24.

STRATIGRAPHIC SUBDIVISION OF THE HEIBERG FORMATION, EASTERN AND CENTRAL SVERDRUP BASIN, ARCTIC ISLANDS

Project 750083

Ashton F. Embry
Institute of Sedimentary and Petroleum Geology, Calgary

Embry, A.F., Stratigraphic subdivision of the Heiberg Formation, eastern and central Sverdrup Basin, Arctic Islands; in Current Research, Part B, Geological Survey of Canada, Paper 83-1B, p. 205-213, 1983.

Abstract

The Heiberg Formation, an Upper Triassic-Lower Jurassic sandstone-dominant unit in the Sverdrup Basin, is divided into three members, named in ascending order, Romulus, Fosheim, and Remus. The Romulus Member consists of interbedded sandstone, siltstone and shale with the lithologies arranged in coarsening-upward cycles of delta front origin. The Fosheim Member consists mainly of fine- to medium-grained sandstone with thin interbeds of carbonaceous siltstone, shale and coal. The member contains both fining-upward and thin, coarsening-upward cycles and is of delta plain origin. The Remus Member consists almost entirely of very fine- to medium-grained sandstone of beach and nearshore marine origin. The Romulus and Fosheim members represent the progradation of a major deltaic complex into the Sverdrup Basin in the Norian to Sinemurian, followed by delta destruction and transgression in the Pliensbachian and Toarcian (Remus Member).

Résumé

La formation de Heiberg dans le bassin de Sverdrup date de la période s'étendant du Trias supérieur au Jurassique inférieur et est dominée par des grès; on la divise en trois niveaux, notamment en ordre ascendant: Romulus, Fosheim et Remus. Le niveau de Romulus se compose de grès, de pélite et de schiste argileux interstratifiés, disposés en cycles où les matériaux deviennent grossiers vers le haut; il résulte d'une mise en place en milieu de front deltaïque. Le niveau de Fosheim comprend surtout des grès à grains fins à moyens avec de minces couches interstratifiées de pélite carbonatée, de schiste argileux et de charbon. Il contient des cycles de matériaux qui deviennent fins vers le haut ainsi que des cycles étroits où les grains deviennent grossiers vers le haut; dans ce cas, la mise en place a eu lieu dans une plaine deltaïque. Le niveau de Remus se compose presque entièrement de grès à grains dont la dimension varie de très fine à moyenne provenant d'un milieu de plage ou de littoral marin. Les niveaux de Romulus et de Fosheim représentent la progradation d'un important réseau deltaïque vers le bassin de Sverdrup, du Norien au Sinémurien, suivie par la destruction du delta et la transgression durant le Pliensbachien et le Toarcien (niveau de Remus).

Introduction

The stratigraphic framework for the Mesozoic succession in the Sverdrup Basin of arctic Canada was established by Heywood (1957), Tozer (1956, 1961, 1963a, 1963b), Souther (1963), Greiner (1963) and Tozer and Thorsteinsson (1964) from reconnaissance field studies done in the 1950's and was summarized by Tozer (1970). Following that reconnaissance over one hundred wells have penetrated Mesozoic strata in the Sverdrup Basin and more detailed stratigraphic and sedimentologic studies of surface exposures have been done by scientists of the Geological Survey of Canada (e.g. Balkwill, in press). The wealth of new surface and subsurface data has led to a revision of the stratigraphic nomenclature system, so that recently recognized stratigraphic relationships of the Mesozoic succession can be adequately described.

Numerous new stratigraphic units, both formations and members, have been delineated from both surface and subsurface studies. Many of these units have direct applicability to petroleum exploration in the Sverdrup Basin because they are established, or potential, reservoir, source or seal strata. In the interest of making these new units available for stratigraphic and petroleum related studies as quickly as possible, a series of short papers will be published in "Current Research" in 1983 and 1984, which will name and describe the new Mesozoic units in an expanded lexicon style. An appendix giving the tops of the units in selected wells will accompany each paper, so that regional correlation of the units will be understood.

This paper and a companion paper (Embry, 1983) describe the new stratigraphic units proposed for the Heiberg Formation/Group, a sandstone-dominant interval of Late Triassic and Early Jurassic age which contains significant oil and gas reserves. The regional stratigraphy, sedimentology and petroleum geology of the Heiberg Formation/Group have been described by Embry (1982) and the new stratigraphic units used in that analysis are formally defined in this paper and in Embry (1983).

Heiberg Formation

Previous Work

The Heiberg Formation was defined by Souther (1963) from studies completed during Operation Franklin in 1955. He established a type section at the southwestern end of Buchanan Lake on east-central Axel Heiberg Island where the formation is 1422 m thick. At that locality the sandstone-dominant Heiberg lies between two shale-siltstone units, the Blaa Mountain Formation below, and the Savik Formation above. Souther (1963) recognized two informal members in the type Heiberg Formation. The lower member consists of interbedded very fine- to fine-grained sandstone, siltstone and shale with ripple crosslamination and burrows common throughout. The upper member also consists of interbedded sandstone, siltstone and shale but is distinguished from the lower member by thicker and coarser grained sandstone units, a higher content of carbonaceous material in the shales and siltstones, the occurrence of thin coal seams, and the relative scarcity of burrows.

During Operation Franklin the Heiberg Formation was also examined by Tozer (1963b, c) on southwestern Ellesmere Island and west-central Axel Heiberg Island; by Glenister (1963) on southeastern Axel Heiberg Island; by McLaren (1963) on northern Cornwall Island; and by Greiner (1963) on central Cornwall Island.

