Cam mudstone	0.633584	diagenetic	0.406002	diagenetic	x
0065-KG03Kelligrews	Lower Cam mudstone	0.690477	diagenetic	0.462893	diagenetic	x
0100-KG03Kelligrews	Lower Cam mudstone	0.690477	diagenetic	0.443929	diagenetic	x
0193-KG03Kelligrews	Lower Cam mudstone	0.614619	diagenetic	0.235328	epizone	x
0196-KG03Kelligrews	Lower Cam mudstone	0.671512	diagenetic	0.462893	diagenetic	x
0095-KG03Kelligrews	Lower Cam mudstone	0.633584	diagenetic	0.443929	diagenetic	x
0036-KG03Kelligrews	Lower Cam mudstone	0.595654	diagenetic	0.424965	diagenetic	x
0008-KG03Kelligrews	Lower Cam mudstone	0.690477	diagenetic	0.481857	diagenetic	x
0009-KG03Kelligrews	Lower Cam mudstone	0.690477	diagenetic	0.462893	diagenetic	x
0050-KG03Kelligrews	Lower Cam mudstone	0.671513	diagenetic	0.424965	diagenetic	x
0004-KG03Kelligrews	Lower Cam mudstone	0.557725	diagenetic	0.462893	diagenetic	x
0049-KG03Kelligrews	Lower Cam mudstone	0.57669	diagenetic	0.462893	diagenetic	x
0006-KG03Kelligrews	Lower Cam mudstone	0.690477	diagenetic	0.462893	diagenetic	x
0097-KG03Kelligrews	Lower Cam mudstone	0.595655	diagenetic	0.216364	epizone	x
0033-KG03Kelligrews	Lower Cam mudstone	0.671512	diagenetic	0.481857	diagenetic	x
0013-KG03Kelligrews	Lower Cam mudstone	0.614619	diagenetic	0.462893	diagenetic	x
0225-KG03Kelligrews	Lower Cam mudstone	0.614619	diagenetic	0.216364	epizone	x
0228-KG03Kelligrews	Lower Cam mudstone	0.633584	diagenetic	0.387038	diagenetic	x
0803-KG03Kelligrews	Lower Cam mudstone	0.614619	diagenetic	0.443929	diagenetic	x
0069-KG02Kelligrews	Middle Car mudstone	0.671512	diagenetic	0.406002	diagenetic	x
0192-KG02Kelligrews	Middle Car mudstone	0.671512	diagenetic	0.387038	diagenetic	x
0066-KG02Kelligrews	Middle Car mudstone	0.709442	diagenetic	0.406002	diagenetic	x
0032-KG02Kelligrews	Middle Car mudstone	0.633584	diagenetic	0.387038	diagenetic	x
0222-KG02Kelligrews	Middle Car mudstone	0.747371	diagenetic	0.406002	diagenetic	x
0195-KG02Kelligrews	Middle Car mudstone	0.728406	diagenetic	0.406002	diagenetic	x
0011-KG02Kelligrews	Middle Car mudstone	0.709442	diagenetic	0.406002	diagenetic	x
0035-KG02Kelligrews	Middle Car mudstone	0.690477	diagenetic	0.424965	diagenetic	x
0002-KG02Kelligrews	Middle Car mudstone	0.709442	diagenetic	0.424965	diagenetic	x
0012-KG02Kelligrews	Middle Car mudstone	0.728406	diagenetic	0.406002	diagenetic	x
0034-KG02Kelligrews	Middle Car mudstone	0.557725	diagenetic	0.387038	diagenetic	x
0045-KG02Kelligrews	Middle Car mudstone	0.709442	diagenetic	0.424965	diagenetic	x
0058-KG02Kelligrews	Middle Car mudstone	0.633584	diagenetic	0.387038	diagenetic	x
0003-KG02Kelligrews	Middle Car mudstone	0.61462	diagenetic	0.406002	diagenetic	x
0982-BOCCBell Island, Lower Ord	mudstone	0.595655	diagenetic	0.462893	diagenetic	x
0981-BOCCBell Island, Lower Ord	mudstone	0.633584	diagenetic	0.462893	diagenetic	x
0962-BOCCBell Island, Lower Ord	mudstone	0.595655	diagenetic	0.50082	diagenetic	x
0973-BOCCBell Island, Lower Ord	sandstone	0.633584	diagenetic	0.216364	epizone	x
0978-BOCCBell Island, Lower Ord	mudstone	0.671512	diagenetic	0.216364	epizone	x
0958-BOCCBell Island, Lower Ord	siltstone	0.7853	diagenetic	0.368074	diagenetic	x
0986-BOCCBell Island, Lower Ord	mudstone	0.557725	diagenetic	0.50082	diagenetic	x
0956-BGNFBell Island, Lower Ord	siltstone	0.709442	diagenetic	0.481857	diagenetic	x
