SW NE

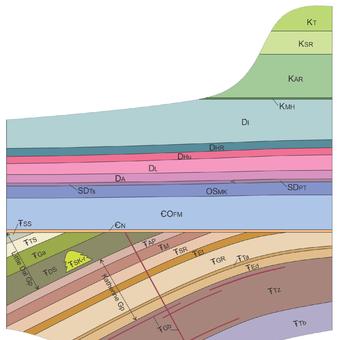


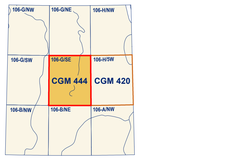
Figure 1. Schematic stratigraphic relationship diagram for the southeast Ramparts River map area (NTS 106-G/SE). Unit abbreviations match those used in the map legend.

Abstract

The southeast Ramparts River map area (NTS 106-G/SE) covers part of the northern Mackenzie Mountains and Peel Plateau, Northwest Territories. Bedrock exposures in the area include carbonate and siliciclastic strata ranging from Neoproterozoic (Tonian) to Cretaceous age. These strata were deformed in Cretaceous to Eocene time by folding and contractional faulting associated with Cordilleran deformation. Major structures include the Deadend fault, Tawu anticline, Story anticline, and Shattered Range anticline. A set of minor pre-Cordilleran extensional faults is preserved within Neoproterozoic strata of the Mackenzie Mountains Supergroup, and are locally associated with diabase or gabbro dykes assigned to the Gunbarrel magmatic event (~780 Ma). Truncation of Neoproterozoic units beneath the sub-Cambrian unconformity indicates tilting or folding of strata before Cambrian time. A second major unconformity between Devonian and Cretaceous strata is marked by low-angle truncation of Paleozoic strata beneath Cretaceous units.

Résumé

La région cartographique de Ramparts River Sud-Est (SNRC 106-G/SE) couvre une partie du nord des monts Mackenzie et du plateau Peel, dans les Territoires du Nord-Ouest. Les affleurements du substratum rocheux dans la région comprennent des strates carbonatées et des strates siliciclastiques s'échelonnant en âge du Néoprotérozoïque (Tonien) au Crétacé. Ces strates ont été déformées du Crétacé à l'Eocène par plissement et par le jeu de failles de compression associés à la déformation de la Cordillère. Les structures d'importance comprennent la faille de Deadend, l'anticlinal de Tawu, l'anticlinal de Story et l'anticlinal de Shattered Range. Un ensemble mineur de failles d'extension antérieur à la déformation de la Cordillère a été conservé dans les strates néoprotérozoïques du Supergroupe de Mackenzie Mountains et est localement associé à des dykes de diabase ou de gabbro attribués à l'événement magmatique de Gunbarrel (~ 780 Ma). La troncature des unités néoprotérozoïques sous la discordance subcambrienne indique un basculement ou un plissement des strates avant le Cambrien. Une deuxième discordance majeure entre les strates du Dévonien et du Crétacé est signalée par la troncature suivant un angle peu prononcé des strates paléozoïques sous les unités du Crétacé.



National Topographic System reference and index to adjoining published Geological Survey of Canada maps