Subsequent to Operation Franklin, Tozer (1961, 1963a) examined the Heiberg Formation on Ellesmere and Axel Heiberg islands and found that the uppermost 50 to 100 m of the formation consists of massive sandstone, characterized by thin, ferruginous layers which occasionally contain burrows and marine fossils. Tozer (1963a) assigned these strata to the Borden Island Formation, a Lower Jurassic ferruginous sandstone unit first recognized on Borden Island on the western edge of the Sverdrup Basin. Tozer (1963a) assumed that the Borden Island Formation of Ellesmere and Axel Heiberg islands was also of Early Jurassic (Sinemurian) age and rested unconformably on the Upper Triassic Heiberg sandstones.

Fricker (1963) described the Heiberg Formation in the Strand Fiord area of west-central Axel Heiberg Island. He noted that the formation was divisible into two members, similar to those described by Souther (1963) for the type section.

Nassichuk and Christie (1969) studied the Heiberg Formation in the vicinity of the head of Tanquary Fiord on northern Ellesmere Island. They mapped two informal members throughout the area. The lower member consists of interbedded sandstone, siltstone and shale with all lithologies containing abundant carbonaceous material. The upper member consists almost entirely of massive sandstone.

Balkwill (in press) describes the outcropping Heiberg Formation of Cornwall and Amund Ringnes islands and also includes descriptions of two subsurface sections (Amund Central Dome H-40, Linckens Island P-46). On Cornwall Island Balkwill (in press) divided the Heiberg Formation into two informal members. The lower member, which conformably overlies the Blaa Mountain Formation, consists of interbedded sandstone, siltstone and shale, commonly arranged in coarsening-upward cycles. The upper member consists of massive to crossbedded, fine- to coarse-grained sandstone with only thin, widely spaced intervals of carbonaceous siltstone, shale and coal. On eastern Cornwall Island pebbly and glauconitic sandstones, which contain Toarcian ammonites, overlie the Heiberg and were assigned by Balkwill (in press) to the Jaeger Formation (member B). On western Cornwall Island similar strata overlie the Heiberg but, in that area, Pliensbachian fossils occur in the strata. Because of this, these strata were assigned to the Borden Island Formation by Balkwill (in press). Stratigraphically higher ferruginous sandstones, which contain Toarcian ammonites, were assigned to the Jaeger Formation. The first shale unit overlying this essentially continuous succession of sandstone (which includes the Heiberg, Borden Island, and lower portion of the Jaeger Formation), was placed in the Jaeger Formation (member C).

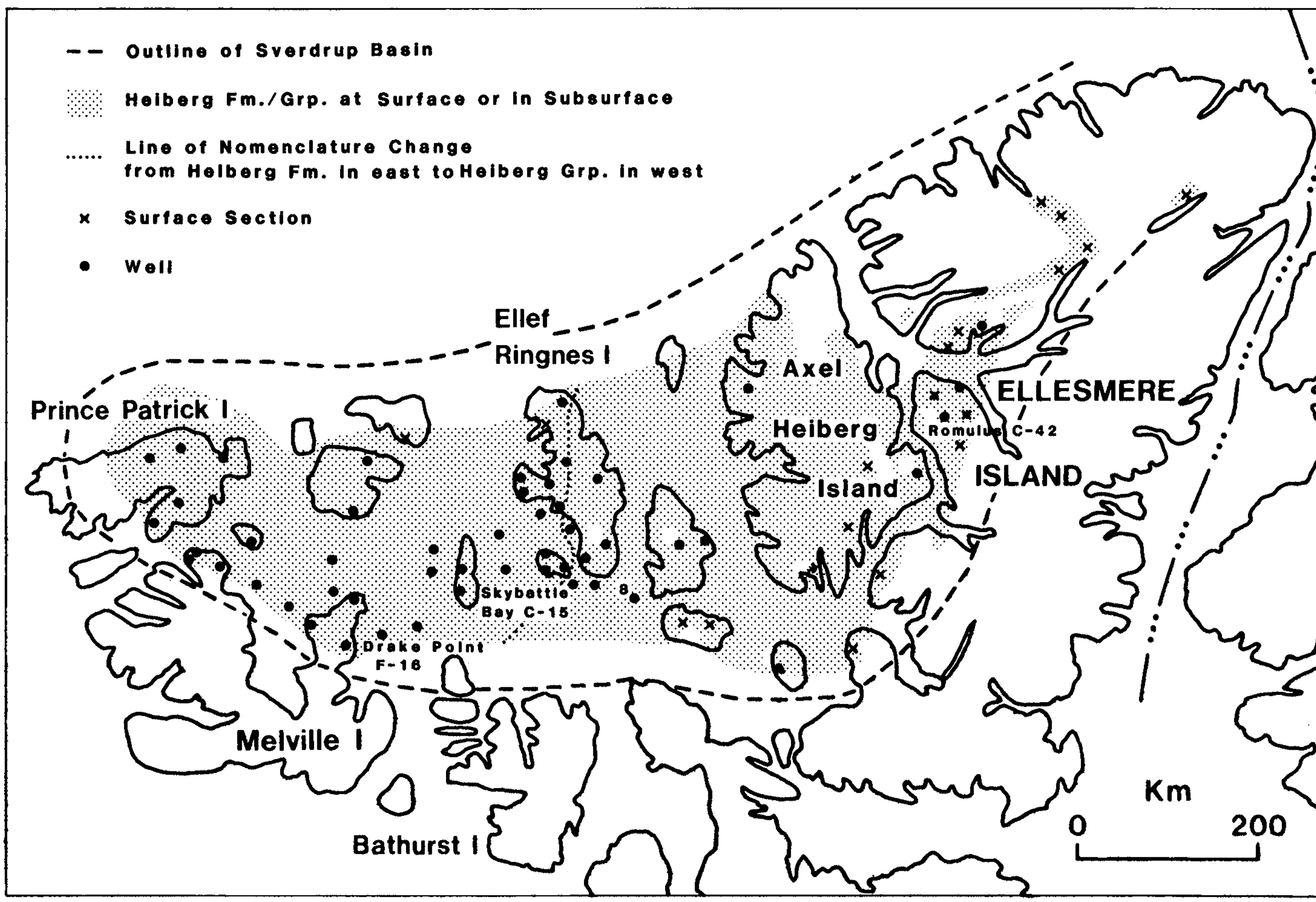

Figure 24.1. *Distribution of Heiberg Formation/Group and control points. Key to numbered wells listed in appendix: 1. Romulus C-42, 2. Neil 0-15, 3. May Point H-02, 4. Graham C-52, 5. Sherwood P-37, 6. Mid Fiord J-53, 7. Amund Central Dome H-40, 8. Linckens Island P-46, 9. Hoodoo Dome H-37.*