0942-BGNFBell Island, Lower Ord	siltstone	0.406009	anchizone	0.50082	diagenetic	x
0991-BGNFBell Island, Lower Ord	siltstone	0.880122	diagenetic	0.481857	diagenetic	x
0936-BGNFBell Island, Lower Ord	siltstone	0.671513	diagenetic	0.424965	diagenetic	x
0661-BGNFBell Island, Lower Ord	sandstone	0.671512	diagenetic	0.538748	diagenetic	x
0602-BGNFBell Island, Lower Ord	siltstone	0.823228	diagenetic	0.50082	diagenetic	x
0710-BGNFBell Island, Lower Ord	sandstone	0.519797	diagenetic	0.462893	diagenetic	x

0709-BGNFBell Island, Lower Ord	siltstone	0.595654	diagenetic	0.481857	diagenetic	x
0464-BGNFBell Island, Lower Ord	sandstone	0.918051	diagenetic	0.519784	diagenetic	x
0708-BGNFBell Island, Lower Ord	sandstone	0.595654	diagenetic	0.443929	diagenetic	x
0707-BGNFBell Island, Lower Ord	sandstone	0.918051	diagenetic	0.519784	diagenetic	x
0662-BGNFBell Island, Lower Ord	mudstone	0.747371	diagenetic	0.519784	diagenetic	x
0604-BGNFBell Island, Lower Ord	mudstone	0.937016	diagenetic	0.538748	diagenetic	x
0465-BGNFBell Island, Lower Ord	mudstone	0.899087	diagenetic	0.481857	diagenetic	x
0659-BGNFBell Island, Lower Ord	sandstone	0.443938	diagenetic	0.424965	diagenetic	x
0633-BGNFBell Island, Lower Ord	mudstone	0.842193	diagenetic	0.557712	diagenetic	x
0630-BGNFBell Island, Lower Ord	mudstone	0.880122	diagenetic	0.557712	diagenetic	x
0706-BGNFBell Island, Lower Ord	mudstone	0.899087	diagenetic	0.519784	diagenetic	x
0944-BGNFBell Island, Lower Ord	siltstone	0.880122	diagenetic	0.424965	diagenetic	x
0768-BGNFBell Island, Lower Ord	mudstone	0.899086	diagenetic	0.557712	diagenetic	x
0766-BGNFBell Island, Lower Ord	mudstone	0.918051	diagenetic	0.557712	diagenetic	x
0955-BGNFBell Island, Lower Ord	siltstone	0.652548	diagenetic	0.443929	diagenetic	x
0764-BGNFBell Island, Lower Ord	sandstone	0.842193	diagenetic	0.519784	diagenetic	x
0704-BGNFBell Island, Lower Ord	sandstone	0.95598	diagenetic	0.557712	diagenetic	x
0769-BGNFBell Island, Lower Ord	mudstone	0.576689	diagenetic	0.519784	diagenetic	x
0703-BGNFBell Island, Lower Ord	sandstone	0.974944	diagenetic	0.557712	diagenetic	x
0742-BGNFBell Island, Lower Ord	mudstone	1.012874	diagenetic	0.481857	diagenetic	x
0741-BGNFBell Island, Lower Ord	sandstone	0.937016	diagenetic	0.462893	diagenetic	x
0461-BGNFBell Island, Lower Ord	sandstone	0.595655	diagenetic	0.443929	diagenetic	x
0702-BGNFBell Island, Lower Ord	sandstone	0.7853	diagenetic	0.462893	diagenetic	x
0437-BGNFBell Island, Lower Ord	sandstone	0.842193	diagenetic	0.519784	diagenetic	x
0701-BGNFBell Island, Lower Ord	sandstone	0.974944	diagenetic	0.557712	diagenetic	x
0700-BGNFBell Island, Lower Ord	siltstone	0.519796	diagenetic	0.481857	diagenetic	x
0663-BGNFBell Island, Lower Ord	sandstone	0.993909	diagenetic	0.424965	diagenetic	x
0434-BGNFBell Island, Lower Ord	mudstone	0.974945	diagenetic	0.557712	diagenetic	x
0740-BGNFBell Island, Lower Ord	sandstone	0.728406	diagenetic	0.519784	diagenetic	x
0667-BGNFBell Island, Lower Ord	sandstone	0.804264	diagenetic	0.424965	diagenetic	x
0665-BGNFBell Island, Lower Ord	sandstone	0.823228	diagenetic	0.443929	diagenetic	x
0601-BGNFBell Island, Lower Ord	sandstone	0.974944	diagenetic	0.519784	diagenetic	x
0727-BILC Bell Island, Lower Ord	siltstone	0.652548	diagenetic	0.462893	diagenetic	x
0605-BILC Bell Island, Lower Ord	sandstone	0.955979	diagenetic	0.652531	diagenetic	x