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CANADIAN GEOSCIENCE MAP 444

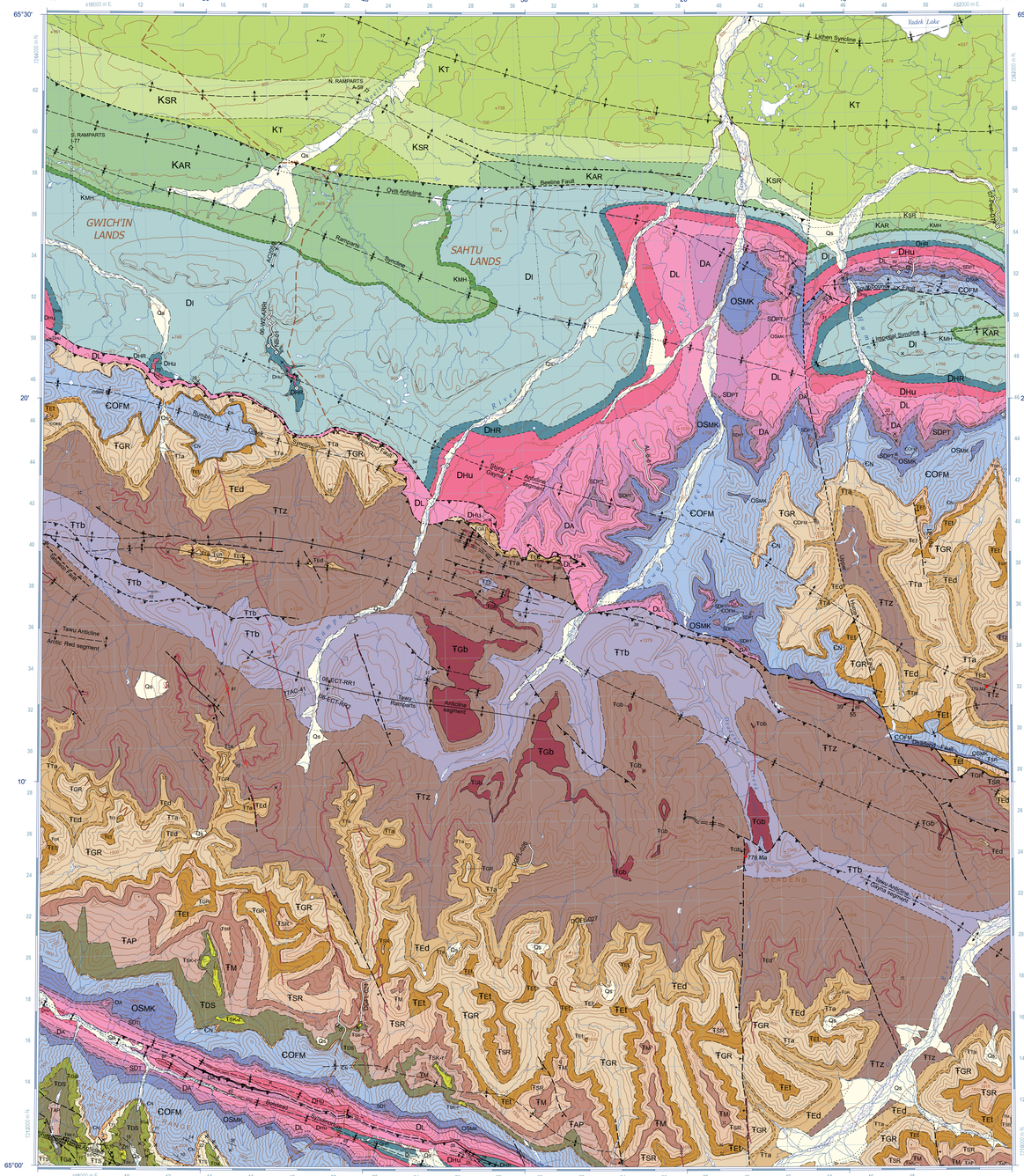
BEDROCK GEOLOGY

RAMPARTS RIVER SOUTHEAST

Northwest Territories

NTS 106-G southeast

1:100 000



QUATERNARY

Qs — **Quaternary sediment:** sand, gravel, and mud; unconsolidated.

CRETACEOUS

KT — **Trevor Formation:** sandstone: chert- and quartz-rich, medium grey, light-brown-weathering, very fine- to medium-grained, thin- to thick-bedded, hummocky cross-stratified, ripple crosslaminated, some parallel lamination, mudstone laminae, rip-up clasts; interbedded with mudstone: clay-rich but can be silty, thin- to medium-bedded, rare bivalves or wood fragments, some horizontal burrows; upward-coarsening packages from mudstone to sandstone dominate.

KSR — **Slater River Formation:** shale and mudstone: dark brown to dark grey, black, or rusty brown, soft, crumbly, and fissile, sideritic concretions common, rare fish scales; minor bentonite and ash tuff; white to yellow, pale green, or orange-brown; and minor sandstone: lithic wacke, brown, grey, or rusty, very thin- to thin-bedded, crosslaminated, and bioturbated.

