GEOLOGICAL SURVEY OF CANADA
OPEN FILE 7199

Ordovician stratigraphy and oil shale, southern Baffin Island, Nunavut

— preliminary field and post-field data

S. Zhang
Canada-Nunavut Geoscience Office

2012

Natural Resources Canada   Ressources naturelles Canada

Canada

GEOLOGICAL SURVEY OF CANADA
OPEN FILE 7199

Ordovician stratigraphy and oil shale, southern Baffin Island, Nunavut — preliminary field and post-field data

S. Zhang
Canada-Nunavut Geoscience Office

2012

doi:10.4095/291521

This publication is available from the Geological Survey of Canada Bookstore (http://gsc.nrcan.gc.ca/bookstore_e.php).
It can also be downloaded free of charge from GeoPub (http://geopub.nrcan.gc.ca/).

Recommended citation:
Zhang, S., 2012. Ordovician stratigraphy and oil shale, southern Baffin Island, Nunavut — preliminary field and post-field data; Geological Survey of Canada, Open File 7199, 26 p. doi:10.4095/291521

Publications in this series have not been edited; they are released as submitted by the author.

1. INTRODUCTION

Southern Baffin Island is part of Foxe Basin, one of the Paleozoic sedimentary basins in Canada. McCracken and Bolton (2000) summarized the most recent Paleozoic stratigraphic and paleontologic studies on southern Baffin Island, which served as foundation for this study. However, the hydrocarbon potential of the Ordovician sequence in Foxe Basin is poorly understood. Based on Sanford and Grant (2000) tentatively interpreted that the “Boas River Formation”, an organic-rich unit, is located between the Amadjuak and Akpatok formations (Fig. 1A) in Foxe Basin. Limited geochemical data (Rock Eval[2]) about the “Boas River Formation” was published by Macauley (1987). Some issues are still unsolved: 1) what is the exact thickness of the oil shale within the Ordovician strata on southern Baffin Island? 2) what is its stratigraphic position? 3) how does it compare facies- and geochemically-wise with the shale oil on Southampton Island (Zhang, 2008)? and 4) does it have any petroleum potential? Answers to these questions are part of research objectives of the Hudson Bay – Foxe Basin project under NRCan’s Geo-mapping for Energy and Mineral (GEM) Program. Field studies in 2011 were designed to answer these questions and to test the stratigraphic position, geographic distribution and petroleum potential of the oil shale on southern Baffin Island. A total of 39 localities were visited through out the Paleozoic area on the Island; samples were collected from 15 localities (Fig. 2). A total of 130 and 46 samples were collected for conodont processing (currently in progress) for a biostratigraphic study and Rock-Eval[6] data collection, respectively.

2. STRATIGRAPHY ON SOUTHERN BAFFIN ISLAND

The Ordovician strata on southern Baffin Island were previously divided into the Middle Ordovician Frobisher Bay Formation, and the Upper Ordovician Amadjuak, Boas River, Akpatok and Forster Bay formations (Fig. 1A; Sanford and Grant, 2000) consisting mainly of carbonate with minor shale. However, the field survey in 2011 modified this stratigraphic framework, namely: 1) the “Boas River Formation” does not exist between the Amadjuak and Akpatok formations (Fig. 1B); the organic-rich black shale (about 2 m of exposed thickness) occurs within the lower part of the Amadjuak Formation; and 2) the Forster Bay Formation has been eroded from southern Baffin Island (Fig. 1B).

(1) Frobisher Bay Formation

The Frobisher Bay Formation is the oldest Paleozoic sedimentary unit on southern Baffin Island (Fig. 1) lying uncomformably on the Precambrian basement rocks (Fig. 6A in Appendix). It is about 15 m in thickness; its lower 8 m consists of light grey and light brown, finely crystalline limestone in thin nodular beds that weather yellowish orange, which are succeeded by light grey, finely crystalline limestone (~ 7 m thick) in uniform beds (5-10 cm) that weather medium grey. This formation contains a distinct *Gonioceras-Labyrinthites* (cephalopod-coral) fauna (Bolton, 2000) and conodont *Polyplacognathus*

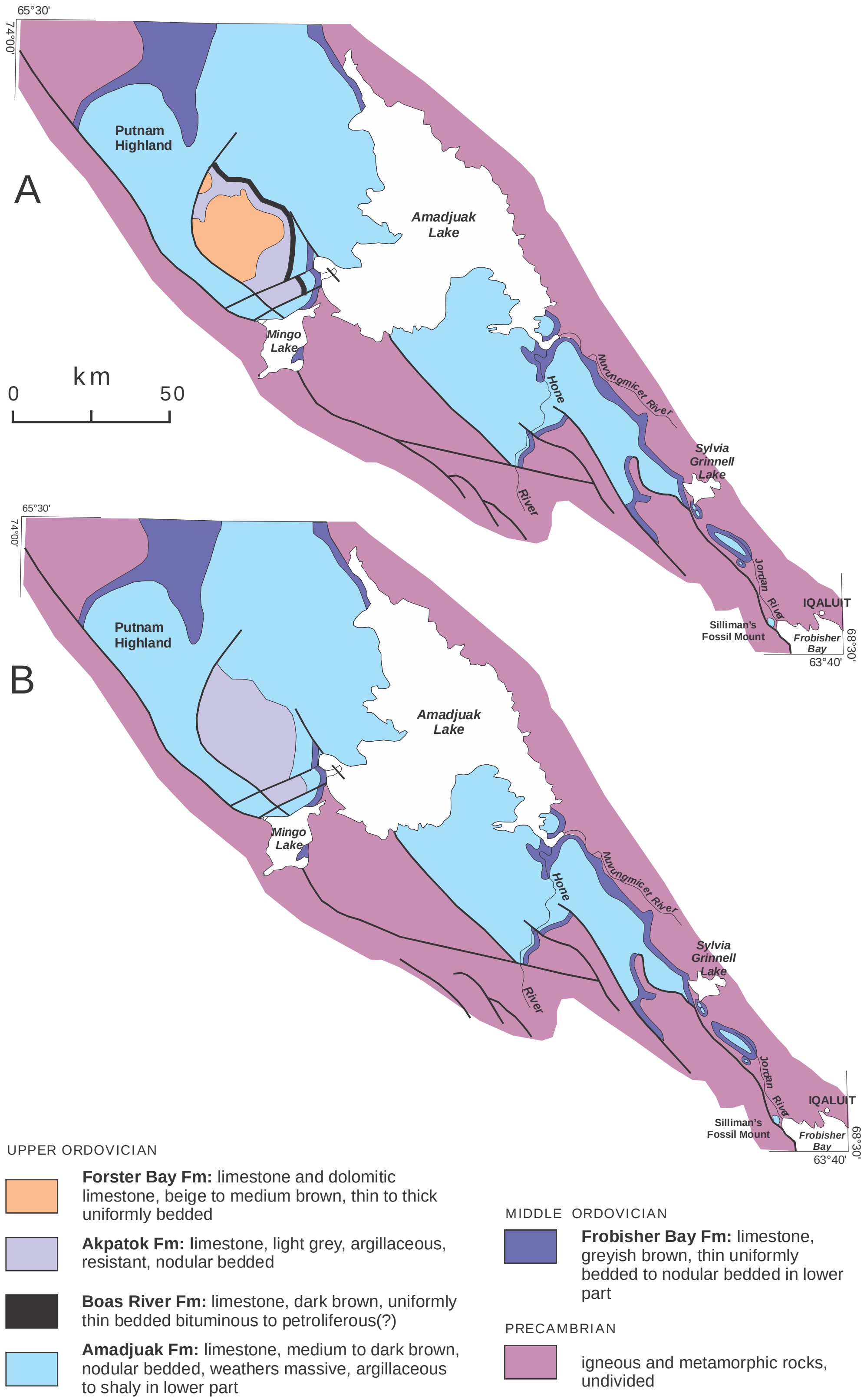

Figure 1. Geology of Amadjuak Lake area, southern Baffin Island. A: adopted from Sanford and Grant (2000); B: this study.

ramosus Stauffer (McCracken, 2000) indicating a late Middle Ordovician (Rocklandian-late Shermanian) age (Bolton, 2000; McCracken, 2000).

(2) Amadjuak Formation

At the type section (Silliman's Fossil Mount), the Amadjuak Formation is divided into three units (Sanford and Grant, 2000). Unit 1 (~21 m thick) consists of interbedded, medium to dark grey and black shale and grey to grey-brown shaly limestone in thin, uniform beds. Unit 2 (~34 m thick) begins with hard, resistant weathering, medium grey-brown limestone, in thick massive beds, abruptly succeeded by medium grey, thin and nodular bedded shaly limestone and grey interbedded shales; the upper part of the unit is slightly more massive, nodular, argillaceous grey limestone with minor shale partings and interbeds. Unit 3 (~ 16 m thick) consists of hard, light to medium brown, nodular bedded, massive weathering limestone with distinct light yellow discoloration. The Amadjuak Formation contains a distinct *Fisherites-Maclurites* (algae-gastropod) fauna (Bolton, 2000) and several representative conodont species (McCracken, 2000) indicating an early Late Ordovician (latest Mohawkian-latest Edenian) age.