0765-BILC Bell Island, Lower Ord	sandstone	0.956311	diagenetic	0.595639	diagenetic	x
0655-BILC Bell Island, Lower Ord	siltstone	1.012874	diagenetic	0.481857	diagenetic	x
0730-BILC Bell Island, Lower Ord	sandstone	0.633584	diagenetic	0.462893	diagenetic	x
0761-BILC Bell Island, Lower Ord	sandstone	0.57669	diagenetic	0.443929	diagenetic	x
0762-BILC Bell Island, Lower Ord	siltstone	0.899086	diagenetic	0.50082	diagenetic	x
0733-BILC Bell Island, Lower Ord	mudstone	0.633584	diagenetic	0.50082	diagenetic	x
0763-BILC Bell Island, Lower Ord	sandstone	0.842193	diagenetic	0.50082	diagenetic	x
0478-BILC Bell Island, Lower Ord	sandstone	0.349115	anchizone	0.443929	diagenetic	x
0534-MR0:Manuels RiUpper Cam	mudstone	0.406009	anchizone	0.387038	diagenetic	x
0536-MR0:Manuels RiUpper Cam	mudstone	0.349116	anchizone	0.387038	diagenetic	x
0047-MR0:Manuels RiUpper Cam	mudstone	0.462903	diagenetic	0.424965	diagenetic	x
0511-MR0:Manuels RiUpper Cam	mudstone	0.368081	anchizone	0.387038	diagenetic	x
0535-MR0:Manuels RiUpper Cam	mudstone	0.368081	anchizone			x
0561-MR0:Manuels RiUpper Cam	mudstone	0.443939	diagenetic	0.235328	epizone	x
0355-MR0:Manuels RiUpper Cam	mudstone	0.443939	diagenetic	0.406002	diagenetic	x
0531-MR0:Manuels RiUpper Cam	sandstone	0.557725	diagenetic	0.406002	diagenetic	x

0155-MR0:Manuels RiUpper Cam sandstone	0.481867	diagenetic	0.406002	diagenetic	x
0199-MR0:Manuels RiUpper Cam mudstone	0.443939	diagenetic	0.216364	epizone	x
0015-MR0:Manuels RiUpper Cam mudstone	0.424974	diagenetic	0.368074	diagenetic	x
0799-MR0:Manuels RiUpper Cam mudstone	0.424974	diagenetic	0.424965	diagenetic	x
0532-MR0:Manuels RiUpper Cam mudstone	0.387045	anchizone	0.424965	diagenetic	x
0533-MR0:Manuels RiUpper Cam sandstone	0.538761	diagenetic	0.235328	epizone	x
0023-MR0:Manuels RiUpper Cam mudstone	0.443939	diagenetic	0.424965	diagenetic	x
0510-MR0:Manuels RiUpper Cam sandstone	0.57669	diagenetic	0.443929	diagenetic	x
0022-MR0:Manuels RiUpper Cam mudstone	0.462903	diagenetic	0.387038	diagenetic	x
0800-MR0:Manuels RiUpper Cam mudstone	0.481867	diagenetic	0.424965	diagenetic	x
0821-MR0:Manuels RiUpper Cam mudstone	0.443938	diagenetic	0.462893	diagenetic	x
0083-MR0:Manuels RiUpper Cam mudstone	0.462903	diagenetic	0.387038	diagenetic	x
0508-MR0:Manuels RiUpper Cam mudstone	0.443938	diagenetic	0.368074	diagenetic	x
0562-MR0:Manuels RiUpper Cam mudstone	0.387045	anchizone	0.387038	diagenetic	x
0075-MR0:Manuels RiUpper Cam mudstone	0.387046	anchizone	0.387038	diagenetic	x
0401-MR0:Manuels RiUpper Cam mudstone	0.406009	anchizone	0.368074	diagenetic	x
0650-MR0:Manuels RiUpper Cam mudstone	0.500832	diagenetic	0.462893	diagenetic	x
0597-MR0:Manuels RiUpper Cam mudstone	0.481867	diagenetic	0.216364	epizone	x
0649-MR0:Manuels RiUpper Cam mudstone	0.481867	diagenetic	0.424965	diagenetic	x
0651-MR0:Manuels RiUpper Cam mudstone	0.443939	diagenetic	0.216364	epizone	x
0467-MR0:Manuels RiUpper Cam mudstone	0.40601	anchizone	0.368074	diagenetic	x
0513-MR0:Manuels RiUpper Cam mudstone	0.442981	diagenetic	0.368074	diagenetic	x
0056-MR0:Manuels RiUpper Cam mudstone	0.424974	diagenetic	0.406002	diagenetic	x
0340-MR0:Manuels RiUpper Cam mudstone	0.406009	anchizone	0.368074	diagenetic	x
0337-MR0:Manuels RiUpper Cam mudstone	0.443938	diagenetic	0.368074	diagenetic	x
0468-MR0:Manuels RiUpper Cam mudstone	0.406009	anchizone	0.34911	anchizone	x