To the north, on Amund Ringnes Island, for both the surface and subsurface sections, Balkwill (in press) recognized a lower Heiberg Formation and an upper Heiberg Formation-Borden Island Formation (undivided). These strata are overlain by shale and siltstone of the Savik Formation. Balkwill (in press) includes a comprehensive discussion on the problem of objectively differentiating a Borden Island Formation from the Heiberg Formation in the eastern and central Sverdrup Basin. He suggests that the nomenclatural system be revised following a basin wide stratigraphic and sedimentologic study.

Present Work

I have recently completed a regional study of the Upper Triassic/Lower Jurassic stratigraphic interval in the Sverdrup Basin (Embry, 1982) and, following Balkwill's suggestion, I have revised the stratigraphic nomenclature for the interval. Souther's (1963) original definition of the Heiberg Formation (sandstone-dominant unit between two shale-siltstone units) has been applied to all of the available surface and subsurface sections (Fig. 24.1). This has provided a consistent and objective determination of the Heiberg Formation over the entire area and it circumvents the problem discussed by Balkwill (in press) of differentiating a Borden Island Formation from the Heiberg Formation.

The shale-siltstone units which bound the Heiberg Formation have been renamed. The underlying shale is referred to the Barrow Formation (Embry, 1982) and the overlying shale-siltstone unit is placed in the Jameson Bay Formation (Embry, 1982). The contact of the Heiberg with the Barrow is placed at the base of the first sandstone unit which is at least 4 m thick and above which sandstone units are common. The upper contact of the Heiberg Formation is placed at the top of the highest sandstone unit, above which shale and siltstone are the dominant lithologies.

Figure 24.1 illustrates the extent of the Heiberg Formation and the available surface and subsurface control. In the western Sverdrup Basin the Heiberg has been given group status and five formations are recognized (Embry, 1982, 1983). The line of nomenclature change (Fig. 24.1) follows the eastern limit of two mappable shale-siltstone units which allow a five-fold subdivision of the Heiberg in the west.

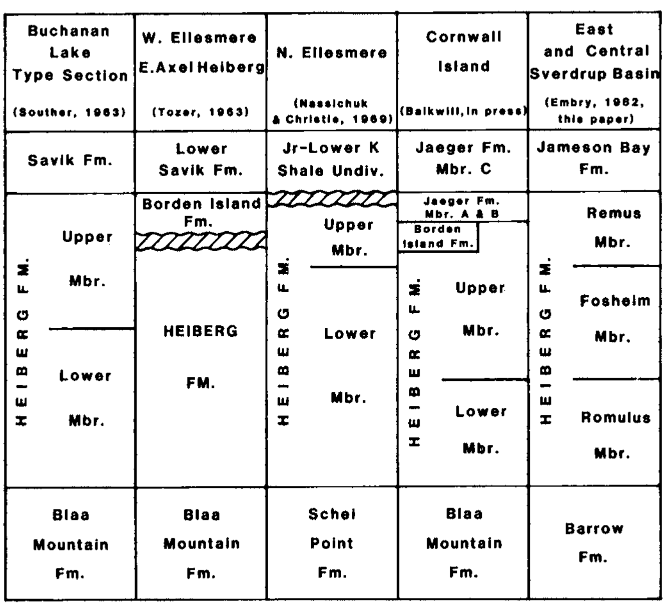

Figure 24.2. *Heiberg Formation nomenclature, past and present.*

In the eastern and central Sverdrup Basin, where the Heiberg has formation status, three new members are now delineated in the formation. Each of the members consists of a distinctive suite of lithologies which is recognizable in both surface and subsurface sections. The three new members are, in ascending order: Romulus, Fosheim, and Remus. They are formally defined herein. The type sections for these three new stratigraphic units are in the Panarctic Romulus C-42 well on Fosheim Peninsula, west-central Ellesmere Island (Fig. 24.1) at 79°51'05"N, and 84°22'42"W.