KAR — **Arctic Red Formation:** shale and mudstone: locally gypsiferous, dark grey, weathers grey and rusty, variably fissile and soft, sideritic concretions fairly common; minor sandstone: silty, very fine- to fine-grained, grey or brown, very thin- to thin-bedded, locally laminated or crosslaminated, more common near top of unit.

KMH — **Martin House Formation:** sandstone: quartz arenite, variably glauconitic, locally conglomeratic, beige to light grey, thin- to thick-bedded, crossbedded, tabular, trace fossils common; interbedded with shale or mudstone: medium to dark grey, weathers grey or rusty brown, proportion of shale and mudstone increases upsection.

DEVONIAN

DI — **Imperial Formation:** shale: locally silty, dark grey to greenish-grey, fissile; interbedded with siltstone: locally micaceous or calcareous, greenish-grey to purplish-brown, laminated, bioturbated; and sandstone: lithic wacke to quartz arenite, micaceous, locally calcareous or glauconitic, grey to greenish-grey or brown, very thin- to medium-bedded, laminated and crosslaminated, abundant and diverse trace fossils.

DHR — **Horn River Group (Hare Indian and Canol formations):** shale: carbonaceous or petroliferous, calcareous near base, siliceous in upper part, locally silty, dark grey or black, weathers grey, black, brown, or rusty, locally fossiliferous; minor limestone: dark grey with tentaculitids, interbedded with shale at base of unit.

DHu — **Hume Formation:** limestone: wackestone to grainstone, floatstone, medium to dark grey or brownish-grey, typically weathers light grey, thin- to very thick-bedded, parallel to irregular or nodular bedded; fossiliferous with abundant and diverse assemblage; unit is thicker bedded and cliff-forming in upper part.

DL — **Landry Formation:** limestone: lime mudstone to crystalline limestone, locally dolomitic, grey to dark grey-brown-grey, weathers light grey, thin- to thick-bedded, parallel-bedded, parallel-laminated, pelletal, no visible body fossils; well defined bedding gives a ribbed appearance.

DA — **Arnica Formation:** dolostone: dolomudstone to crystalline dolostone, medium grey, weathers in light and dark brown-grey, thin- to thick-bedded, parallel-laminated, crinoids, corals, and stromatoporoid fossils may be present.

SILURIAN TO DEVONIAN

Delorme Group (Twetso, Peel, and Tatsiета formations)

SDPT — **Peel and Tatsiета formations:** Peel Formation: dolostone: silty, sandy, or argillaceous, locally calcareous, siliceous or cherty, pale yellowish-brown and grey, orange-weathering, finely crystalline, very thin- to thin-bedded; planar and algal lamination, common burrow mottling, intraclast-bearing, mud cracks, rare fossils including gastropods and stromatoporoids, semi-recessive; overlain by Tatsiета Formation: limestone: locally dolomitic, light to dark grey, light-grey- to beige-weathering, some lime mudstone or argillaceous limestone beds, thin- to thick-bedded, laminated, locally stromatolitic, peloidal or conglomeratic beds also present, blocky and resistant; and minor shale: green.

SDT — **Twetso Formation:** dolostone: dolomudstone to dolograinstone, locally calcareous or quartzose (sandy), cream to light grey, weathers light grey to yellow or light orange, thin- to thick-bedded, parallel-bedded, laminated, stromatolitic; interbedded locally with sandstone: dolomitic, silty, light brown, thin- to medium-bedded, laminated, and crossbedded.

ORDOVICIAN TO SILURIAN

OSMK — **Mount Kindle Formation:** dolostone: dolowackestone to dolopackstone and dolofloatstone, siliceous and cherty, light to dark grey or brownish-grey fresh and weathered surfaces, thin- to very thick-bedded; vuggy, recrystallized, bioturbated, and fossiliferous (mainly silicified corals, crinoids, orthocone cephalopods, and stromatoporoids).

CAMBRIAN TO ORDOVICIAN

COFM — **Franklin Mountain Formation:** dolostone: dolomudstone to dolograinstone, locally calcareous or cherty, grey, cream, or light brown, weathers light grey or yellowish-grey, very thin- to thick-bedded, typically recrystallized, locally vuggy, stromatolitic, bioturbated, oolitic, crossbedded, or intraclast-bearing, rare crinoids or brachiopods; minor shale or siltstone: greenish-grey or grey, fissile, and laminated; calcareous, darker weathering and less resistant in middle part of unit.