0339-MR0:Manuels RiUpper Cam mudstone	0.462903	diagenetic	0.216364	epizone	x
0438-MR0:Manuels RiUpper Cam mudstone	0.424974	diagenetic	0.368074	diagenetic	x
0466-MR0:Manuels RiUpper Cam mudstone	0.462903	diagenetic	0.235328	epizone	x
0652-MR0:Manuels RiUpper Cam mudstone	0.443939	diagenetic	0.368074	diagenetic	x
0336-MR0:Manuels RiUpper Cam mudstone	0.462903	diagenetic	0.216364	epizone	x
0335-MR0:Manuels RiUpper Cam mudstone	0.500832	diagenetic	0.387038	diagenetic	x
0338-MR0:Manuels RiUpper Cam mudstone	0.557725	diagenetic	0.216364	epizone	x
0469-MR0:Manuels RiUpper Cam mudstone	0.406009	anchizone	0.406002	diagenetic	x
0021-MR0:Manuels RiUpper Cam mudstone	0.424973	diagenetic	0.216364	epizone	x
0509-MR0:Manuels RiUpper Cam mudstone	0.443939	diagenetic	0.368074	diagenetic	x
0231-MR0:Manuels RiUpper Cam mudstone	0.424974	diagenetic	0.216364	epizone	x
0537-MR0:Manuels RiUpper Cam mudstone	0.406009	anchizone	0.216364	epizone	x
0061-MR0:Manuels RiUpper Cam mudstone	0.387046	anchizone			x
0554-MR0:Manuels RiUpper Cam mudstone	0.424974	diagenetic	0.216364	epizone	x
0357-MR0:Manuels RiUpper Cam mudstone	0.462904	diagenetic	0.368074	diagenetic	x
0257-MR0:Manuels RiUpper Cam mudstone	0.387046	anchizone	0.330146	anchizone	x
0256-MR0:Manuels RiUpper Cam mudstone	0.424974	diagenetic	0.34911	anchizone	x
0560-MR0:Manuels RiUpper Cam mudstone	0.406009	anchizone	0.34911	anchizone	x
0356-MR0:Manuels RiUpper Cam mudstone	0.462904	diagenetic	0.34911	anchizone	x
0559-MR0:Manuels RiUpper Cam mudstone	0.424974	diagenetic	0.368074	diagenetic	x
0354-MR0:Manuels RiUpper Cam mudstone	0.387045	anchizone	0.216364	epizone	x
0439-MR0:Manuels RiUpper Cam mudstone	0.406009	anchizone	0.216364	epizone	x
0626-MR0:Manuels RiUpper Cam mudstone	0.500832	diagenetic zone			x
0625-MR0:Manuels RiUpper Cam mudstone	0.519796	diagenetic zone			x

0474-MR0:Manuels RiUpper Cam mudstone	0.462904	diagenetic	0.368074	diagenetic	x
0647-MR0:Manuels RiUpper Cam mudstone	0.462903	diagenetic	0.216364	epizone	x
0475-MR0:Manuels RiUpper Cam mudstone	0.462904	diagenetic	0.34911	anchizone	x
0358-MR0:Manuels RiUpper Cam mudstone	0.481867	diagenetic	0.216364	epizone	x
0359-MR0:Manuels RiUpper Cam mudstone	0.368081	anchizone	0.216364	epizone	x
0472-MR0:Manuels RiUpper Cam mudstone	0.462903	diagenetic	0.34911	anchizone	x
0318-MR0:Manuels RiUpper Cam mudstone	0.406009	anchizone	0.406002	diagenetic	x
0473-MR0:Manuels RiUpper Cam mudstone	0.443939	diagenetic	0.330146	anchizone	x
0342-MR0:Manuels RiUpper Cam mudstone	0.443938	diagenetic	0.235328	epizone	x
0758-MR0:Manuels RiUpper Cam mudstone	0.462904	diagenetic zone			x
0619-MR0:Manuels RiUpper Cam mudstone	0.500832	diagenetic	0.216364	epizone	x
0624-MR0:Manuels RiUpper Cam mudstone	0.424974	diagenetic	0.216364	epizone	x
0726-MR0:Manuels RiUpper Cam mudstone	0.424974	diagenetic	0.216364	epizone	x
0697-MR0:Manuels RiUpper Cam mudstone	0.443939	diagenetic	0.368074	diagenetic	x
0447-MR0:Manuels RiUpper Cam mudstone	0.406009	anchizone	0.34911	anchizone	x
1001-MR0:Manuels RiUpper Cam mudstone	0.57669	diagenetic	0.538748	diagenetic	x
1002-MR0:Manuels RiUpper Cam mudstone	0.61462	diagenetic	0.443929	diagenetic	x
1003-MR0:Manuels RiUpper Cam mudstone	0.652548	diagenetic	0.443929	diagenetic	x
1004-MR0:Manuels RiUpper Cam mudstone	0.500832	diagenetic zone			x