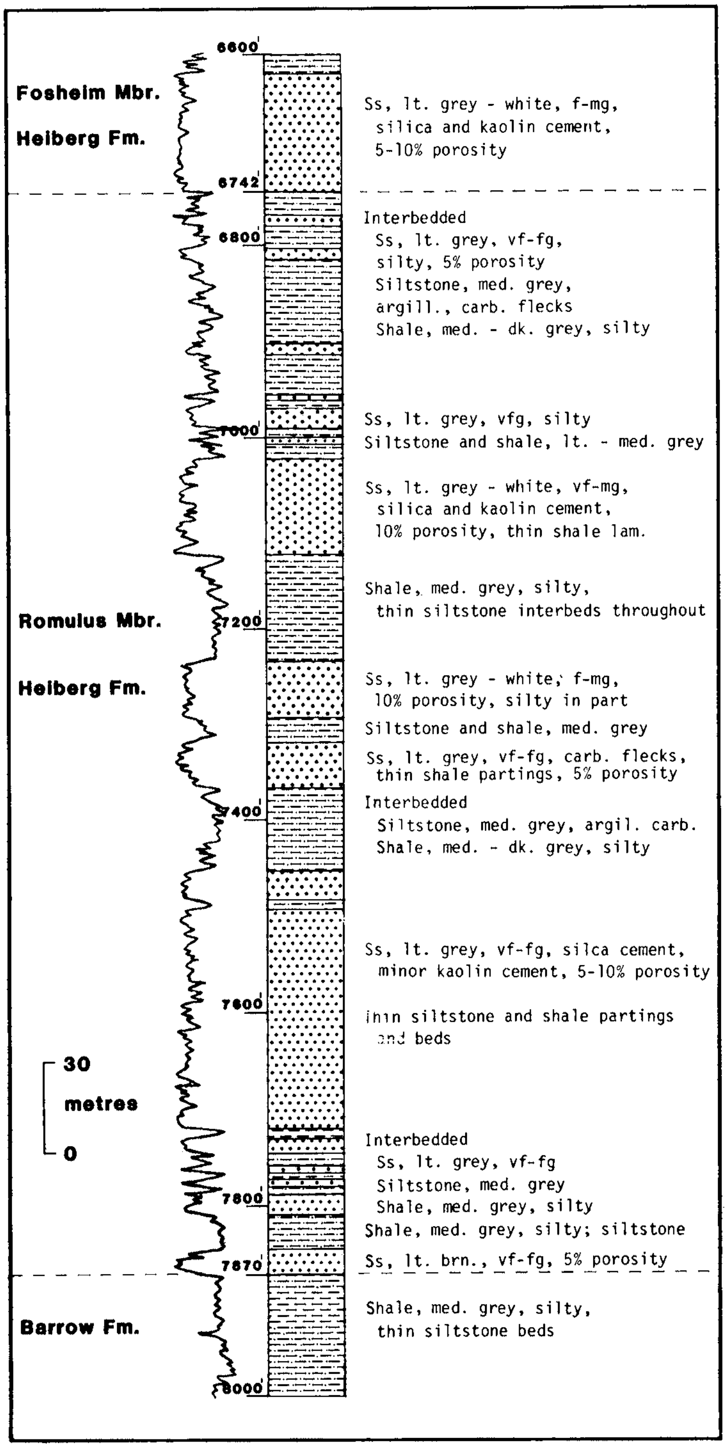

Figure 24.3. *Lithology and gamma ray curve of type section of Romulus Member, Romulus C-42 well.*

The Romulus C-42 well was spudded on January 28, 1972 and was abandoned on July 25, 1972 at a total depth of 4554 m. The elevation of the K.B. is 160 m.

Subsurface type sections were chosen because chip samples (3 m intervals) from the Romulus C-42 well are available for study at the Institute of Sedimentary and Petroleum Geology in Calgary, Alberta. Subsurface type sections are, therefore, far more accessible to interested geologists than are remote surface sections in the Arctic Islands.

Figure 24.2 illustrates the present nomenclature for the Heiberg Formation in the eastern and central Sverdrup Basin and compares it with the nomenclature used by previous workers.

Romulus Member

Definition

The Romulus Member of the Heiberg Formation consists of interbedded, very fine- to fine-grained sandstone, siltstone and shale. The type section is in the Romumuls C-42 well, between 2055.5 m (6742 ft) and 2400 m (7870 ft), and the member is 344.5 m thick (Fig. 24.3). The member is named after Romulus Lake which lies 13 km west of the Panarctic Romulus C-42 well site.

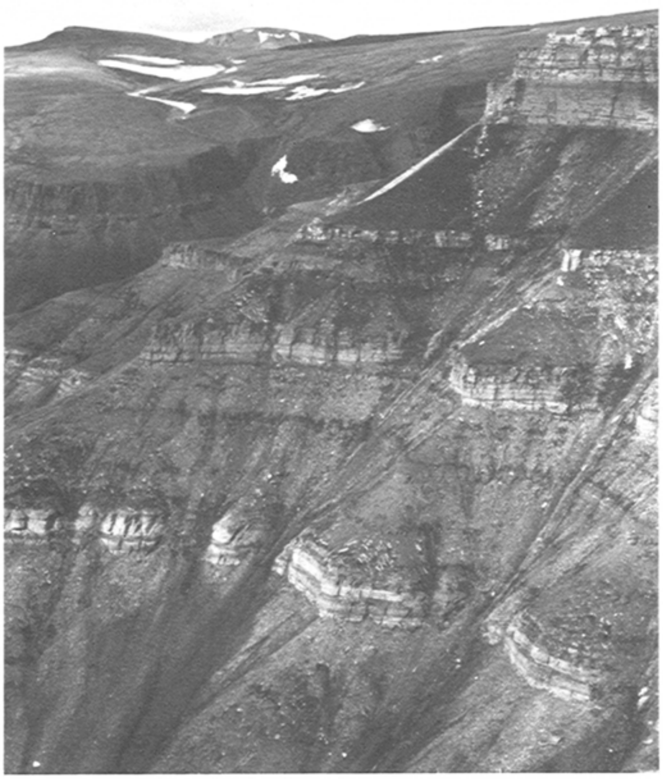

Figure 24.4. *Interbedded sandstone, siltstone and shale of Romulus Member, Raanes Peninsula, Ellesmere Island. Contact with Fosheim Member at base of sandstone in upper right.*