CAMBRIAN

CN — **Nainlin Formation:** shale: light green, brick red, or grey, fissile, mud cracks; interbedded with sandstone: quartz wacke to quartz arenite, locally dolomitic, rarely conglomeratic, cream to pink, red, or brown, variable weathering colour, very thin- to medium-bedded, parallel-bedded or crossbedded, salt casts, ripple marks, sporadic horizontal or vertical burrows; minor conglomerate: found at base or within unit.

TONIAN (NEOPROTEROZOIC)

Tgb / Tgk — **Gunbarrel mafic intrusions:** gabbro and diabase: fine- to medium-grained, dark grey to dark green, weathers brown to grey or black, homogeneous texture, occurs as both dykes and sills in strata of the Mackenzie Mountains Supergroup.

Mackenzie Mountains Supergroup (Tabasco Formation, Tsezotene Formation, Katherine Group, and Little Dal Group)

Little Dal Group (Dodo Creek, Stone Knife, Gayna, Ten Stone, and Snail Spring formations)

TSS — **Snail Spring Formation:** siltstone and shale: locally sandy, weathers brown to orange, desiccation cracks, minor ripple crosslamination; interbedded with quartz sandstone: weathers pale grey to rusty brown, ripple crosslaminated, crossbedded, rip-up clasts, and desiccation cracks; and dolostone: locally calcareous or sandy, weathers grey to orange, molar-tooth structure, intraclast-bearing, stromatolitic, and oolitic, more abundant at base and top of unit.

TTS — **Ten Stone Formation:** evaporite: gypsum, locally sandy or argillaceous, white, grey, pink, or red fresh and weathered surfaces, parallel- and ripple crosslamination common, nodules and enterolithic folds also present; very minor dolostone: locally calcareous, weathers grey to pale brown, very thin- to medium-bedded.

TGa — **Gayna Formation:** dolograinstone: quartz-silty, locally cherty, weathers beige to orange, thin- to medium-bedded, oolitic, intraclast-bearing, crossbedded, crosslaminated, locally stromatolitic or contains molar-tooth structure; interbedded with dolomudstone: silty, weathers yellow to beige, thin-bedded, contains desiccation cracks.

TSk-r — **Stone Knife Formation, reef:** limestone and lesser dolostone: grey to orange-brown weathering, massive reef mounds, stromatolitic; reef mounds are up to 300 m thick, spanning some or nearly all of the thickness of the Stone Knife Formation.

TDS — **Dodo Creek and Stone Knife formations:** Dodo Creek Formation: shale and siltstone: dark grey, lesser red or green, synaeresis cracks common; interbedded with sandstone: quartz arenite, slightly micaceous, cream, grey, brown, or red, thin- to medium-bedded, parallel-bedded and crosslaminated; and dolomudstone: locally calcareous, dark grey, weathers grey or orange, thin- to medium-bedded, locally intraclast-bearing; overlain by Stone Knife Formation: limestone: lime mudstone to dolomudstone, medium to dark grey, weathers lighter shades of grey, beige, or orange, parallel-laminated, intraclast-bearing, molar-tooth structure, and locally stromatolitic; interbedded with shale: red or dark grey to black, limestone nodules common; orange oncoid marker bed at base; limestone-dominant and shale-dominant intervals alternate through the formation.

Katherine Group (Eduni, Tawu, Grafe River, Etagochite, Shattered Range, McClure, and Abraham Plains formations)

TAP — **Abraham Plains Formation:** sandstone: quartz arenite, hematitic, cream to brown, light grey, orange, pink, or maroon, thin- to very thick-bedded, well cemented, parallel-bedded and crossbedded, crosslaminated, ripple marks, rip-up clasts; interbedded with minor conglomerate: granule to pebble, white to orange-brown, pink, red, or purple, massive to crossbedded; and siltstone: locally shaly or micaceous, maroon or green, very thin-bedded, and crosslaminated.