The black shale in unit 1 of the Amadjuak Formation was not found at the type locality, but does occur at locality 32 (Fig. 14 in Appendix), a small creek running down a hill of large Paleozoic outlier south of Sylvia Grinnell Lake (Figs. 1 and 2), and perpendicular to the Jordan River (Fig. 14A). The grey shale of unit 1 of the Amadjuak Formation is well exposed at locality 31 (Fig. 12 in Appendix) on the northwest shore of Amadjuak Lake (Fig. 2).

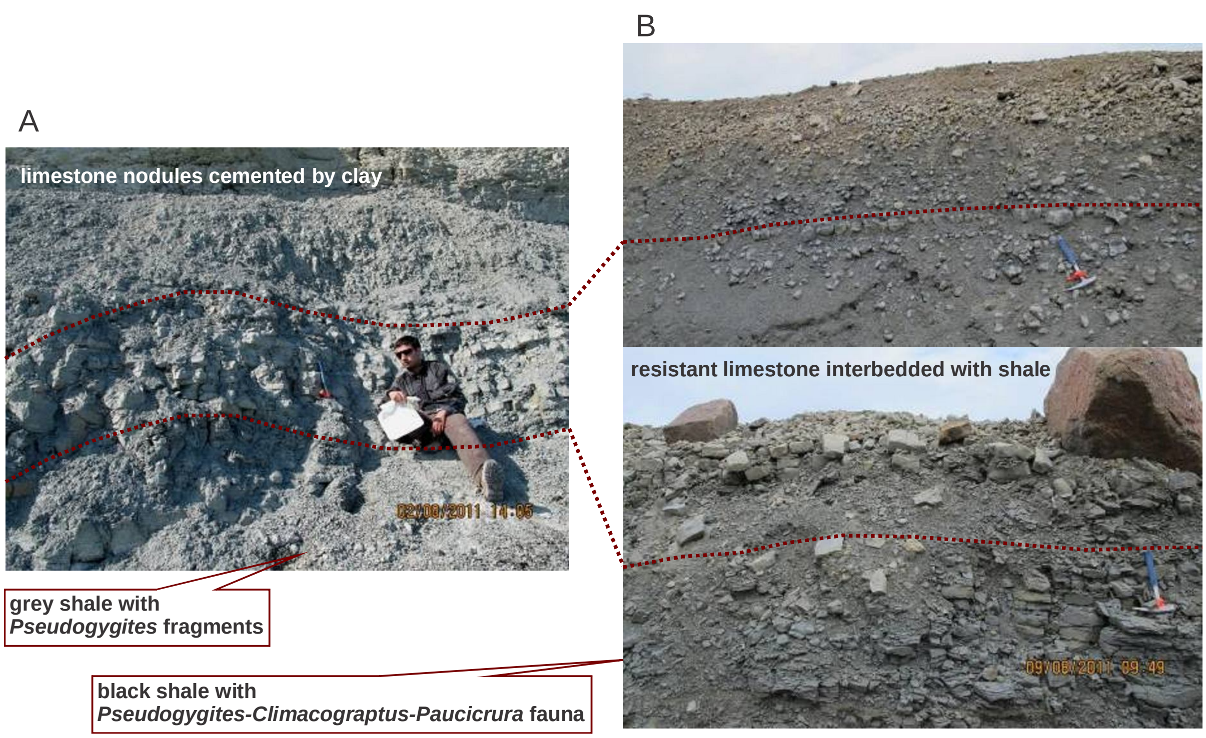

Fig. 3 Correlation between grey shale at locality 31 (A) and black shale interval at locality 32 (B).

The black shale at locality 32 (Fig. 14 in Appendix) and grey shale at locality 31 (Fig. 12 in Appendix) are interpreted to occur at the same stratigraphic level herein, an assumption based on the following field observations on fossils and sedimentary sequence:

1) the black shale interval at locality 32 (Fig. 3B) contains the well preserved *Pseudogygites-Climacograptus-Paucicrura* fauna; this fauna was not observed from the grey interval at locality 31 (Fig. 3A), but the fragments of *Pseudogygites* sp. were present;

2) both the black shale interval at locality 32 (Fig. 3B) and the grey shale interval at locality 31(Fig. 3A) are overlain by about 1.5-m-thick interval of resistant limestone interbedded with shale;

3) at both localities (Figs. 3A and 3B), a 1.5-m-thick interval of resistant limestone interbedded with shale is succeeded by an interval of limestone nodules encased in lime mud.

Therefore, it is proposed that the black shale interval in unit 1 of the Amadjuak Formation laterally changes into grey shale, the facies change occurring over a NW maximum distance of approximately 200 km.

(3) "Boas River Formation"

The "Boas River Formation" was interpreted as an organic-rich shale unit between the Bad Cache Rapids and Churchill River groups in the Hudson Bay Basin (Sanford in Heywood and Sanford, 1976; Sanford, 1987; Sanford and Grant, 1990) and between the Amadjuak and Akpatok formations in the Foxe Basin (Sanford and Grant, 2000). Although it was indicated that because of its recessive weathering character, the "Boas River Formation" may not be exposed in Foxe Basin, and its distribution and thickness are thus largely unknown (Sanford and Grant 2000), nonetheless, this formation was mapped as a recognized unit on southern Baffin Island (fig. 11 in Sanford and Grant, 2000; Fig. 1A).

The Ordovician organic-rich black shale with the characteristic *Pseudogygites-Climacograptus* fauna is widely distributed at different stratigraphic level in southern Ontario (Sharma et al., 2003) and on Southampton Island (Zhang, 2008). This black shale on Southampton Island was called the "Boas River shale" (Sanford in Heywood and Sanford, 1976); however, its stratigraphic position has be reassessed to the lower part of the Red Head Rapids Formation (Zhang 2008), rather than between Bad Cache Rapids and Churchill River groups as previously interpreted (Sanford in Heywood and Sanford, 1976; Sanford, 1987; Sanford and Grant, 1990). As discussed earlier, about 2-m-thick black shale interval with the special *Pseudogygites-Climacograptus-Paucicrura* fauna was found in the unit 1 of the Amadjuak Formation at locality 32 (Fig. 2 and Fig.14 in Appendix) in a large Paleozoic outlier south of Sylvia Grinnell Lake on southern Baffin Island. Therefore, the "Boas River Formation" is not present between the Amadjuak and Akpatok formations on southern Baffin Island, but rather occurs in the lower portion of the Amadjuak Formation.

(4) Akpatok Formation

The Akpatok Formation only exists at a single locality (locality 30; Fig. 2 and Fig. 11 in Appendix) on southern Baffin Island; it is in a stream-cut immediately to the southwest of Amadjuak Lake. About 9 m of Akpatok strata are preserved which consist of light grey argillaceous limestone in resistant nodular beds of 5 to 7.5 cm in thickness that weather medium to dark grey. The upper boundary of the formation is not preserved. The conodonts from the formation indicate a mid-late Late Ordovician (latest Edenian-early Richmondian) age (McCracken, 2000).

(5) Forster Bay Formation

Sanford and Grant (2000) interpreted that "the remnants of Forster Bay strata on southern Baffin Island (Fig. 1A), although very poorly exposed, may reach a thickness of 45 m or more". To test whether the Forster Bay Formation is present on southern Baffin Island, a survey was specially made in the Putnam Highland area, because 1) this area has the highest altitude on southern Baffin Island; and 2) the lower Paleozoic strata are horizontally distributed in the area; therefore, the youngest strata should be found at the highest altitude. However, no outcrop with Forster Bay strata was found; rather few brown argillaceous dolostone rubble are scattered on the top of the hills (Fig. 2; locality 30, 33, 35 and 36) where the Amadjuak Formation is exposed. Besides the Putnam Highland area, the same rubble was also found at locality 32 (Fig. 15 in Appendix). The brown argillaceous dolostone rubble at these localities on southern Baffin Island are similar to the rock in the laminated beds of unit 1 of the Red Head Rapids Formation on Southampton Island (Zhang, 2008), and likely represent the erosional remnants of the Forster Bay Formation on southern Baffin Island (Fig. 1B), and the thickness of the formation is unknown.

3. PRELIMINARY RESULTS OF ROCK EVAL^6 ANALYSIS

A total of 46 samples were collected for Rock Eval^6 on southern Baffin Island (see Table 2 for details), giving the following results:

1) Five rubble samples from locality 16 (Fig. 2 and Fig. 5 in Appendix; Table 2), a swamp area south of Sylvia Grinnell Lake. Within the rubble, graptolites are abundant; therefore, they are from the black shale interval of lower part of the Amadjuak Formation. TOC among the five samples ranges between 8.83 and 13.95% with an average of 11.76% (see Table 2 for details).

2) 12 rubble/semi-outcrop samples from locality 19 (Fig. 2 and Fig. 7 in Appendix), a hillside of a large Paleozoic outlier. With the rubble, graptolites are abundant; therefore, they are from the black shale interval of lower part of the Amadjuak Formation. TOC among the 12 samples ranges between 9.85% and 14.78% with an average of 12.9% (see Table 2 for details).