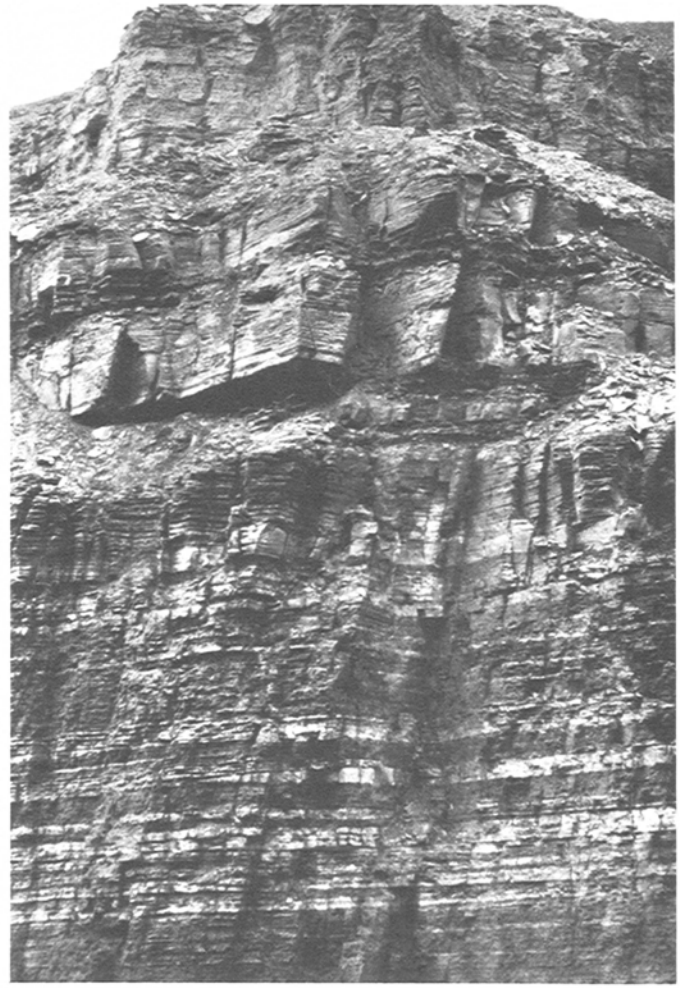

Figure 24.5. *Interbedded shale, siltstone and sandstone overlain by sandstone unit, Romulus Member, Raanes Peninsula, Ellesmere Island.*

Synonyms

1. Lower portions of lower member of Heiberg Formation of Souther (1963).
2. Lower member of Heiberg Formation of McLaren (1963) and Balkwill (in press).
3. Basal portion of lower member of Heiberg Formation of Nassichuk and Christie (1969).

Boundaries

The contact of the Romulus Member with the underlying Barrow Formation is placed at the base of the first thick sandstone unit (>4 m) above which sandstone is relatively common. The upper contact with the Fosheim Member of the Heiberg Formation is placed at the base of the sandstone unit above which carbonaceous siltstone, shale and coal are common and argillaceous intervals seldom exceed 10 m in thickness. Both contacts are conformable.

Lithology

The Romulus Member consists of interbedded sandstone, siltstone and shale with the lithologies commonly arranged in coarsening-upward cycles between 5 and 50 m thick (Fig. 24.4, 24.5). Shales and siltstones are light to medium grey and commonly exhibit parallel lamination.

Ripple crosslamination and burrows occur in siltstone beds. Thin, pelecypod coquinas are present within some thick shale units. The argillaceous intervals vary in thickness from 5 to 100 m.

Sandstone units are up to 60 m thick and consist mainly of very fine- to fine-grained quartzose sandstone. The most common sedimentary structures are ripple crosslamination and burrows. Thin shale laminations and flasers occur throughout the sandstone units and many individual sandstone beds have sharp, basal contacts. The flasers consist of red, silty shale and are one of the most characteristic features of the member.

In most areas sandstone is the predominant lithology and comprises between 60 and 80 per cent of the member. However, in the southwestern Ellesmere – southern Axel Heiberg area, shale and siltstone dominate the member and sandstone units are thinner and more widely spaced.

Distribution and Thickness

The Romulus Member has the same areal extent as the Heiberg Formation (Fig. 24.1) and varies in thickness from 50 m on the basin margin to 400 m in the basin centre.

Age

Macrofossils are rare within the Romulus Member but have been reported from southwest Ellesmere Island (Tozer, 1961), Wolf Fiord, southeastern Axel Heiberg Island (Glenister, 1963), and Cornwall Island (McLaren, 1963; Balkwill, in press). In all cases a Norian (Late Triassic) age was indicated for the member. Palynological study also indicates a Norian age for the member over its extent (unpublished GSC paleontological reports).

Environment of Deposition

The lithologies, fossil content, cyclicity, and stratigraphic relationships of the Romulus Member are all compatible with a delta front origin for the member (Balkwill, in press; Embry, 1982).

Fosheim Member

Definition

The Fosheim Member of the Heiberg Formation is a sandstone-dominant unit which contains thin interbeds of carbonaceous shale, siltstone and coal. The type section for the member is in the Panarctic Romulus C-42 well, between 1535 m (5034 ft) and 2055.5 m (6742 ft), and it is 520.5 m thick (Fig. 24.6). The name is taken from Fosheim Peninsula where the Romulus C-42 well is located.

Synonyms

1. Upper portion of lower member and most of upper member of type Heiberg Formation (Souther, 1963).
2. Upper member of Heiberg Formation of McLaren (1963) and Balkwill (in press).
3. Lower member of Heiberg Formation of Nassichuk and Christie (1969) with the exception of the basal portion.