TM — **McClure Formation:** shale: locally dolomitic or silty, grey, rusty brown, green, and maroon, fissile, desiccation cracks; interbedded with dolostone: commonly cherty, silty, or sandy, medium grey, weathers to orange or orange-brown, very thin- to thick-bedded, typically stromatolitic, pisolitic, oolitic, intraclast-bearing, and parallel- or crosslaminated; and sandstone: lithic wacke to quartz arenite, can be micaceous, hematitic, or dolomitic, cream to brown, grey, red, or purple, very thin- to medium-bedded, crosslaminated, ripple marks, rip-up clasts, sole marks, and desiccation

TSR — **Shattered Range Formation:** sandstone: quartz arenite, cream to light pink, weathers grey to light reddish-brown, medium- to thick-bedded; very fine- to fine-grained, planar or crossbedded, wavy or ripple crosslaminated, parallel laminated, mudstone rip-up clasts; rare interbeds of black or red mudstone.

TEt — **Etagochile Formation:** shale: purple, red, dark grey, and greenish-grey, minor silt; interbedded with lesser sandstone: locally glauconitic, weathers cream to light brown, pink, or reddish, thin- to medium-bedded, very fine- to fine-grained, crossbedded, ripple crosslaminated, minor mudstone rip-up clasts; and minor dolostone: weathers orange, thin-bedded, laminated, intraclast-bearing, mudcracks; red to purple shale is prominent; sandstone locally forms medial unit up to 50 m thick.

TGR — **Grafe River Formation:** sandstone: quartz arenite, white to cream or pink, weathers light brown to light orange-pink, medium- to thick-bedded, fine- to very fine-grained, planar or crossbedded, wavy or ripple crosslaminated, parallel laminated, mudstone rip-up clasts; rare interbeds of mudstone or siltstone: black or red.

TTa — **Tawu Formation:** shale and mudstone: dark grey to greenish-grey or red; interbedded with lesser sandstone: weathers light brown, thin- to medium-bedded, and/or dolostone: light grey, weathers orange, thin- to medium-bedded, laminated.

Ted — **Eduni Formation:** sandstone: quartz arenite, white to pink or purple, weathers light brown to pink or purple, thin- to thick-bedded, fine- to very fine-grained, planar or crossbedded, wavy or ripple crosslaminated, parallel laminated; rare mudstone rip-up clasts; rare interbeds of mudstone or siltstone: black, dark grey, or red.

TTZ — **Tseozotene Formation:** shale: micaceous, silty in places, grey, maroon, or green, fissile, minor desiccation cracks; interbedded with sandstone: lithic wacke to quartz arenite, micaceous, locally conglomeratic, varicoloured, typically weathers brown or orange-brown, thin- to thick-bedded, parallel-bedded, crossbedded, and crosslaminated, rip-up clasts, ripple marks; minor dolostone: dolomudstone to dolograinstone, calcareous, grey to greenish-grey, weathers beige to orange-brown, thin- to thick-bedded, laminated.

TTb — **Tabasco Formation:** dolostone: cherty in upper part, light to dark grey, weathers grey to yellowish-grey or light orange-brown, thin- to thick-bedded, stromatolites (cuspate, columnal, and domal), intraclast-bearing, oolitic, minor quartz sand grains, fenestral fabric, tepee structures; interbedded with minor sandstone: dolomitic, crossbedded, ripple crosslaminated, tepee structures; dolomudstone: laminated; and shale: dark grey.

Geological contact:
- *Defined*
- *Approximate*
- *Inferred*
- *Concealed*

Distinctive lithology, Imperial Formation, resistant sandstone

Thrust fault, symbol on hanging-wall side:
- *Defined*
- *Approximate*
- *Inferred*
- *Concealed*

Thrust fault, overturned, symbol on hanging-wall side:
- *Defined*

Backthrust, symbol on hanging-wall side:
- *Approximate*
- *Inferred*
- *Concealed*

Normal fault, symbol on hanging-wall side:
- *Defined*
- *Approximate*
- *Inferred*
- *Concealed*

Dextral strike-slip fault:
- *Approximate*

Fault, hanging wall undefined (steep dip):
- *Defined*
- *Approximate*
- *Inferred*
- *Concealed*