3) 9 outcrop samples from a grey shale interval of the lower part of the Amadjuak Formation at locality 31 on the northwest shore of Amadjuak Lake (Fig. 2 and Fig. 12 in Appendix). As discussed earlier, this shale interval can be correlated to the organic-rich black shale interval at locality 32 (Fig. 14 in Appendix). The TOC among the 9 shale samples ranges between 0.28% and 0.76% with an average of 0.47% (see Table 2 for details).

4) 14 outcrop samples and one rubble sample from a *circa* 2-m-thick black shale interval and overlying strata of the lower part of the Amadjuak Formation at locality 32

(Fig. 2 and Fig. 14 in Appendix), a small creek running down a hillside of a large Paleozoic outlier, perpendicular to the Jordan River. 11 out of 14 outcrop samples are from a 2-m-thick interval changing from black laminated papery oil shale to grey mudstone upwards; and three from the overlying non-black shale interval. TOC among 11 samples from the 2-m-thick black shale interval ranges between 1.68% and 12.97% with an average of 7.8% (see Table 2 for details). The general trend is that the higher TOC values are concentrated in the lower part of the black shale interval, and the TOC values gradually decrease toward the top of the interval.

5) Four brown argillaceous dolostone rubble samples of the Forster Bay Formation were collected from four different localities (locality 30, 33, 35 and 36; Fig. 2 and Figs. 11 and 17 in Appendix) in the Putnam Highland area. The rubble samples contain TOC values that range between 2.82% and 5.13%, with an average of 4.21%. As discussed earlier, the Forster Bay Formation has been eroded from southern Baffin Island, but it may exist in the offshore area as another low yield source rock.

All samples discussed above are thermally immature; Tmax values range between 416°C and 432°C with an average of 424°C (see Table 2 for details).

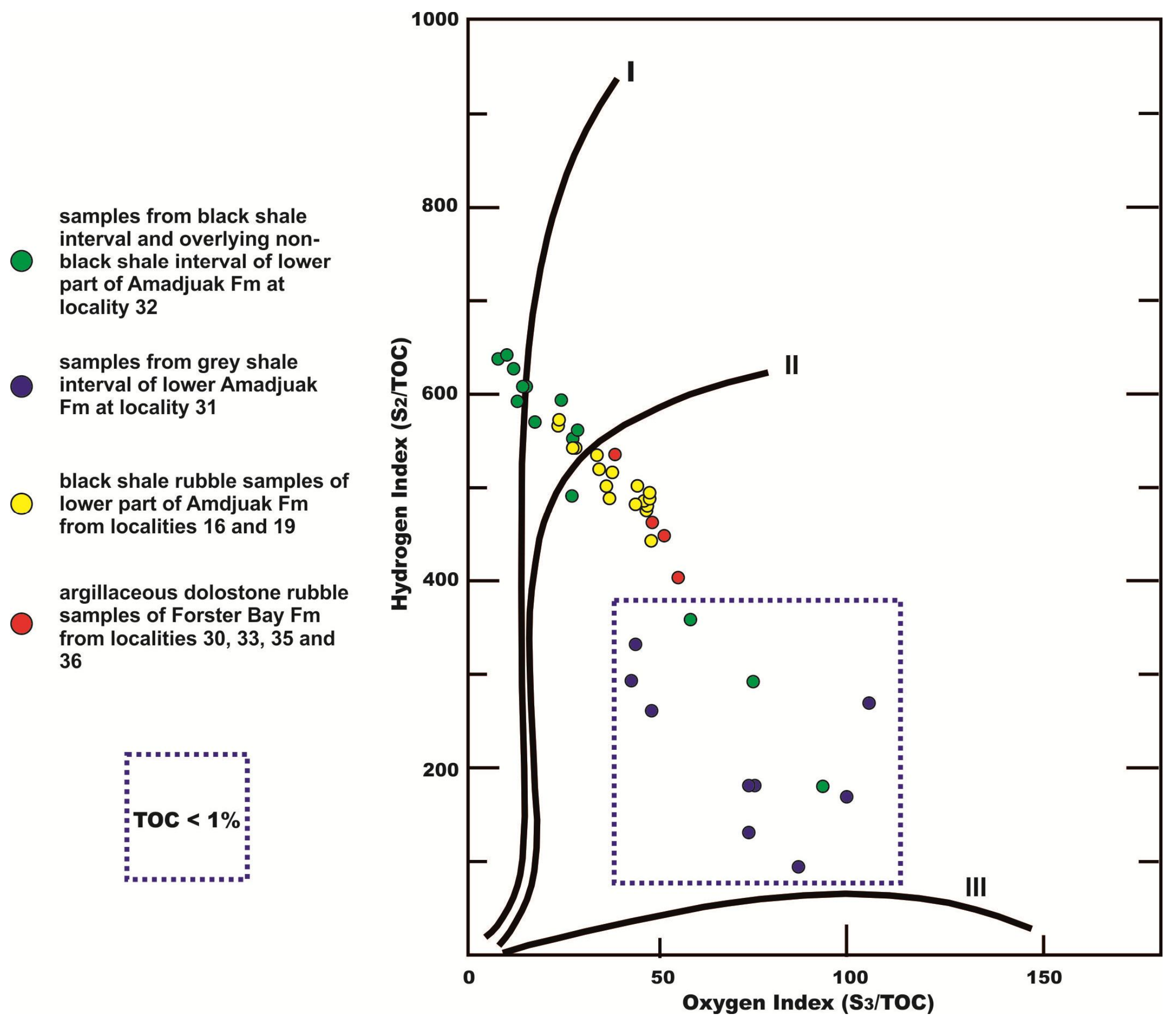

Fig. 4 Modified van Krevelen diagram showing different HI and OI among different shales

Figure 4 shows hydrogen and oxygen indices of all 46 samples. The preliminary data show that the black shale from the outcrop of the lower part of the Amadjuak Formation at locality 32 basically contains immature Type I marine kerogen (green dots except for the three in blue box in Fig. 4). However, the rubble samples of both the lower part of the Amadjuak (yellow dots in Fig. 4) and Akpatok (red dots in Fig. 4) formations exhibit a Type II kerogen, which may be related to the oxidation that tends to remove hydrogen from the kerogen and add oxygen to the kerogen.

Almost all those samples containing less than 1% TOC are from the grey shale interval (Fig. 4) of the lower part of the Amadjuak Formation at locality 31 on the northwest shore of Amadjuak Lake. As discussed earlier, the grey shale at locality 31 is at the same stratigraphic interval as the black shale at locality 32; therefore, the organic-rich black shale interval of the lower Amadjuak Formation is not geographically widely distributed in Foxe Basin, but laterally in a north-westerly direction, changes to an inorganic shale facies.

Macauley (1987) collected 4 rubble and outcrop samples from locality 32 [Macauley's (1987) location A] and 5 outcrop samples from locality 31 [Macauley's (1987) location C]. The TOC among the 4 samples (BI-3—BI-6) from locality 32 ranges between 2.89% and 14.76% with an average of 9.02%, which are similar to the results in 1), 2) and 4) discussed above; the TOC among the 5 samples (BI-10—BI14) from locality 31 varies from 0.04% to 2.47% with an average of 1.02%, which is slightly higher than the results in 3) discussed above. An immature Type II kerogen was identified by Macauley (1987) rather than an immature Type I kerogen recognized herein.

4. CONCLUSIONS

The 2011 field and post-field study on southern Baffin Island

1) established the stratigraphic position of the organic-rich black shale interval in the lower part of the Upper Ordovician Amadjuak Formation;

2) identified the organic-rich black shale characterized by TOC values that range between 1.68% and14.9% with an average of about 11%; the organic matter is thermally immature and consists of Type I kerogen;

3) demonstrated that the organic-rich black shale interval of the lower part of the Amadjuak Formation changes laterally (north-westerly) into inorganic shale; therefore, it is not geographically widely distributed on southern Baffin Island;

4) recognized, in characteristic rubble, another low yield shale interval with TOC values ranging between 2.82% and 5.13% with an average of 4.21% at a higher stratigraphic level (Forster Bay Formation); the formation has been eroded from the study area;

5) demonstrated that the previously interpreted Forster Bay Formation overlying the Akpatok Formation does not outcrop, the unit has likely been eroded from southern Baffin Island.

ACKNOWLEDGEMENTS

Financial support provided by the Hudson Bay – Foxe Basin project under NRCan's Geo-mapping for Energy and Mineral (GEM) Program and the logistic support provided by Polar Continental Shelf Program (PCSP) are acknowledged. Supervision of the publication by D. Mate (Canada-Nunavut Geoscience Office; CNGO) and critical review of D. Lavoie (GSC, Quebec) are greatly appreciated. Field assistance was provided by H. Ali, University of Calgary.

REFERENCES

Bolton, T.E. 2000: Ordovician magafauna, southern Baffin Island, Nunavut. Geological Survey of Canada, Bulletin 557, p. 39-157.

Heywood, W.W. and Sanford, B.V. 1976: Geology of Southampton, Coats, and Mansel Islands, District of Keewatin, Northwest Territories. Geological Survey of Canada, Memoir 382, 35 p.