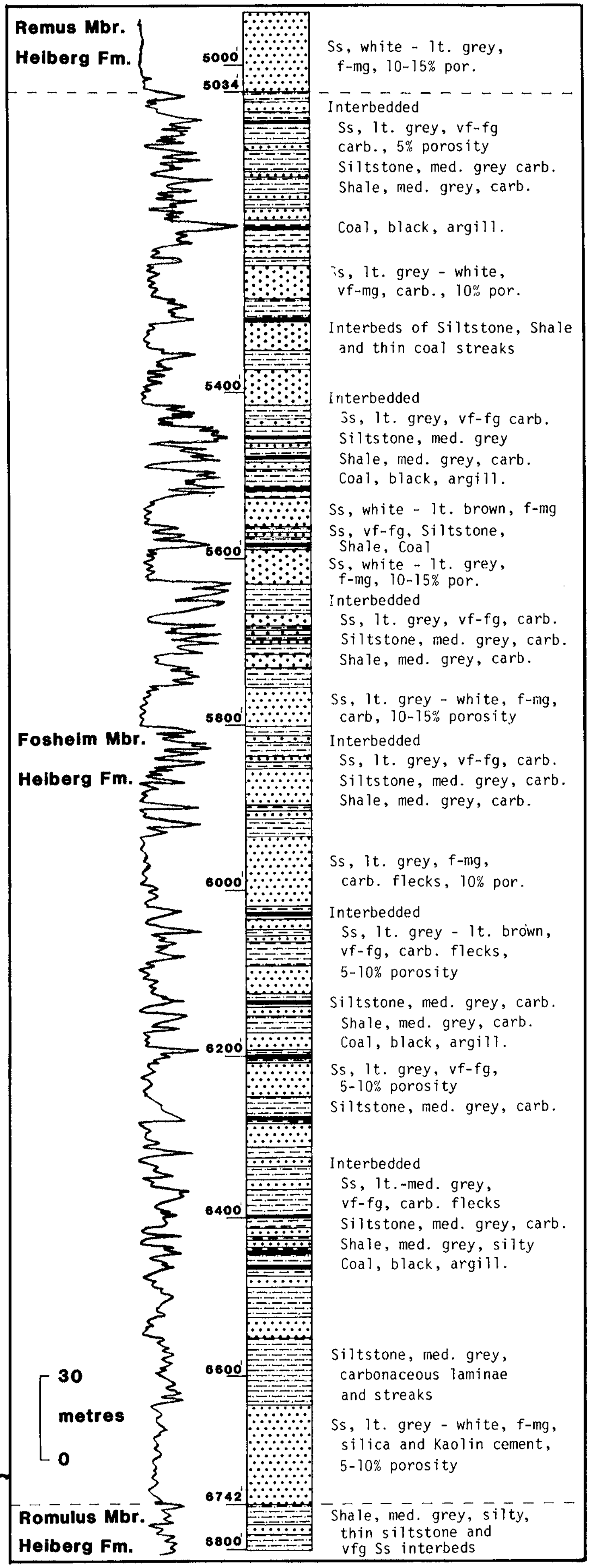

Figure 24.6. Lithology and gamma ray curve of type section of Fosheim Member, Romulus C-42 well.

Boundaries

The contact of the Fosheim Member with the underlying Romulus Member is placed at the base of the first sandstone unit above which carbonaceous shale and siltstone and coal are relatively common. The upper contact of the Fosheim Member with the Remus Member is placed at the top of the highest carbonaceous shale and siltstone unit, above which sandstone is nearly continuous to the top of the Heiberg Formation.

Lithology

The Fosheim Member consists mainly of fine- to medium-grained, quartzose sandstone, with thin interbeds of carbonaceous shale, siltstone and coal. In the Cornwall-Ringnes islands area of the central Sverdrup Basin, sandstone commonly comprises over 90 per cent of the member. To the east, on Axel Heiberg and western Ellesmere, sandstone content is usually between 60 and 90 per cent.

In central Sverdrup Basin, sandstone occurs in units up to 100 m thick. The sandstone is fine- to medium-grained, but contains chert pebbles and conglomerate bands along the southern basin margin. Carbonaceous material is very common and is concentrated along bedding planes. In outcrop, the sandstone usually appears to be massive, but trough and planar crossbeds are sometimes discernable with sets up to 3 m thick. Units of dark grey, carbonaceous shale and siltstone with thin coal seams occur throughout the member. These units seldom exceed 5 m in thickness and many are widely spaced.

In the eastern Sverdrup Basin, where shale and siltstone are more common, the Fosheim Member has a characteristic striped appearance in outcrop (Fig. 24.7). Both fining-upward and coarsening-upward cycles are common within the member. Fining-upward cycles are up to 15 m thick. They consist of a basal scour surface, fine- to medium-grained, crossbedded sandstone in the lower portion; very fine grained, horizontally bedded and ripple crosslaminated sandstone in the middle; and carbonaceous shale and siltstone, with parallel lamination and root markings, in the upper portion.

The coarsening-upward cycles range in thickness from 2 to 10 m. The cycles display an upward gradation from carbonaceous, silty shale at the base, through siltstone in the middle, to ripple crosslaminated and massive sandstone at the top (Fig. 24.8). The upper portion of the sandstone commonly contains root markings and/or burrows.

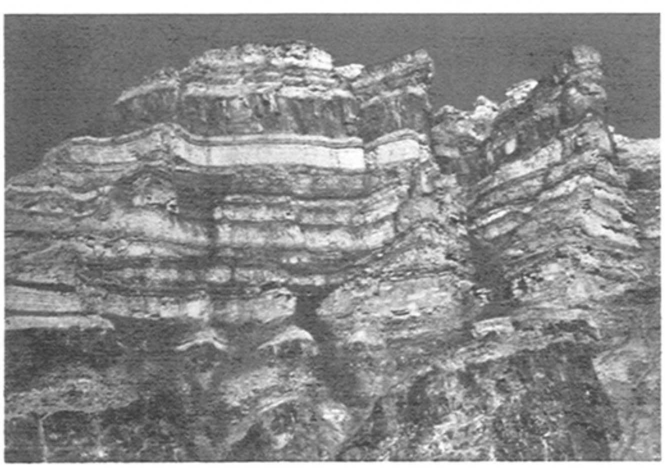

Figure 24.7. *Section of Fosheim Member in the Yelverton Pass area of northern Ellesmere. Striped appearance is characteristic of member.*

Figure 24.8. *Coarsening-upward cycle of bay-fill origin, Fosheim Member.*

Also present in the Fosheim Member of the eastern Sverdrup Basin are lenticular, massive, fine- to medium-grained sandstone units up to 20 m thick and 500 m wide.