Anticline, upright:
- *Defined*
- *Approximate*
- *Inferred*
- *Concealed*

Anticline, overturned:
- *Defined*
- *Approximate*

Syncline, upright:
- *Defined*
- *Approximate*
- *Concealed*

Syncline, overturned:
- *Defined*

Anticline, homeoclinic, shorter arrow on steeper limb:
- *Defined*
- *Approximate*
- *Concealed*

Syncline, homeoclinic, shorter arrow on steeper limb:
- *Defined*
- *Approximate*
- *Concealed*

× Visited locality, no measurements

Locality observed from aircraft

Bedding strike and dip, inclined, upright:
- *Younging direction known*
- *Younging direction known, estimated measurement*
- *No evidence for younging direction or younging evidence unknown*

Bedding strike and dip, inclined, overturned:
- *No evidence for younging direction, estimated measurement*
- *Evidence for younging direction unknown (historical data)*

Dyke or sill margin

Fault plane, measured at outcrop, inclined

Fault striae, fault grooves, or slickensides

77AC-41 — Measured stratigraphic section with identifier

Fossil analysis locality

Radiometric age

Petroleum wells:
- *Dry and abandoned*

Seismic survey line

X — Mineral occurrence with commodity

Descriptive Notes

Initial bedrock mapping and stratigraphic studies by the Geological Survey of Canada (GSC) in the Ramparts River map area (NTS 106-G) were conducted in 1968 to 1970 as part of Operation Norman. This operation and subsequent stratigraphic work up to 1977 led to the release of a GSC Memoir and 1:250 000 scale map of the area (Aitken et al., 1982). In the present compilation, observations collected from 2016 to 2018 as part of the Geo-mapping for Energy and Minerals (GEM) Program were combined with observations from Operation Norman, along with observations from the Peel Project of the Northwest Territories Geological Survey collected in 2006 to 2007 (Pyle and Gal, 2007; Pyle and Jones, 2009; Pierce and Jones, 2009). Petroleum exploration wells and reflection-seismic data drilled or collected since 1970 also helped constrain the map interpretation. Bedrock units are interpreted beneath local Quaternary cover to provide a seamless bedrock interpretation.

Formal stratigraphic nomenclature used for the Operation Norman maps in the area (Aitken et al., 1982) is largely still in use, although more recent stratigraphic work has added new formal terms for previously informal units found in southeast Ramparts River map area. An outline of updated stratigraphic relationships in the northern Mackenzie Mountains was provided by Fallas et al. (2016), and schematic relationships within southeast Ramparts River map area are illustrated in Figure 1. Within the Mackenzie Mountains Supergroup, the Katherine Group is subdivided into seven formations (Long and Turner, 2014), replacing the "lower" and "upper" subdivisions of Aitken et al. (1982). Although typically not well exposed, these seven formations have been mapped within this area as outlined by Fallas (2019). Two geochronological analyses on gabbro intrusions within Mackenzie Mountains Supergroup strata of southeast Ramparts River map area record dates of 770 ± 23 Ma and 778 ± 10 Ma (S. Kamo and K. Fallas, unpublished data), confirming these are part of the Gunbarrel mafic magmatic event of Harlan et al. (2003).

Within the Cambrian succession, the Nainlin Formation of MacNaughton and Fallas (2014) is introduced in place of the "basal red beds" of the Franklin Mountain Formation, and is considered to be a lateral equivalent of the Saline River Formation found to the east. Nainlin Formation is a clastic-dominated unit beneath dolostone of the Franklin Mountain Formation, and lacks the evaporite deposits of the Saline River Formation. It lies unconformably on Neoproterozoic (Tonian) strata of the Katherine and Little Dal groups. Aside from the exclusion of the basal red beds, Franklin Mountain Formation follows the usage of Aitken et al. (1982), as does Mount Kindle Formation. The unnamed SD unit of Aitken et al. (1982) has more recently been identified as Twetso Formation within the Mackenzie Mountains (Morrow, 1991) and Peel and Tatsiета formations along the mountain front (Pyle and Gal, 2007). Devonian units in the southeast Ramparts River map area follow the usage of Aitken et al. (1982).