McCracken, A.D. 2000: Middle and Late Ordovician conodonts from the Foxe Lowland of southern Baffin Island, Nunavut. Geological Survey of Canada, Bulletin 557, p. 159-216.

McCracken, A.D. and Bolton, T.E. (eds.) 2000: Geology and Paleontology of the southeast Arctic Platform and southern Baffin Island, Nunavut. Geological Survey of Canada, Bulletin 557, 248 p.

Macauley, G. 1987. Geochemistry of organic-rich Ordovician sediments on Akpatok and Baffin Islands, Northwest Territories. Geological Survey of Canada, Open File 1502, 27 p.

Sanford, B.V. 1987: Paleozoic geology of Hudson Platform. In: Beaumont, C. and Tankard, A.J. (Eds.), Sedimentary basins and basin forming mechanism. Canadian Society of Petroleum Geologists, Memoir 12, p. 483-505.

Sanford, B.V. and Grant, A.C. 1990: New findings relating to the stratigraphy and structure of the Hudson Bay Platform. Current Research, Part D; Geological Survey of Canada, Paper 90-1D, p. 17-30.

Sanford, B.V. and Grant, A.C. 2000: Geological framework of the Ordovician System in the southeast Arctic Platform, Nunavut. Geological Survey of Canada, Bulletin 557, p. 13-38.

Sharma, S., Dix, G.R., and Riva, J.F.V. 2003. Late Ordovician platform foundering, its paleoceanography and burial, as preserved in separated (eastern Michigan Basin, Ottawa Embayment) basins, southern Ontario. Canadian Journal of Earth Sciences, 40 (2): 135-147.

Zhang, S. 2008. New insights into Ordovician oil shales in Hudson Bay Basin: their number, stratigraphic position, and petroleum potential. Bulletin of Canadian Petroleum Geology, 56 (4): 300–324.

Table 1. Summary of collected samples (black and red font represents outcrop and rubble samples of Amadjuak Formation, respectively; green font represents rubble samples of Forster Bay Formation)

Locality Description	Locality ID	Sample #	Latitude	Longitude	Purpose
A swamp South of Sylvia Grinnell Lake	16	11SZ-03-01	64°06'37.4"N	69°25'44.3"W	Rock Eval
A swamp South of Sylvia Grinnell Lake	16	11SZ-03-02	64°06'34.1"N	69°25'38.1"W	Rock Eval
A swamp South of Sylvia Grinnell Lake	16	11SZ-03-03	64°06'35.9"N	69°25'37.4"W	Rock Eval
A swamp South of Sylvia Grinnell Lake	16	11SZ-03-04	64°06'35.9"N	69°25'37.4"W	Rock Eval
A swamp South of Sylvia Grinnell Lake	16	11SZ-03-05	64°06'36.4"N	69°25'37.5"W	Rock Eval
A creek South of Sylvia Grinnell Lake	17	11SZ-12-01	64°06'16.4"N	69°27'53.4"W	Conodont
A creek South of Sylvia Grinnell Lake	17	11SZ-12-02	64°06'16.4"N	69°27'53.4"W	Conodont
A creek South of Sylvia Grinnell Lake	17	11SZ-12-03	64°06'16.4"N	69°27'53.4"W	Conodont
A creek South of Sylvia Grinnell Lake	17	11SZ-12-04	64°06'16.4"N	69°27'53.4"W	Conodont
A creek South of Sylvia Grinnell Lake	17	11SZ-12-05	64°06'16.4"N	69°27'53.4"W	Conodont
A creek South of Sylvia Grinnell Lake	17	11SZ-12-06	64°06'03.3"N	69°27'47.1"W	Conodont
A creek South of Sylvia Grinnell Lake	17	11SZ-12-07	64°06'03.3"N	69°27'47.1"W	Conodont
A creek South of Sylvia Grinnell Lake	17	11SZ-12-08	64°06'03.3"N	69°27'47.1"W	Conodont
A creek South of Sylvia Grinnell Lake	17	11SZ-12-09	64°06'03.3"N	69°27'47.1"W	Conodont
A creek South of Sylvia Grinnell Lake	17	11SZ-12-10	64°06'03.3"N	69°27'47.1"W	Conodont
A creek South of Sylvia Grinnell Lake	17	11SZ-12-11	64°06'03.3"N	69°27'47.1"W	Conodont
A creek South of Sylvia Grinnell Lake	17	11SZ-12-12	64°06'03.3"N	69°27'47.1"W	Conodont
A creek South of Sylvia Grinnell Lake	17	11SZ-12-13	64°06'03.3"N	69°27'47.1"W	Conodont
A creek South of Sylvia Grinnell Lake	17	11SZ-12-14	64°06'03.3"N	69°27'47.1"W	Conodont
A creek South of Sylvia Grinnell Lake	17	11SZ-12-15	64°06'03.3"N	69°27'47.1"W	Conodont
A creek South of Sylvia Grinnell Lake	17	11SZ-12-16	64°06'03.3"N	69°27'47.1"W	Conodont
A creek South of Sylvia Grinnell Lake	17	11SZ-12-17	64°06'03.3"N	69°27'47.1"W	Conodont
A creek South of Sylvia Grinnell Lake	17	11SZ-12-18	64°06'03.3"N	69°27'47.1"W	Conodont
A creek South of Sylvia Grinnell Lake	17	11SZ-12-19	64°06'03.3"N	69°27'47.1"W	Conodont
A creek South of Sylvia Grinnell Lake	17	11SZ-12-20	64°06'03.3"N	69°27'47.1"W	Conodont
Hill by Jordan River	19	11SZ-04-01	63°58'01.0"N	69°09'54.0"W	Rock Eval
Hill by Jordan River	19	11SZ-04-02	63°58'01.0"N	69°09'54.0"W	Rock Eval
Hill by Jordan River	19	11SZ-04-03	63°58'01.0"N	69°09'54.0"W	Conodont
Hill by Jordan River	19	11SZ-04-04	63°58'01.0"N	69°09'54.0"W	Rock Eval
Hill by Jordan River	19	11SZ-04-05	63°58'01.0"N	69°09'54.0"W	Rock Eval
Hill by Jordan River	19	11SZ-04-06	63°58'01.0"N	69°09'54.0"W	Conodont
Hill by Jordan River	19	11SZ-04-07	63°58'03.2"N	69°09'54.8"W	Rock Eval
Hill by Jordan River	19	11SZ-04-08	63°58'03.2"N	69°09'54.8"W	Rock Eval
Hill by Jordan River	19	11SZ-04-09	63°58'03.2"N	69°09'54.8"W	Rock Eval
Hill by Jordan River	19	11SZ-04-10	63°58'03.2"N	69°09'54.8"W	Rock Eval
Hill by Jordan River	19	11SZ-04-11	63°58'03.2"N	69°09'54.8"W	Rock Eval
Hill by Jordan River	19	11SZ-04-12	63°58'03.7"N	69°09'54.3"W	Rock Eval
Hill by Jordan River	19	11SZ-04-13	63°58'03.7"N	69°09'54.3"W	Rock Eval