1005-MR0:Manuels RiUpper Cam mudstone	0.633584	diagenetic zone			x
1006-MR0:Manuels RiUpper Cam mudstone	0.443939	diagenetic zone			x
1007-MR0:Manuels RiUpper Cam mudstone	0.57669	diagenetic	0.406002	diagenetic	x
1008-MR0:Manuels RiUpper Cam mudstone	0.406009	anchizone			x
1009-MR0:Manuels RiUpper Cam mudstone	0.481867	diagenetic	0.424965	diagenetic	x
1010-MR0:Manuels RiUpper Cam mudstone	0.406009	anchizone	0.273255	epizone	x
1011-MR0:Manuels RiUpper Cam mudstone	0.443938	diagenetic	0.34911	anchizone	x
1012-MR0:Manuels RiUpper Cam mudstone	0.538761	diagenetic zone			x
1013-MR0:Manuels RiUpper Cam mudstone	0.443938	diagenetic zone			x
1014-MR0:Manuels RiUpper Cam mudstone	0.387045	anchizone			x
1015-MR0:Manuels RiUpper Cam mudstone	0.406009	anchizone			x
1016-MR0:Manuels RiUpper Cam mudstone	0.424974	diagenetic zone			x
1017-MR0:Manuels RiUpper Cam mudstone	0.387046	anchizone			x
1018-MR0:Manuels RiUpper Cam mudstone	0.424974	diagenetic zone			x
1019-MR0:Manuels RiUpper Cam mudstone	0.406009	anchizone	0.387038	diagenetic	x
1020-MR0:Manuels RiUpper Cam mudstone	0.519797	diagenetic	0.387038	diagenetic	x
1021-MR0:Manuels RiUpper Cam mudstone	0.387046	anchizone	0.254291	epizone	x
1022-MR0:Manuels RiUpper Cam mudstone	0.387045	anchizone	0.406002	diagenetic	x
1023-MR0:Manuels RiUpper Cam mudstone	0.387045	anchizone	0.387038	diagenetic	x
1024-MR0:Manuels RiUpper Cam mudstone	0.387046	anchizone	0.406002	diagenetic	x
1025-MR0:Manuels RiUpper Cam mudstone	0.387045	anchizone	0.406002	diagenetic	x
1026-MR0:Manuels RiUpper Cam mudstone	0.481867	diagenetic	0.406002	diagenetic	x
0684-MR0:Manuels RiUpper Cam mudstone	0.424974	diagenetic	0.387038	diagenetic	x
0446-MR0:Manuels RiUpper Cam mudstone	0.387046	anchizone	0.216364	epizone	x
0653-MR0:Manuels RiUpper Cam mudstone	0.406009	anchizone	0.368074	diagenetic	x
0696-MR0:Manuels RiUpper Cam mudstone	0.406009	anchizone	0.406002	diagenetic	x
0441-MR0:Manuels RiUpper Cam mudstone	0.424974	diagenetic	0.216364	epizone	x
0471-MR0:Manuels RiUpper Cam mudstone	0.349116	anchizone	0.330146	anchizone	x
0593-MR0:Manuels RiUpper Cam mudstone	0.424974	diagenetic	0.387038	diagenetic	x
0442-MR0:Manuels RiUpper Cam mudstone	0.406009	anchizone	0.235328	epizone	x
0598-MR0:Manuels RiUpper Cam mudstone	0.406009	anchizone	0.368074	diagenetic	x

0759-MR0:Manuels RiUpper Cam mudstone	0.387045	anchizone	0.387038	diagenetic	x
0682-MR0:Manuels RiUpper Cam mudstone	0.424974	diagenetic	0.406002	diagenetic	x
0596-MR0:Manuels RiUpper Cam mudstone	0.406009	anchizone	0.387038	diagenetic	x
0623-MR0:Manuels RiUpper Cam mudstone	0.406009	anchizone	0.387038	diagenetic	x
0443-MR0:Manuels RiUpper Cam mudstone	0.40601	anchizone	0.216364	epizone	x
0444-MR0:Manuels RiUpper Cam mudstone	0.424974	diagenetic	0.387038	diagenetic	x
0618-MR0:Manuels RiUpper Cam mudstone	0.406009	anchizone	0.216364	epizone	x
0595-MR0:Manuels RiUpper Cam mudstone	0.406009	anchizone	0.387038	diagenetic	x
0599-MR0:Manuels RiUpper Cam mudstone	0.462904	diagenetic	0.368074	diagenetic	x
0621-MR0:Manuels RiUpper Cam mudstone	0.424974	diagenetic	0.387038	diagenetic	x
0476-MR0:Manuels RiUpper Cam mudstone	0.387045	anchizone	0.387038	diagenetic	x
0477-MR0:Manuels RiUpper Cam mudstone	0.424973	diagenetic	0.424965	diagenetic	x
0445-MR0:Manuels RiUpper Cam mudstone	0.387046	anchizone	0.34911	anchizone	x
0594-MR0:Manuels RiUpper Cam mudstone	0.424974	diagenetic	0.34911	anchizone	x