Distribution and Thickness

The Fosheim Member has the same areal extent as the Heiberg Formation and ranges in thickness from 10 m on the basin margin to over 800 m in the basin centre [see Fig. 10 in Embry (1982) for an isopach map of the member].

Age

The only marine macrofossil obtained from the Fosheim Member is a Norian pelecypod in the lower portion of the member at Buchanan Lake (Souther, 1963). The overlying Remus Member has yielded late Pliensbachian ammonites. Because the contact between the Fosheim and Remus members is conformable and no unconformities have been recognized within the Fosheim Member it is inferred that the Fosheim Member contains strata of Norian, Hettangian, Sinemurian and early Pliensbachian age. Palynological studies (unpublished GSC reports) indicate a Late Triassic to Early Jurassic age for the member, which is compatible with the above inference. Also, the Fosheim Member is laterally equivalent to the Maclean Strait, Lougheed Island and King Christian formations of the Heiberg Group which range in age from Hettangian to Pliensbachian (Embry, 1982, 1983).

Environment of Deposition

The lithologies, cycles and stratigraphic relationships of the Fosheim Member are compatible with a deltaic plain origin (Embry, 1982). Sandstones are of channel and crevasse-splay origin, whereas the siltstone, shale and coal formed in interdistributary bay, marsh, swamp and lake environments.

Remus Member

Definition

The Remus Member of the Heiberg Formation consists almost entirely of very fine- to medium-grained sandstone and is characterized by a near-absence of shale and siltstone interbeds. The type section is in the Panarctic Romulus C-42 well, between 1436 m (4711 ft) and 1535 m (5034 ft), and the member is 99 m thick (Fig. 24.9). The member is named after Remus Creek which is 20 km northwest of the Romulus C-42 well.

Synonyms

1. Uppermost portion (100 m) of the upper member of the type Heiberg Formation (Souther, 1963).
2. Uppermost portion of the Heiberg Formation and the Borden Island Formation of Tozer (1963a).
3. Upper member of Heiberg Formation of Nassichuk and Christie (1969).
4. Uppermost Heiberg Formation, Borden Island Formation and lower portion of Jaeger Formation (members A and B) of Balkwill (in press).

Boundaries

The Remus Member conformably overlies the Fosheim Member with the contact placed at the top of the highest carbonaceous shale and siltstone bed above which sandstone is nearly continuous to the top of the Heiberg Formation. The contact of the Remus Member with the overlying Jameson Bay Formation is also conformable, and is placed at the top of the highest sandstone unit above which shale and siltstone are the predominant lithologies.

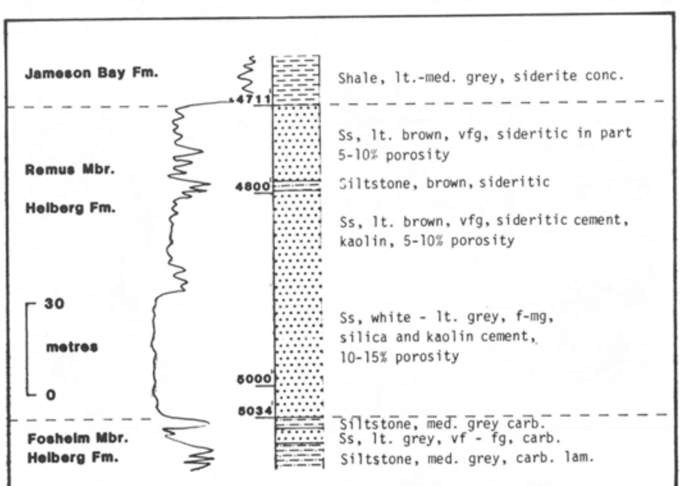

Figure 24.9. *Lithology and gamma ray curve of type section of Remus Member, Romulus C-42 well.*

Figure 24.10. *Massive sandstone of Remus Member at Yelverton Pass, northern Ellesmere Island. The member is about 200 m thick and the contact with the Fosheim Member is placed at the top of the highest, dark weathering, shale-siltstone unit.*

Lithology

The Remus Member consists almost entirely of very fine- to medium-grained sandstone which is commonly massive in appearance. Thin, sideritic sandstone units, which commonly contain burrows and fossils, are present and are most common in the upper portion of the member. Red weathering ironstone bands up to 50 cm thick are also characteristic of the member at many localities.

On the southern margin of the basin, chert pebbles occur in pebbly sandstone beds or in thin conglomerate bands and pods. Glauconite is locally present and is most common in the upper portion of the member. Shale and siltstone interbeds, when present, are thin and usually occur near the top of the member.

Distribution and Thickness

The Remus Member has the same areal extent as the Heiberg Formation and ranges in thickness from 5 to 220 m. It is in the 30 to 100 m range over most of its extent.

Age

Late Pliensbachian ammonites occur in the lower portion of the member on western Ellesmere Island and eastern Axel Heiberg Island (Frebold, 1975; unpublished GSC data). On Cornwall Island, strata now assigned to the Remus Member, contain Pliensbachian pelecypods and Toarcian ammonites (Balkwill, in press). The overlying Jameson Bay Formation contains Toarcian ammonites (Tozer, 1963a). From these data the Remus Member is assumed to be Pliensbachian to Early Toarcian in age.

Environment of Deposition

The Remus Member is interpreted to represent strand plain and nearshore deposits of a destructive delta on the basis of the well sorted, quartzose nature of the sandstone, the near-absence of argillaceous units, the presence of burrows, marine fossils and glauconite, and the widespread occurrence of the sandstone (Embry, 1982).