Hill by Jordan River	19	11SZ-04-14	63°58'03.7"N	69°09'54.3"W	Rock Eval
A creek in Putnam Highland area	26	11SZ-05-01	65°18'49.9"N	73°06'40.4"W	Conodont
A creek in Putnam Highland area	26	11SZ-05-02	65°18'49.9"N	73°06'40.4"W	Conodont
A creek in Putnam Highland area	26	11SZ-05-03	65°18'49.9"N	73°06'40.4"W	Conodont
A creek in Putnam Highland area	26	11SZ-05-04	65°18'49.9"N	73°06'40.4"W	Conodont
A creek in Putnam Highland area	26	11SZ-05-05	65°18'49.9"N	73°06'40.4"W	Conodont
A creek in Putnam Highland area	26	11SZ-05-06	65°18'49.9"N	73°06'40.4"W	Conodont
A creek in Putnam Highland area	27	11SZ-06-01	65°14'16.1"N	73°01'15.1"W	Conodont
A creek in Putnam Highland area	27	11SZ-06-02	65°14'16.1"N	73°01'15.1"W	Conodont
A creek in Putnam Highland area	27	11SZ-06-03	65°14'16.1"N	73°01'15.1"W	Conodont
A creek in Putnam Highland area	27	11SZ-06-04	65°14'16.1"N	73°01'15.1"W	Conodont
A creek in Putnam Highland area	27	11SZ-06-05	65°14'16.1"N	73°01'15.1"W	Conodont
A creek in Putnam Highland area	29	11SZ-07-01	65°12'41.9"N	72°53'54.5"W	Conodont
A creek in Putnam Highland area	29	11SZ-07-02	65°12'41.9"N	72°53'54.5"W	Conodont
A creek in Putnam Highland area	29	11SZ-07-03	65°12'41.9"N	72°53'54.5"W	Conodont
A creek in Putnam Highland area	29	11SZ-07-04	65°12'41.9"N	72°53'54.5"W	Conodont
A creek in Putnam Highland area	29	11SZ-07-05	65°12'41.9"N	72°53'54.5"W	Conodont
A creek in Putnam Highland area	29	11SZ-07-06	65°12'41.9"N	72°53'54.5"W	Conodont
A creek in Putnam Highland area	29	11SZ-07-07	65°12'41.9"N	72°53'54.5"W	Conodont
A creek in Putnam Highland area	29	11SZ-07-08	65°12'41.9"N	72°53'54.5"W	Conodont
A creek in Putnam Highland area	29	11SZ-07-09	65°12'41.9"N	72°53'54.5"W	Conodont
A creek in Putnam Highland area	29	11SZ-07-10	65°12'41.9"N	72°53'54.5"W	Conodont
A creek in Putnam Highland area	29	11SZ-07-11	65°12'41.9"N	72°53'54.5"W	Conodont
A creek in Putnam Highland area	29	11SZ-07-12	65°12'41.9"N	72°53'54.5"W	Conodont
A creek in Putnam Highland area	29	11SZ-07-13	65°12'41.9"N	72°53'54.5"W	Conodont
A creek in Putnam Highland area	29	11SZ-07-14	65°12'41.9"N	72°53'54.5"W	Conodont
A creek in Putnam Highland area	29	11SZ-07-15	65°12'41.9"N	72°53'54.5"W	Conodont
A creek in Putnam Highland area	29	11SZ-07-16	65°12'41.9"N	72°53'54.5"W	Conodont
A creek in Putnam Highland area	29	11SZ-07-17	65°12'38.9"N	72°54'10.3"W	Conodont
A creek in Putnam Highland area	29	11SZ-07-18	65°12'36.8"N	72°54'23.0"W	Conodont
A creek in Putnam Highland area	30	11SZ-11-01	65°01'24.1"N	72°30'35.7"W	Conodont
A creek in Putnam Highland area	30	11SZ-11-02	65°01'24.1"N	72°30'35.7"W	Conodont
A creek in Putnam Highland area	30	11SZ-11-03	65°01'24.1"N	72°30'35.7"W	Conodont
A creek in Putnam Highland area	30	11SZ-11-04	65°01'24.1"N	72°30'35.7"W	Conodont
A creek in Putnam Highland area	30	11SZ-11-05	65°01'24.1"N	72°30'35.7"W	Conodont
A creek in Putnam Highland area	30	11SZ-11-06A	65°01'24.1"N	72°30'35.7"W	Conodont
A creek in Putnam Highland area	30	11SZ-11-06B	65°01'24.1"N	72°30'35.7"W	Rock Eval
Hill above the previous creek	30	11SZ-11-07	65°01'20.6"N	72°30'28.9"W	Conodont
Hill above the previous creek	30	11SZ-11-08	65°01'20.6"N	72°30'28.9"W	Conodont
Hill above the previous creek	30	11SZ-11-09	65°01'20.6"N	72°30'28.9"W	Conodont
Hill above the previous creek	30	11SZ-11-10	65°01'20.6"N	72°30'28.9"W	Conodont
Hill above the previous creek	30	11SZ-11-11	65°01'20.6"N	72°30'28.9"W	Conodont
West bank of Amadjuak Lake	31	11SZ-08-01A	65°14'16.0"N	71°41'52.4"W	Conodont
West bank of Amadjuak Lake	31	11SZ-08-02A	65°14'16.0"N	71°41'52.4"W	Conodont
West bank of Amadjuak Lake	31	11SZ-08-03A	65°14'16.0"N	71°41'52.4"W	Conodont
West bank of Amadjuak Lake	31	11SZ-08-03B	65°14'16.0"N	71°41'52.4"W	Rock Eval
West bank of Amadjuak Lake	31	11SZ-08-04A	65°14'16.0"N	71°41'52.4"W	Conodont
West bank of Amadjuak Lake	31	11SZ-08-04B	65°14'16.0"N	71°41'52.4"W	Rock Eval

West bank of Amadjuak Lake	31	11SZ-08-05A	65°14'16.0"N	71°41'52.4"W	Conodont
West bank of Amadjuak Lake	31	11SZ-08-05B	65°14'16.0"N	71°41'52.4"W	Rock Eval
West bank of Amadjuak Lake	31	11SZ-08-06A	65°14'16.0"N	71°41'52.4"W	Conodont
West bank of Amadjuak Lake	31	11SZ-08-06B	65°14'16.0"N	71°41'52.4"W	Rock Eval
West bank of Amadjuak Lake	31	11SZ-08-07B	65°14'16.0"N	71°41'52.4"W	Rock Eval
West bank of Amadjuak Lake	31	11SZ-08-08A	65°14'16.0"N	71°41'52.4"W	Conodont
West bank of Amadjuak Lake	31	11SZ-08-08B	65°14'16.0"N	71°41'52.4"W	Rock Eval
West bank of Amadjuak Lake	31	11SZ-08-09A	65°14'16.0"N	71°41'52.4"W	Conodont
West bank of Amadjuak Lake	31	11SZ-08-09B	65°14'16.0"N	71°41'52.4"W	Rock Eval
West bank of Amadjuak Lake	31	11SZ-08-10A	65°14'16.0"N	71°41'52.4"W	Conodont
West bank of Amadjuak Lake	31	11SZ-08-11A	65°14'16.0"N	71°41'52.4"W	Conodont
West bank of Amadjuak Lake	31	11SZ-08-11B	65°14'16.0"N	71°41'52.4"W	Rock Eval
West bank of Amadjuak Lake	31	11SZ-08-12A	65°14'16.0"N	71°41'52.4"W	Conodont
West bank of Amadjuak Lake	31	11SZ-08-13A	65°14'16.0"N	71°41'52.4"W	Conodont
West bank of Amadjuak Lake	31	11SZ-08-13B	65°14'16.0"N	71°41'52.4"W	Rock Eval
West bank of Amadjuak Lake	31	11SZ-08-14A	65°14'16.0"N	71°41'52.4"W	Conodont
A creek north of Amdjuak Lake	31A	11SZ-09-01	65°14'47.2"N	71°41'32.3"W	Conodont
A creek north of Amdjuak Lake	31A	11SZ-09-02	65°14'47.2"N	71°41'32.3"W	Conodont
A creek north of Amdjuak Lake	31A	11SZ-09-03	65°14'47.2"N	71°41'32.3"W	Conodont
A creek north of Amdjuak Lake	31A	11SZ-09-04	65°14'47.2"N	71°41'32.3"W	Conodont
A creek north of Amdjuak Lake	31A	11SZ-09-05	65°14'47.2"N	71°41'32.3"W	Conodont
A creek north of Amdjuak Lake	31A	11SZ-09-06	65°14'47.2"N	71°41'32.3"W	Conodont
A creek north of Amdjuak Lake	31A	11SZ-09-07	65°14'44.3"N	71°41'26.6"W	Conodont
A creek north of Amdjuak Lake	31A	11SZ-09-08	65°14'44.3"N	71°41'26.6"W	Conodont
A creek north of Amdjuak Lake	31A	11SZ-09-09	65°14'44.3"N	71°41'26.6"W	Conodont
A creek north of Amdjuak Lake	31A	11SZ-09-10	65°14'44.3"N	71°41'26.6"W	Conodont
A creek north of Amdjuak Lake	31A	11SZ-09-11	65°14'44.3"N	71°41'26.6"W	Conodont
A creek north of Amdjuak Lake	31A	11SZ-09-12	65°14'44.3"N	71°41'26.6"W	Conodont
A Creek perpendicular to Jordan River	32	11SZ-10-01	63°59'12.9"N	69°10'08.6"W	Conodont
A Creek perpendicular to Jordan River	32	11SZ-10-02	63°59'12.9"N	69°10'08.6"W	Conodont
A Creek perpendicular to Jordan River	32	11SZ-10-03	63°59'12.9"N	69°10'08.6"W	Conodont
A Creek perpendicular to Jordan River	32	11SZ-10-04	63°59'12.9"N	69°10'08.6"W	Conodont
A Creek perpendicular to Jordan River	32	11SZ-10-05	63°59'12.9"N	69°10'08.6"W	Conodont
A Creek perpendicular to Jordan River	32	11SZ-10-06	63°59'12.9"N	69°10'08.6"W	Conodont
A Creek perpendicular to Jordan River	32	11SZ-10-07	63°59'12.9"N	69°10'08.6"W	Conodont
A Creek perpendicular to Jordan River	32	11SZ-10-08	63°59'12.9"N	69°10'08.6"W	Conodont
A Creek perpendicular to Jordan River	32	11SZ-10-09	63°59'12.9"N	69°10'08.6"W	Conodont
A Creek perpendicular to Jordan River	32	11SZ-10-10	63°59'12.9"N	69°10'08.6"W	Conodont
A Creek perpendicular to Jordan River	32	11SZ-10-11	63°59'12.9"N	69°10'08.6"W	Conodont
A Creek perpendicular to Jordan River	32	11SZ-10-12	63°59'09.1"N	69°10'37.7"W	Conodont
A Creek perpendicular to Jordan River	32	11SZ-10-13	63°59'08.6"N	69°10'40.7"W	Conodont
A Creek perpendicular to Jordan River	32	11SZ-10-14	63°59'08.6"N	69°10'40.7"W	Conodont
A Creek perpendicular to Jordan River	32	11SZ-10-15	63°59'08.6"N	69°10'40.7"W	Conodont
A Creek perpendicular to Jordan River	32	11SZ-10-16	63°59'08.6"N	69°10'40.7"W	Conodont
A Creek perpendicular to Jordan River	32	11SZ-10-17B	63°59'08.6"N	69°10'40.7"W	Rock Eval
A Creek perpendicular to Jordan River	32	11SZ-10-17B/B	63°59'08.6"N	69°10'40.7"W	Rock Eval
A Creek perpendicular to Jordan River	32	11SZ-10-18B	63°59'08.6"N	69°10'40.7"W	Rock Eval
A Creek perpendicular to Jordan River	32	11SZ-10-18B/B	63°59'08.6"N	69°10'40.7"W	Rock Eval