0654-MR0:Manuels RiUpper Cam mudstone	0.387045	anchizone	0.368074	diagenetic	x
0620-MR0:Manuels RiUpper Cam mudstone	0.424974	diagenetic	0.406002	diagenetic	x
0913-FEHFerryland FUpper Edia siltstone	0.368081	anchizone			x
0921-FEHFerryland FUpper Edia siltstone	0.311188	epizone			x
0923-FEHFerryland FUpper Edia siltstone	0.368081	anchizone			x
0907-FEHFerryland FUpper Edia siltstone	0.330151	anchizone	0.311183	anchizone	x
0910-FEHFerryland FUpper Edia siltstone	0.311187	epizone			x
0890-FEHFerryland FUpper Edia siltstone	0.349116	anchizone	0.216364	epizone	x
0865-FEHFerryland FUpper Edia siltstone	0.330152	anchizone	0.292219	anchizone	x
0864-FEHFerryland FUpper Edia siltstone	0.311187	epizone	0.292219	anchizone	x
0860-FEHFerryland FUpper Edia siltstone	0.349115	anchizone	0.311183	anchizone	x
0872-FEHFerryland FUpper Edia siltstone	0.368081	anchizone	0.34911	anchizone	x
0925-FEHFerryland FUpper Edia siltstone	0.406009	anchizone	0.330146	anchizone	x
0855-FEHFerryland FUpper Edia siltstone	0.311187	epizone	0.216364	epizone	x
0916-FEHFerryland FUpper Edia siltstone	0.406009	anchizone	0.368074	diagenetic	x
0885-FEHFerryland FUpper Edia siltstone	0.330152	anchizone	0.216364	epizone	x
0880-FEHFerryland FUpper Edia siltstone	0.349116	anchizone	0.216364	epizone	x
0875-FEHFerryland FUpper Edia siltstone	0.330151	anchizone	0.292219	anchizone	x

[illegible]

Ant	Lithostratigraphy	Stratigraphic height (m)
x	Smith Point Formation	0
x	Smith Point Formation	0.25
x	Smith Point Formation	0.5
x	Smith Point Formation	0.75
x	Smith Point Formation	1.25
x	Smith Point Formation	1.5
x	Smith Point Formation	1.75
x	Smith Point Formation	2
x	Smith Point Formation	2.25
x	Brigus Formation	4.5
x	Brigus Formation	4.75
x	Brigus Formation	5
x	Brigus Formation	5.25
x	Brigus Formation	5.5
x	Brigus Formation	5.75
x	Brigus Formation	6.25
x	Brigus Formation	6.75
x	Brigus Formation	7.25
x	Brigus Formation	7.5
x	Brigus Formation	7.75
x	Brigus Formation	8
x	Brigus Formation	8.5
x	Brigus Formation	8.75
x	Brigus Formation	9.25
x	Brigus Formation	9.5
x	Brigus Formation	9.75
x	Brigus Formation	10.5
x	Brigus Formation	10.75
x	Brigus Formation	11
x	Brigus Formation	12
x	Brigus Formation	12.25
x	Brigus Formation	12.5
x	Brigus Formation	12.75
x	Brigus Formation	13
x	Brigus Formation	13.25
x	Brigus Formation	13.5
x	Brigus Formation	13.75
	Bonavista Formation	1
	Bonavista Formation	1.9
	Bonavista Formation	1.98
	Bonavista Formation	3.5
	Bonavista Formation	4.5
	Bonavista Formation	5.25
	Smith Point Formation	7.46
	Smith Point Formation	8.5
	Smith Point Formation	10.1
	Smith Point Formation	10.33
	Smith Point Formation	10.55
	Brigus Formation	11.9

Brigus Formation	3
Brigus Formation	3.9
Brigus Formation	5
Brigus Formation	5.5
Brigus Formation	7
Brigus Formation	9
Brigus Formation	11
Brigus Formation	13
Brigus Formation	14
Brigus Formation	15
Chamberlains Brook F	4.5
Chamberlains Brook F	5
Chamberlains Brook F	5.75
Chamberlains Brook F	6
Chamberlains Brook F	6.25
Chamberlains Brook F	6.5
Chamberlains Brook F	6.75
Chamberlains Brook F	7
Chamberlains Brook F	7.25
Chamberlains Brook F	7.5
Chamberlains Brook F	7.75
Chamberlains Brook F	8
Chamberlains Brook F	8.25
Chamberlains Brook F	8.5
Manuels River Format	9
Manuels River Format	9.25
Manuels River Format	9.5
Manuels River Format	9.75