Unconformably overlying the Devonian succession, the Cretaceous succession was treated as an undivided package of Arctic Red River and Trevor formations by Aitken et al. (1982), largely following the work of Yorath and Cook (1981). Subsequent work by Dixon (1999) and Thomson et al. (2011) provided a basis for subdividing the Cretaceous into four units, the Lower Cretaceous Martin House and Arctic Red formations, and Upper Cretaceous Slater River and Trevor formations. Subsurface data from petroleum exploration wells and reflection-seismic surveys helped constrain the distribution of these Cretaceous units.

The names of major structures identified by Aitken et al. (1982) for the southeast Ramparts River area have been retained as revisions to the structural interpretation of these features is minor. Subsurface data have aided with the delineation of previously known and newly identified structures along the mountain front and within Cretaceous strata of Peel Plateau. In particular the Beeline Fault, north of the Ovis anticline, was added on the basis of relationships identified in seismic-reflection data. The Upper Hume Fault is introduced as a transverse fault dissecting the west end of the Story anticline and links two previously mapped fault segments of Aitken et al. (1982). The linkage is recognizable in high-resolution satellite imagery used during compilation. Some adjustments have been made to the distribution of normal faults in the core of Tawu anticline based on offsets of Katherine Group strata and sills, and the association with Gunbarrel suite dykes.

NOTE: The name Tawu anticline was introduced by Aitken et al. (1982) to indicate the broad culmination cored by Tabasco and Tsezotene formations without differentiating individual anticlinal hinges. As refined mapping has revealed that this structure comprises multiple en échelon anticlinal hinges along its full strike length, these are differentiated on this map as segments, each of which is named for a nearby geographic feature.

Acknowledgments

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Geological Survey of Canada
Canadian Geoscience Maps

Authors: K.M. Fallas and R.B. MacNaughton

Geological compilation by K.M. Fallas and R.B. MacNaughton, 2016 to 2019

Geological data conforms to Bedrock Data Model v.4.0

Geological field observations by K.M. Fallas, R.B. MacNaughton, and G.S. Stockmal, Geological Survey of Canada, 2016; Y. Lemieux, Geological Survey of Canada, 2006 and 2007; T. Hadlari, Northwest Territories Geological Survey, 2006 and 2007; Rio Tinto geologists, 1975; J.D. Aitken, H.R. Balkwill, D.G. Cook, C.W. Thayer, and C.J. Yorath, Geological Survey of Canada, 1968 to 1970

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Reflection-seismic data interpreted by B.C. MacLean and K.M. Fallas, 2015 to 2019

Geomatics by K.M. Fallas and M. Le

Cartography by M. Le and K. Rentmeister

Scientific editing by L. Ewert

CANADIAN GEOSCIENCE MAP 444

BEDROCK GEOLOGY

RAMPARTS RIVER SOUTHEAST

Northwest Territories

NTS 106-G southeast

1:100 000

2 0 2 4 6 8 km

Initiative of the Geological Survey of Canada, conducted under the auspices of the Mackenzie Project as part of Natural Resources Canada's Geo-mapping for Energy and Minerals (GEM) program

Logistical support provided by the Polar Continental Shelf Program (PCSP) as part of its mandate to promote scientific research in the Canadian north, PCSP 055-16

Map projection Universal Transverse Mercator, zone 9
North American Datum 1983

Base map at the scale of 1:50 000 from Natural Resources Canada, with modifications
Elevations in metres above mean sea level

Mean magnetic declination 2022, 20°09'E, decreasing 17.2' annually
Readings vary from 20°05'E in the SW corner to 20°12'E in the NE corner of the map.

This map is not to be used for navigational purposes.

Title photograph: View looking southeast at a mafic dyke of the Gunbarrel intrusions (dark brown) cutting through grey dolostone of the Neoproterozoic Tabasco Formation. Photograph by K.M. Fallas. NRCan photo 2019-678

The Geological Survey of Canada welcomes corrections or additional information from users (gscpublications-cgcpublications@nrcan-rncan.gc.ca).

Data may include additional observations not portrayed on this map. See map info document accompanying the downloaded data for more information about this publication.

This publication is available for free download through GEOSCAN (https://geoscan.nrcan.gc.ca/).

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