A Creek perpendicular to Jordan River	32	11SZ-10-19B	63°59'08.6"N	69°10'40.7"W	Rock Eval
A Creek perpendicular to Jordan River	32	11SZ-10-19B/B	63°59'08.6"N	69°10'40.7"W	Rock Eval
A Creek perpendicular to Jordan River	32	11SZ-10-20B	63°59'08.6"N	69°10'40.7"W	Rock Eval
A Creek perpendicular to Jordan River	32	11SZ-10-21A	63°59'08.6"N	69°10'40.7"W	Conodont
A Creek perpendicular to Jordan River	32	11SZ-10-21B	63°59'08.6"N	69°10'40.7"W	Rock Eval
A Creek perpendicular to Jordan River	32	11SZ-10-22B	63°59'08.6"N	69°10'40.7"W	Rock Eval
A Creek perpendicular to Jordan River	32	11SZ-10-23B	63°59'08.6"N	69°10'40.7"W	Rock Eval
A Creek perpendicular to Jordan River	32	11SZ-10-24A	63°59'08.6"N	69°10'40.7"W	Conodont
A Creek perpendicular to Jordan River	32	11SZ-10-24B	63°59'08.6"N	69°10'40.7"W	Rock Eval
A Creek perpendicular to Jordan River	32	11SZ-10-25A	63°59'08.6"N	69°10'40.7"W	Conodont
A Creek perpendicular to Jordan River	32	11SZ-10-25B	63°59'08.6"N	69°10'40.7"W	Rock Eval
A Creek perpendicular to Jordan River	32	11SZ-10-26A	63°59'08.6"N	69°10'40.7"W	Conodont
A Creek perpendicular to Jordan River	32	11SZ-10-26B	63°59'08.6"N	69°10'40.7"W	Rock Eval
A Creek perpendicular to Jordan River	32	11SZ-10-27A	63°59'08.6"N	69°10'40.7"W	Conodont
A Creek perpendicular to Jordan River	32	11SZ-10-28A	63°59'08.6"N	69°10'40.7"W	Conodont
A Creek perpendicular to Jordan River	32	11SZ-10-29A	63°59'08.6"N	69°10'40.7"W	Conodont
A Creek perpendicular to Jordan River	32	11SZ-10-30A	63°59'08.6"N	69°10'40.7"W	Conodont
A Creek perpendicular to Jordan River	32	11SZ-10-31A	63°59'08.6"N	69°10'40.7"W	Conodont
A Creek perpendicular to Jordan River	32	11SZ-10-31B	63°59'08.6"N	69°10'40.7"W	Rock Eval
A Creek perpendicular to Jordan River	32	11SZ-10-32A	63°59'08.6"N	69°10'40.7"W	Conodont
A Creek perpendicular to Jordan River	32	11SZ-10-33A	63°59'08.6"N	69°10'40.7"W	Conodont
A Creek perpendicular to Jordan River	32	11SZ-10-34A	63°59'08.6"N	69°10'40.7"W	Conodont
A Creek perpendicular to Jordan River	32	11SZ-10-35A	63°59'08.6"N	69°10'40.7"W	Conodont
A Creek perpendicular to Jordan River	32	11SZ-10-36A	63°59'10.4"N	69°10'58.1"W	Conodont
A Creek perpendicular to Jordan River	32	11SZ-10-36B	63°59'10.4"N	69°10'58.1"W	Rock Eval
A Creek perpendicular to Jordan River	32	11SZ-10-37A	63°59'10.6"N	69°11'09.6"W	Conodont
A Creek perpendicular to Jordan River	32	11SZ-10-38A	63°59'15.9"N	69°11'22.6"W	Conodont
A Creek perpendicular to Jordan River	32	11SZ-10-39A	63°5915.9"N	69°11'27.3"W	Conodont
Hill by Jordan River	32	11SZ-10-40A	63°59'14.1"N	69°11'34.3"W	Conodont
Hill by Jordan River	32	11SZ-10-41A	63°59'14.1"N	69°11'34.3"W	Conodont
Hill by Jordan River	32	11SZ-10-42A	63°59'14.1"N	69°11'34.3"W	Conodont
Hill by Jordan River	32	11SZ-10-43A	63°59'14.1"N	69°11'34.3"W	Conodont
Hill by Jordan River	32	11SZ-10-44A	63°59'14.1"N	69°11'34.3"W	Conodont
Hill by Jordan River	32	11SZ-10-45A	63°59'09.1"N	69°11'34.1"W	Conodont
A Hill in Putnam Highland area	33	11SZ-12A-01	64°57'40.0"N	72°16'02.4"W	Rock Eval
A Hill in Putnam Highland area	35	11SZ-13-01	64°49'33.7"N	72°29'26.2"W	Rock Eval
A Hill in Putnam Highland area	36	11SZ-14-01	64°49'38.5"N	72°27'15.9"W	Rock Eval
A creek southwest of Nettling Lake	38	11SZ-15-01	65°49'58.4"N	71°5600.7"W	Conodont
A creek southwest of Nettling Lake	39	11SZ-16-01A	65°48'55.8"N	71°58'32.1"W	Conodont
A creek southwest of Nettling Lake	39	11SZ-16-01B	65°48'55.8"N	71°58'32.1"W	Rock Eval

Table 2. Rock Eval[6] for samples from both outcrop and rubble on southern Baffin Island (black and red font represents outcrop and rubble samples of Amadjuak Formation, respectively; green font represents rubble samples of Forster Bay Formation)