Manuels River Format	10.25
Manuels River Format	10.5
Manuels River Format	10.75
Manuels River Format	11
Manuels River Format	11.25
Manuels River Format	11.5
Manuels River Format	11.75
Manuels River Format	12
Manuels River Format	12.25
Manuels River Format	12.5
Manuels River Format	13
Manuels River Format	13.25
Manuels River Format	13.5
Manuels River Format	13.75
Manuels River Format	14.5
Manuels River Format	14.75
Brigus Formation	0.25
Brigus Formation	1
Brigus Formation	1.5
Brigus Formation	1.75
Brigus Formation	2
Brigus Formation	2.25

	Brigus Formation	2.5
	Brigus Formation	2.75
	Brigus Formation	3
	Brigus Formation	3.5
	Brigus Formation	4
	Brigus Formation	4.25
	Brigus Formation	4.5
	Brigus Formation	4.75
	Brigus Formation	5
	Brigus Formation	5.25
	Brigus Formation	5.5
	Brigus Formation	5.75
	Brigus Formation	6
	Brigus Formation	6.25
	Brigus Formation	6.5
	Brigus Formation	6.75
	Brigus Formation	7
	Brigus Formation	7.25
	Brigus Formation	7.5
	Brigus Formation	7.75
	Brigus Formation	8
	Brigus Formation	8.25
	Chamberlains Brook F	0
	Chamberlains Brook F	0.5
	Chamberlains Brook F	1
	Chamberlains Brook F	1.25
	Chamberlains Brook F	1.5
	Chamberlains Brook F	2
	Chamberlains Brook F	2.25
	Chamberlains Brook F	2.5
	Chamberlains Brook F	2.75
	Chamberlains Brook F	3
	Chamberlains Brook F	3.25
	Chamberlains Brook F	3.5
	Chamberlains Brook F	3.75
	Chamberlains Brook F	4
	Powers Steps Formati	3.7
	Powers Steps Formati	4.65
	Powers Steps Formati	7.45
	Powers Steps Formati	8.5
	Powers Steps Formati	9.45
	Powers Steps Formati	14.1
	Powers Steps Formati	33.55
	Powers Steps Formati	50.3
	Powers Steps Formati	58
x	Powers Steps Formati	59.5
	Powers Steps Formati	60.8
	Powers Steps Formati	63.84
	Powers Steps Formati	64.09
	Powers Steps Formati	64.34

	Powers Steps Formation	64.59
	Powers Steps Formation	64.84
	Powers Steps Formation	65.09
	Powers Steps Formation	65.59
	Powers Steps Formation	65.84
	Powers Steps Formation	66.34
	Powers Steps Formation	66.59
	Powers Steps Formation	66.84
	Powers Steps Formation	67.09
	Powers Steps Formation	67.34
	Powers Steps Formation	67.84
	Powers Steps Formation	68
x	Powers Steps Formation	68.09
	Powers Steps Formation	68.34
	Powers Steps Formation	68.7
	Powers Steps Formation	69.09
	Powers Steps Formation	69.34
	Powers Steps Formation	69.84
	Powers Steps Formation	70.34
	Powers Steps Formation	70.59
	Powers Steps Formation	70.84
	Powers Steps Formation	71.09
	Powers Steps Formation	71.59
	Powers Steps Formation	71.84
x	Powers Steps Formation	72.09
	Powers Steps Formation	72.34
	Powers Steps Formation	72.59
	Powers Steps Formation	73.34
	Powers Steps Formation	73.59
	Powers Steps Formation	74.34
	Powers Steps Formation	74.59
	Powers Steps Formation	75.09
x	Beach Formation	0.5
x	Beach Formation	0.75
x	Beach Formation	1.25
x	Beach Formation	2
x	Beach Formation	2.75
x	Beach Formation	4
x	Beach Formation	4.25
x	Beach Formation	4.5
x	Beach Formation	5.5
x	Beach Formation	5.75
	Elliot Cove Formation	0.1
	Elliot Cove Formation	0.15
	Elliot Cove Formation	0.25
	Elliot Cove Formation	0.38
	Elliot Cove Formation	0.5
	Elliot Cove Formation	0.75
	Elliot Cove Formation	1
	Elliot Cove Formation	1.14

Elliot Cove Formation	1.25
Elliot Cove Formation	1.5
Elliot Cove Formation	1.75
Elliot Cove Formation	1.95
Elliot Cove Formation	2
Elliot Cove Formation	2.25
Elliot Cove Formation	2.5