References

Balkwill, H.R.
— Geology of Amund Ringnes, Cornwall and Haig-Thomas islands, District of Franklin; Geological Survey of Canada, Memoir 390. (in press)

Embry, A.F.
1982: The Upper Triassic - Lower Jurassic Heiberg Deltaic Complex of the Sverdrup Basin; in Arctic Geology and Geophysics, ed. A.F. Embry and H.R. Balkwill; Canadian Society of Petroleum Geologists, Memoir 8, p. 189-217.

1983: The Heiberg Group, western Sverdrup Basin; in Current Research, Part B; Geological Survey of Canada, Paper 83-1B, report 46.

Frebold, H.
1975: The Jurassic faunas of the Canadian Arctic, Lower Jurassic ammonites, biostratigraphy and correlations; Geological Survey of Canada, Bulletin 243.

Fricker, P.E.
1963: Geology of the Expedition Fiord area, west central Axel Heiberg Island, Canadian Arctic Archipelago; McGill University, Axel Heiberg Island Research Reports, Geology No. 1.

Glenister, B.F.
1963: Localities on southern Axel Heiberg Island; in Y.O. Fortier et al., Geology of the north-central part of the Arctic Archipelago, Northwest Territories (Operation Franklin); Geological Survey of Canada, Memoir 320, p. 472-481.

Greiner, H.R.
1963: Jaeger River, eastern Cornwall Island; in Y.O. Fortier et al., Geology of the north-central part of the Arctic Archipelago, Northwest Territories (Operation Franklin); Geological Survey of Canada, Memoir 320, p. 533-537.

Heywood, W.W.
1957: Isachsen area, Ellef Ringnes Island, District of Franklin, Northwest Territories; Geological Survey of Canada, Paper 56-8.

McLaren, D.J.
1963: Mount Nicolag, Cornwall Island; in Y.O. Fortier et al., Geology of the north-central part of the Arctic Archipelago, Northwest Territories (Operation Franklin); Geological Survey of Canada, Memoir 320, p. 529-533.

Nassichuk, W.W. and Christie, R.L.
1969: Upper Paleozoic and Mesozoic stratigraphy in the Yelverton Pass region, Ellesmere Island, District of Franklin; Geological Survey of Canada, Paper 68-31.

Souther, J.G.
1963: Geological traverse across Axel Heiberg Island from Buchanan Lake to Strand Fiord; in Y.O. Fortier et al., Geology of the north-central part of the Arctic Archipelago, Northwest Territories (Operation Franklin); Geological Survey of Canada, Memoir 320, p. 426-448.

Tozer, E.T.
1956: Geological reconnaissance, Prince Patrick, Eglinton and western Melville Islands, Arctic Archipelago, Northwest Territories; Geological Survey of Canada, Paper 55-2.

1961: Triassic stratigraphy and faunas, Queen Elizabeth Islands, Arctic Archipelago; Geological Survey of Canada, Memoir 316.

1963a: Mesozoic and Tertiary stratigraphy, western Ellesmere Island and Axel Heiberg Island, District of Franklin; Geological Survey of Canada, Paper 63-30.

1963b: Northwestern Bjorne Peninsula; in Y.O. Fortier et al., Geology of the north-central part of the Arctic Archipelago, Northwest Territories (Operation Franklin); Geological Survey of Canada, Memoir 320, p. 363-370.

1963c: South side of Strand Fiord; in Y.O. Fortier et al., Geology of the north-central part of the Arctic Archipelago, Northwest Territories (Operation Franklin); Geological Survey of Canada, Memoir 320, p. 448-456.

1970: Geology of the Arctic Archipelago, Mesozoic; in Geology and Economic Minerals of Canada, ed. R.J.W. Douglas; Geological Survey of Canada, Economic Geology Report 1, p. 574-583.

Tozer, E.T. and Thorsteinsson, R.
1964: Western Queen Elizabeth Islands, Arctic Archipelago; Geological Survey of Canada, Memoir 332.

Appendix

Selected well tops, Heiberg Formation, eastern and central Sverdrup Basin
(location of wells shown on Figure 24.1)

Panarctic Romulus C-42	
Remus Member	1436 m (4711 ft)
Fosheim Member	1535 m (5034 ft)
Romulus Member	2055.5 m (6742 ft)
Barrow Formation	2400 m (7870 ft)
Gulf Neil 0-15	
Fosheim Member	spud
Romulus Member	357 m (1170 ft)
Barrow Formation	609 m (1997 ft)
Panarctic May Point H-02	
Remus Member	2515.5 m (8251 ft)
Fosheim Member	2582 m (8470 ft)
BP Graham C-52	
Remus Member	1360 m (4460 ft)
Fosheim Member	1415 m (4640 ft)
Romulus Member	1472.5 m (4830 ft)
Barrow Formation	1519.5 m (4984 ft)
Imperial Sherwood P-37	
Remus Member	631 m (2070 ft)
Fosheim Member	665 m (2180 ft)
Romulus Member	1116.5 m (3662 ft)
Barrow Formation	2476 m (8122 ft)
Horn River Mid Fiord J-53	
Remus Member	1452 m (4762 ft)
Fosheim Member	1491.5 m (4892 ft)
Romulus Member	1770 m (5806 ft)
Panarctic Amund Central Dome H-40	
Remus Member	313 m (1026 ft)
Fosheim Member	362 m (1188 ft)
Romulus Member	1365 m (4478 ft)
Barrow Formation	1811.5 m (5942 ft)
Sun Linckens Island P-46	
Remus Member	980 m (3215 ft)
Fosheim Member	1010.5 m (3314 ft)
Romulus Member	1460.5 m (4790 ft)
Barrow Formation	1570 m (5150 ft)
Panarctic Hoodoo Dome H-37	
Remus Member	2301.5 m (7549 ft)
Fosheim Member	2353.5 m (7720 ft)
Romulus Member	2807.5 m (9208 ft)
Barrow Formation	3244 m (10640 ft)