Location ID	Sample	Qty	S_1	S_2	PI	S_3	Tmax	Tpeak	S_3CO	PC%	TOC%	RC%	HI	OICO	OI	MINC %
16	11SZ-03-01	70.5	2.07	68.27	0.03	5.12	418	457	2.44	6.12	13.95	7.83	489	17	37	1.1
	11SZ-03-02	70.1	1.85	61.60	0.03	3.16	420	459	1.58	5.44	11.35	5.91	543	14	28	1.7
	11SZ-03-03	70.2	1.97	63.18	0.03	4.13	421	460	1.97	5.63	12.16	6.53	520	16	34	1.6
	11SZ-03-04	70.6	2.29	70.89	0.03	2.91	422	461	1.76	6.25	12.51	6.26	567	14	23	1.3
	11SZ-03-05	70.6	1.21	47.14	0.02	2.95	422	461	1.58	4.19	8.83	4.64	534	18	33	2.2
19	11SZ-04-01	70.4	1.10	55.35	0.02	5.93	423	462	2.22	4.99	12.45	7.46	445	18	48	1.5
	11SZ-04-02	70.2	1.94	71.25	0.03	6.93	422	461	2.76	6.43	14.91	8.48	478	19	46	0.5
	11SZ-04-04	70.7	1.39	60.19	0.02	5.85	423	462	2.23	5.41	12.36	6.95	487	18	47	0.7
	11SZ-04-05	70.2	1.31	58.82	0.02	5.53	421	460	2.55	5.29	12.08	6.79	487	21	46	0.6
	11SZ-04-07	70.8	1.35	60.69	0.02	5.88	424	463	2.63	5.46	12.71	7.25	477	21	46	0.8
	11SZ-04-08	70.4	1.27	56.05	0.02	5.44	423	462	2.21	5.04	11.73	6.69	478	19	46	1.1
	11SZ-04-09	70.7	1.86	71.42	0.03	6.43	422	461	3.02	6.43	14.78	8.35	483	20	44	0.4
	11SZ-04-10	70.6	1.32	64.47	0.02	6.11	425	464	2.44	5.78	13.02	7.24	495	19	47	1.6
	11SZ-04-11	70.2	1.04	49.29	0.02	4.34	423	462	1.70	4.40	9.85	5.45	500	17	44	3.0
	11SZ-04-12	70.1	2.04	69.51	0.03	5.05	422	461	2.38	6.21	13.48	7.27	516	18	37	1.1
	11SZ-04-13	70.4	2.67	73.74	0.03	3.69	421	460	1.88	6.55	13.61	7.06	542	14	27	1.6
	11SZ-04-14	70.9	2.20	71.24	0.03	5.10	420	459	2.60	6.38	14.22	7.84	501	18	36	1.1
31	11SZ-08-03B	70.5	0.01	0.90	0.01	0.35	432	471	0.06	0.09	0.33	0.24	273	18	106	6.7
	11SZ-08-04B	70.7	0.03	2.27	0.01	0.30	431	470	0.02	0.21	0.68	0.47	334	3	44	2.9
	11SZ-08-05B	70.5	0.03	2.25	0.01	0.33	430	469	0.08	0.21	0.76	0.55	296	11	43	1.7
	11SZ-08-06B	70.3	0.03	1.90	0.02	0.35	430	469	0.00	0.17	0.72	0.55	264	0	49	1.1
	11SZ-08-07B	69.9	0.01	0.75	0.02	0.32	431	470	0.01	0.08	0.42	0.34	179	2	76	3.0
	11SZ-08-08B	70.2	0.01	0.79	0.02	0.32	431	470	0.24	0.09	0.43	0.34	184	56	74	2.6
	11SZ-08-09B	70.5	0.01	0.48	0.02	0.28	428	467	0.05	0.05	0.28	0.23	171	18	100	3.2
	11SZ-08-11B	70.6	0.01	0.41	0.02	0.23	427	466	0.23	0.06	0.31	0.25	132	74	74	2.7
	11SZ-08-13B	70.3	0.01	0.31	0.03	0.28	428	467	0.05	0.04	0.32	0.28	97	16	88	2.6
32	11SZ-10-17B	70.7	1.32	55.57	0.02	1.30	422	461	0.87	4.81	9.15	4.34	607	10	14	0.7
	11SZ-10-17B/B	70.7	2.81	82.37	0.03	1.02	424	463	0.89	7.16	12.97	5.81	635	7	8	1.1
	11SZ-10-18B	70.4	2.14	61.87	0.03	0.97	423	462	0.71	5.38	9.66	4.28	640	7	10	2.0
	11SZ-10-18B/B	70.7	2.16	62.73	0.03	1.37	421	460	0.86	5.48	10.61	5.13	591	8	13	1.9
	11SZ-10-19B	70.5	2.30	67.03	0.03	1.66	423	462	0.96	5.86	11.05	5.19	607	9	15	2.0
	11SZ-10-19B/B	70.9	0.87	35.27	0.02	1.45	422	461	0.83	3.09	5.95	2.86	593	14	24	3.7
	11SZ-10-20B	70.0	1.14	45.50	0.02	0.86	424	463	0.48	3.93	7.25	3.32	628	7	12	2.8
	11SZ-10-21B	70.3	0.95	41.75	0.02	2.09	422	461	1.12	3.67	7.58	3.91	551	15	28	2.6
	11SZ-10-22B	70.5	0.82	35.01	0.02	1.80	422	461	0.85	3.07	6.26	3.19	559	14	29	3.7
	11SZ-10-23B	70.4	0.32	20.25	0.02	0.62	423	462	0.36	1.75	3.56	1.81	569	10	17	3.1
	11SZ-10-24B	71.0	0.10	8.24	0.01	0.46	425	464	0.27	0.73	1.68	0.95	490	16	27	4.5
	11SZ-10-25B	70.1	0.03	2.26	0.01	0.37	427	466	0.08	0.21	0.63	0.42	359	13	59	5.5
	11SZ-10-26B	69.8	0.02	1.55	0.01	0.40	430	469	0.10	0.15	0.53	0.38	292	19	75	7.1
	11SZ-10-31B	70.3	0.01	0.87	0.02	0.45	430	469	0.08	0.10	0.48	0.38	181	17	94	3.1
	11SZ-10-36B	70.3	3.08	81.14	0.04	3.32	422	461	1.97	7.19	14.20	7.01	571	14	23	1.0
30	11SZ-11-06B	70.8	0.23	11.37	0.02	1.54	420	459	0.42	1.04	2.82	1.78	403	15	55	7.2
33	11SZ-12A-01	70.2	0.59	25.68	0.02	1.83	416	455	0.58	2.27	4.79	2.52	536	12	38	6.2
35	11SZ-13-01	70.2	0.32	18.39	0.02	2.09	422	461	0.82	1.67	4.10	2.43	449	20	51	6.7
36	11SZ-14-01	70.8	0.38	23.81	0.02	2.46	422	461	0.85	2.13	5.13	3.00	464	17	48	4.6
39	11SZ-16-01	70.2	0.01	0.20	0.03	0.34	430	469	0.03	0.03	0.18	0.15	111	17	189	4.8

Appendix: Description of field localities

A total of 39 localities were visited through out the Paleozoic area on southern Baffin Island, where the Paleozoic rocks are either exposed or covered by rubble. Some of them are observation localities; therefore, samples were collected from 15 localities (Fig. 2). A total of 130 conodont samples (processing is currently in progress) and 46 shale samples were collected from the 15 representative sections and rubble localities (Fig. 2) for biostratigraphic study and Rock-Eval[6] data collection, respectively.

The following described localities are those where samples were collected (Fig. 2).

Locality 16 (64°06′34.1″N, 69°25′38.1″W; Figs. 2 and 5)

A swamp area south of Silvia Grinnell Lake, where no outcrops were found, but the black shale rubble are scattered on the surface. Among the rubble, graptolite fossils are found, which are the same as those from the outcrop at locality 32, the black shale interval of Amadjuak Formation. Five black shale rubble samples were collected for Rock Eval[6] data collection (Table 1).

Fig. 5 Black organic rich shale rubble of lower Amadjuak Fm found at a swamp area (locality 16 in Fig. 2)

A: swamp area
B: black shale fragments from a few cm beneath ground surface
C: black organic rich shale rubble scattered among the grass

Locality 17 (64°06"16.4"N, 69°27'53.4"W — 64°06'03.3"N, 69°27'47.1"W; Figs. 2 and 6)

A creek south of Sylvia Grinnell Lake, along which the Precambrian-Paleozoic boundary is well exposed and the Middle Ordovician Frobisher Bay Formation outcrops continuously (Fig. 6A and 6B). The Frobisher Bay Formation is rich in large domed colony coral *Labyrinthites chidlensis* (Fig. 6C) and cephalopods, but they were not collected. A total of 20 limestone samples were collected for processing conodonts.

Fig. 6 Outcrop of Frobisher Bay Fm (locality 17 in Fig. 2)

A: contact between Frobisher Bay Fm and Precambrian

B: middle part of the formation

C: coral *Labyrinthites chidlensis*

Locality 19 (63°58'01.0"N, 69°09'54.0"W; Figs. 2 and 7)

A hill by the Jordan River, where no outcrops were found, but the black shale and limestone rubble of the Upper Ordovician Amadjuak Formation are scattered on the surface (Fig. 7A), and a layer of black shale (about 50 cm) was exposed by digging (Fig. 7B). 12 black shale samples from both rubble and semi-outcrop and 2 limestone rubble samples were collected for Rock Eval[6] and processing conodonts, respectively (Table 1).

Fig. 7 Black shale rubble at locality 19. A: black shale rubble scattered on the surface; B: the layer of black shale exposed through digging

Locality 26 (65°18'49.9"N, 73°06'40.4"W; Figs. 2 and 8)

A creek in Putnam Highland area. The rocks exposed at Site 26 are from the Upper Ordovician Amadjuak Formation, where the invertebrate fossils *Fisherites* sp. and *Maclurites* sp. are abundant. Six rock samples (white bags in Fig. 6; Table 1) were collected for processing conodonts.

Fig. 8 Outcrop of Amadjuak Formation at locality 26 in Putnam Highland area

Locality 27 (65°14'16.1"N, 73°01'15.1"W; Figs. 2 and 9)

A creek in Putnam Highland area. The rocks exposed at locality 27 are probably of unit 2 and unit 3 of the Upper Ordovician Amadjuak Formation (Fig. 9A showing part of the samples collected from lower part of the outcrop). Fossil corals, gastropods and cephalopods (Figs. 9B-9D) were seen at the locality but not collected. A total of 5 rock samples (Table 1) were collected for processing conodonts.

Fig. 9 Outcrop of Amadjuak Formation at locality 27

A: part of the outcrop with conodont sample located

B: fossil coral

C: fossil cephalopod

D: fossil gastropod

Locality 29 (65°12'41.9"N, 72°53'54.5"W; Figs. 2 and 10)

A creek in Putnam Highland area. The rocks of the Upper Ordovician Amadjuak Formation are fairly well exposed. A total of 18 rock samples (Table 1) were collected for processing conodonts. Figure 10 shows the lower part of the section.

Locality 30 (65°01'24.1"N, 72°30'35.7"W; Figs. 2 and 11)

A creek cut section in Putnam Highland area. Rocks here are continuously exposed along the creek (Fig. 11A) but discontinuously exposed on the hill near-by, which belong to the Upper Ordovician Akpatok Formation. A total of 12 rock samples were collected (Table 1); 11 of them are limestone that were collected from outcrop for conodont processing; one of them is brown argillaceous dolostone that was collected from rubble (Figs. 11B and 11C) on the top of the hill for the Rock Eval[6] analysis. This rubble sample represents the trace of Forster Bay Formation that has been eroded from this locality.