Elliot Cove Formation	2.75
Elliot Cove Formation	2.85
Elliot Cove Formation	3
Elliot Cove Formation	3.25
Elliot Cove Formation	3.3
Elliot Cove Formation	3.7
Elliot Cove Formation	3.95
Elliot Cove Formation	4.5
Elliot Cove Formation	0
Elliot Cove Formation	0.25
Elliot Cove Formation	0.5
Elliot Cove Formation	0.75
Elliot Cove Formation	1
Elliot Cove Formation	1.25
Elliot Cove Formation	1.5
Elliot Cove Formation	1.75
Elliot Cove Formation	2
Elliot Cove Formation	2.25
Elliot Cove Formation	2.5
Elliot Cove Formation	3.5
Elliot Cove Formation	3.75
Elliot Cove Formation	4
Elliot Cove Formation	4.25
Elliot Cove Formation	4.5
Elliot Cove Formation	4.75
Elliot Cove Formation	5
Elliot Cove Formation	5.25
Elliot Cove Formation	6.75
Elliot Cove Formation	7
Elliot Cove Formation	7.25
Elliot Cove Formation	7.5
Elliot Cove Formation	7.65
Elliot Cove Formation	7.75
Elliot Cove Formation	8
Elliot Cove Formation	8.25
Elliot Cove Formation	8.5
Elliot Cove Formation	8.75
Elliot Cove Formation	9.5
Elliot Cove Formation	9.75
Elliot Cove Formation	10.25
Elliot Cove Formation	10.5
Elliot Cove Formation	11.5
Elliot Cove Formation	11.75

Elliot Cove Formation	12.25
Elliot Cove Formation	12.5
Elliot Cove Formation	12.75
Elliot Cove Formation	13.25
Elliot Cove Formation	13.5
Elliot Cove Formation	13.75
Elliot Cove Formation	13.9
Elliot Cove Formation	15
Elliot Cove Formation	15.5
Elliot Cove Formation	15.75
Elliot Cove Formation	16
Elliot Cove Formation	16.25
Elliot Cove Formation	16.75
Elliot Cove Formation	16.9
Elliot Cove Formation	17
Manuels River Format	0.5
Manuels River Format	1.65
Manuels River Format	2
Manuels River Format	2.5
Manuels River Format	3.5
Manuels River Format	4
Manuels River Format	4.5
Manuels River Format	5.65
Manuels River Format	6.26
Manuels River Format	6.52
Manuels River Format	7.25
Manuels River Format	8.95
Manuels River Format	9.52
Manuels River Format	10.42
Manuels River Format	10.52
Manuels River Format	10.98
Manuels River Format	11.5
Manuels River Format	12.05
Manuels River Format	12.97
Manuels River Format	14
Manuels River Format	15.05
Manuels River Format	15.57
Manuels River Format	16.05
Manuels River Format	18.05
Manuels River Format	18.58
Manuels River Format	18.95
Elliot Cove Formation	19.07
Elliot Cove Formation	19.32
Elliot Cove Formation	19.57
Elliot Cove Formation	19.82
Elliot Cove Formation	20.07
Elliot Cove Formation	20.32
Elliot Cove Formation	20.57
Elliot Cove Formation	21.07
Elliot Cove Formation	21.42

Elliot Cove Formation	21.57
Elliot Cove Formation	21.82
Elliot Cove Formation	21.99
Elliot Cove Formation	22.04
Elliot Cove Formation	22.07
Elliot Cove Formation	22.57
Elliot Cove Formation	22.82
Elliot Cove Formation	23.07
Elliot Cove Formation	23.22
Elliot Cove Formation	23.57
Elliot Cove Formation	23.82
Elliot Cove Formation	24.07
Elliot Cove Formation	24.32
Elliot Cove Formation	24.57
Elliot Cove Formation	25.07
Elliot Cove Formation	25.57
Ferryland Head Forma	3
Ferryland Head Forma	8.8
Ferryland Head Forma	10.6
Ferryland Head Forma	13.6
Ferryland Head Forma	14.5
Ferryland Head Forma	19.5
Ferryland Head Forma	28.5
Ferryland Head Forma	32.1
Ferryland Head Forma	36.8
Ferryland Head Forma	39.2
Ferryland Head Forma	43.1
Ferryland Head Forma	47.3
Ferryland Head Forma	54.7
Ferryland Head Forma	60.1
Ferryland Head Forma	63.4
Ferryland Head Forma	67.8