Fig. 10 Lower Amadjuak Formation at locality 29, Putnam Highland area

Fig. 11 Outcrop of Akpatok Formation and rubble of Forster Bay Formation at locality 30

A: outcrop of Akpatok Fm
B and C: brown argillaceous dolomitic limestone rubble of Forster Bay Fm on the top of the outcrop of Akpatok Fm

Locality 31 (65°14'16.0"N, 71°41'52.4"W; Figs. 2 and 12)

A cliff section on the northwest shore of Amadjuak Lake. The lower part of the outcrop contains three intervals in ascending order: 2-3 m interval of grey shale, 1-1.5 m interval of resistant limestone interbedded with shale, and 1-1.5 m interval of limestone nodules cemented by lime mud. The upper part of the outcrop is dolomitic limestone. The rocks at locality 31 belong to the lower part of the Amadjuak Formation. A total of 22 rock samples were collected from this site, 9 and 13 samples are for Rock Eval[6] and processing conodonts, respectively (Table 1).

Fig. 12
A: outcrop of lower part of Amadjuak Fm at locality 31, northwest bank of Amadjuak Lake
B: close view of grey shale interval

Fig. 13 Outcrop of middle Amadjuak Formation at locality 31A, a creek north of Amadjuak Lake

Locality 31A (65°14'47.2"N, 71°41'32.3"W; Figs. 2 and 13)

A deeply cut creek section north of Amadjuak Lake. Rocks here are continuously exposed, and are stratigraphically correlated to the upper part of the section at locality 31 (the interval of limestone nodules cemented by lime mud is still seen in the lower part of Fig. 13); therefore, most of the section belongs to the middle Amadjuak Formation of Upper Ordovician. A total of 12 rock samples were collected for processing conodonts (Table 1).

Locality 32 (63°59'12.9"N, 69°10'08.6"W — 63°59'09.1"N, 69°11'34.1"W; Figs. 2 and 14)

This locality starts at Jordan Rover (Fig. 14A) that cuts the Middle Ordovician Frobisher Bay Formation at 63°59'12.9"N, 69°10'08.6"W (Fig. 14C). There is a small creek (Figs. 14A and 14B) that is perpendicular to the Jordan River, and originates near the top of the hill. This creek discontinuously exposed the Amadjuak Formation; this is the best exposed section for the oil shale (Figs. 14B and 14 D). A total of 54 rock samples were collected, 15 and 39 samples are for Rock Eval[6] and processing conodonts, respectively (Table 1). The trilobite, graptolite and brachiopod fauna (*Pseudogygites-Climacograptus-Paucicrura* fauna; Figs. 14E-14G) was observed. Among 15 samples for Rock Eval[6], 11 were from the black shale interval, three from the overlying non-black shale interval, and one from rubble (11SZ-10-36).

On the top of the hill, occurs scattered brown argillaceous dolostone rubble similar to those at locality 30 (Fig. 15).

Locality 33 (64°57'40.0"N, 72°16'02.4"W; Figs. 2, 16A and 16B)
Locality 35 (64°49'33.7"N, 72°29'26.2"W; Figs. 2 and 16C)
Locality 36 (64°49'38.5"N, 72°27'15.9"W; Figs. 2 and 16D)

Three hills in the Putnam Highland area with the highest altitude in the area. The hills are composed of the rocks of the Upper Ordovician Amadjuak Formation. On the slope and top of the hills, there are scattered brown argillaceous dolomitic limestone rubbles, which are the remnants of the Upper Ordovician Forster Bay Formation that has been eroded off. Many pieces of rubble were collected at each locality for both Rock-Eval[6] data and processing conodonts.

Locality 38 (65°49'58.4"N, 71°56"00.7"W; Figs. 2 and 17)
A creek southwest of Netting Lake. It is not clear whether the rocks here belong to the Frobisher Bay Formation, or the Amadjuak Formation. However, based on the Precambrian boulders in the creek, the rocks should be close to the Precambrian-Paleozoic boundary; therefore, it is most likely that the rocks at locality 38 are from the Frobisher Bay Formation. Only one sample (11SZ-15-01) (Table 1) was taken from this site for processing conodonts.

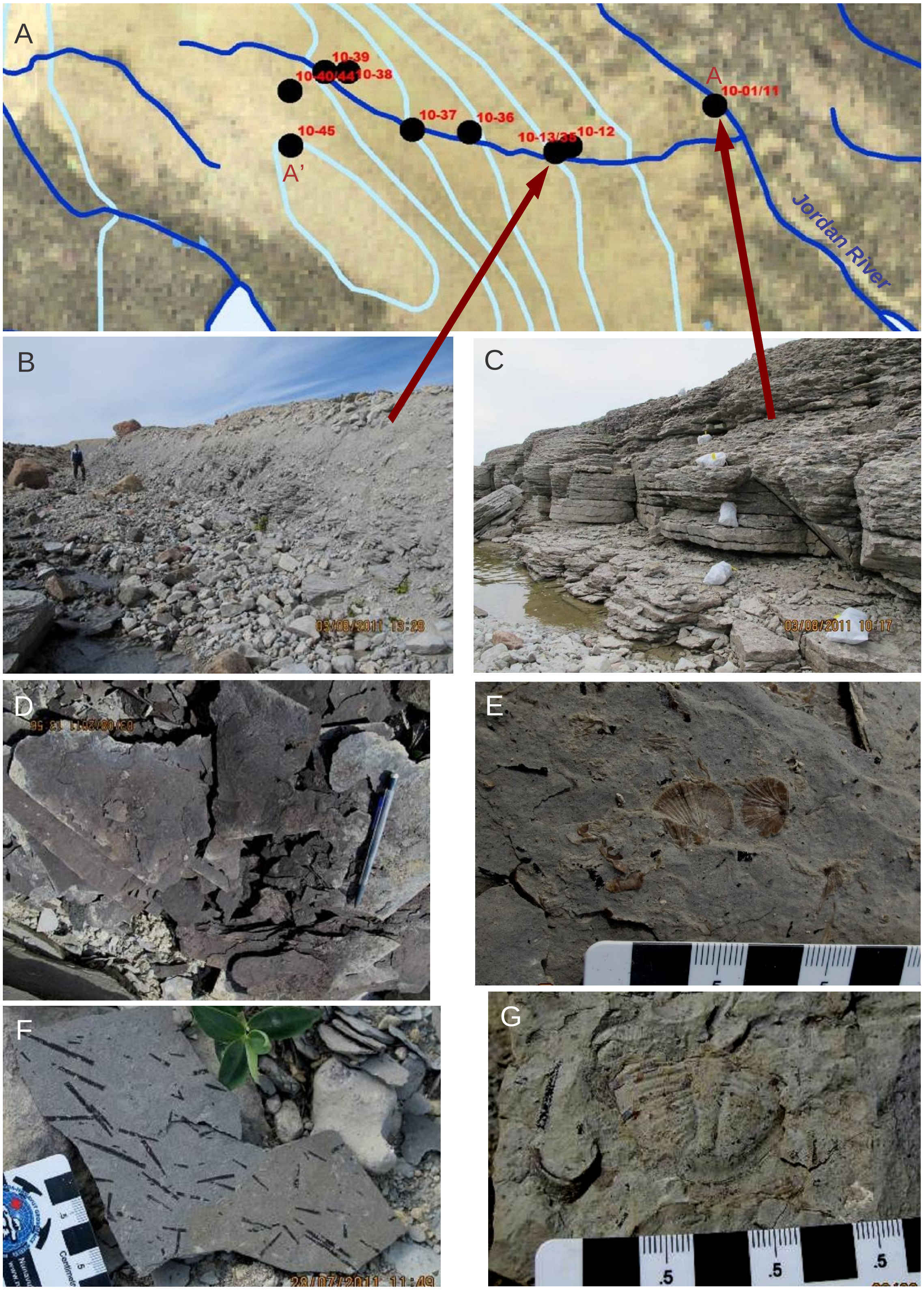

Fig. 14 Outcrops of Frobisher Bay and Amadjuak formations at locality 32. A: a map showing the major sample spots; B: outcrop of Frobisher Bay Fm along Jordan River; C: outcrop of Amadjuak Fm black shale interval; D: close view of black shale; E-G: *Pseudogygites-Climacograptus-Paucicrura* fauna in the black shale interval.

Fig. 15 Brown argillaceous dolostone rubble on the top of the hill at locality 32.

Fig. 16 Brown argillaceous dolostone rubble found at locality 33 (A and B), 35 (C) and 36 (D)

Fig. 17 Outcrop of Frobisher Bay Formation (?) at locality 38

Locality 39 (65°48'55.8"N, 71°58'32.1"W; Figs. 2 and 18)

A creek southwest of Netting Lake. This is the only locality where the rocks are dipping about 20-25 degrees. No macro-fossils were found at this locality; based on the lithology (very fine argillaceous partings between the limestone layers), it is most likely the Amadjuak Formation. Only two samples (11SZ-16-01A, 11SZ-16-01B) (Table 1) were collected for processing conodonts and Rock Eval[6], respectively. The sample for Rock Eval[6] is from the very fine argillaceous partings.

Fig. 18 Outcrop of Amadjuak Formation (?) at locality 39