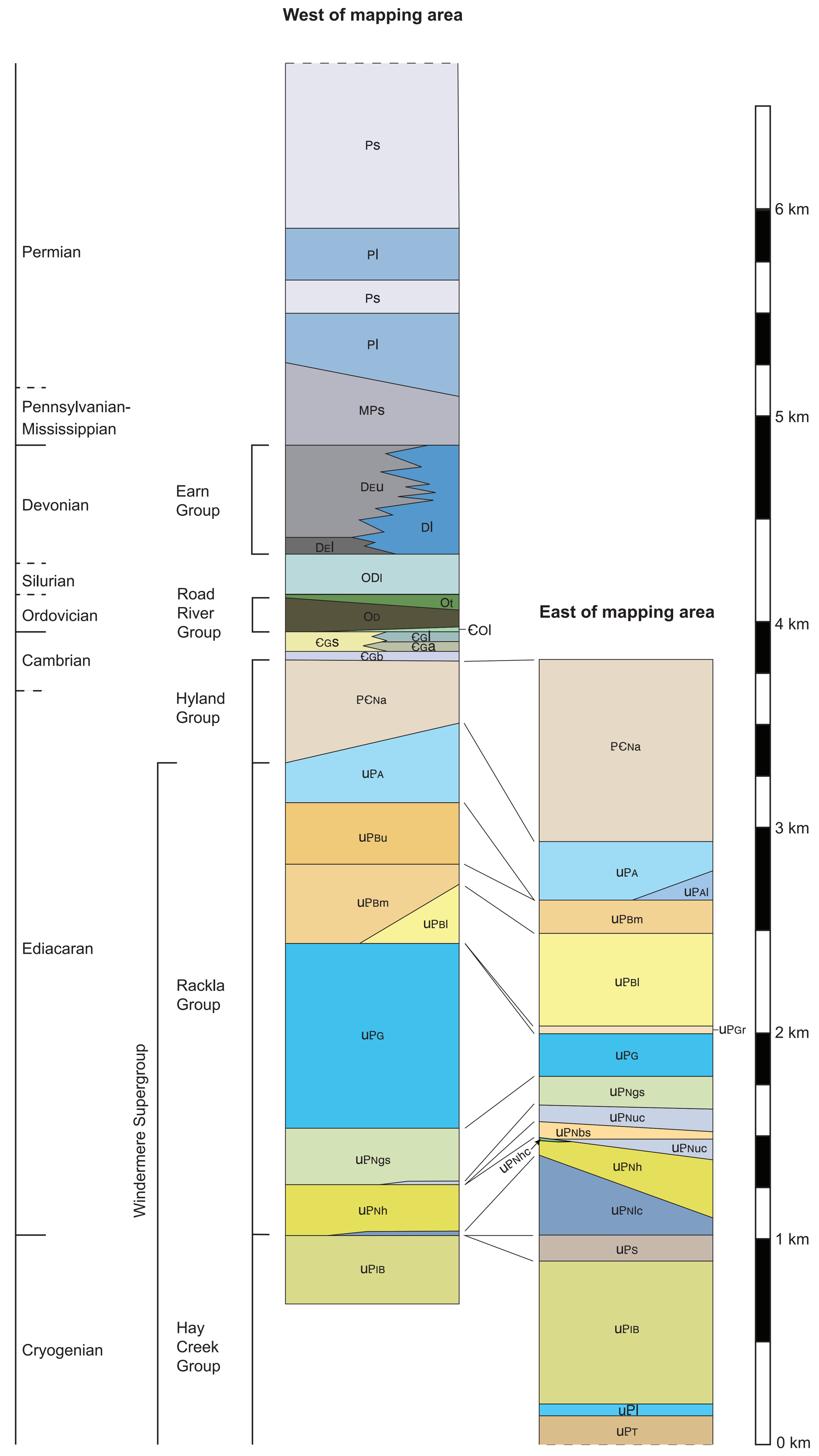
Map #	Sample	Unit	Macrofossils	Identified by	Conodont species	Identified by	Age	Reference
1	0481`VI	DEl	Crinoid, Brachiopod, Coral	V. Ispolatov	Icriodus, Polygnathus, Pandorinellina, Panderodus, Belodella	P. A. Zippi	Devonian, Emsian	
2	0230`CH	Pl	Crinoid	C. Herron	Idiognathodus sinuosus, Idiognathoides sulcatus sulcatus	P. A. Zippi	Pennsylvanian, Morrowan	
3	0294KM	Dl	-	-	Polygnathus sp.	P. A. Zippi	Devonian, Emsian	
4	0970`VI	Pl	Crinoid	V. Ispolatov	Dec. noduliferous, Adeto. sp., Idiognathodus sinuosus, Strepto. expansus	P. A. Zippi	Pennsylvanian, Morrowan	
5	0363KM	Dl	2-hole Crinoid, Trilobite	K. Marlowe	-	-	Devonian, Emsian-Eifelian	
6	0248KM	OD	Crinoid	K. Marlowe	Ansella jemtlandica, Histiodella kristinae, Paltodus sp, Paroistodus sp, Periodon aculeatus, Protopanderodus robustus, Spinodus spinatus, Tripodus combsi	P. A. Zippi	Ordovician, Whiterockian	
7	0187`JM	OD	Graptolite (Dicranograptus?)	J. Milton	-	-	Ordovician, Arenigian-Caradocian	Churkin and Carter, 1972
8	12-SI-036	OD	Graptolite	R. Blodgett	-	-	Ordovician	
9	12-SI-037-1	OD	Coral (Favosites)	R. Blodgett	-	-	Late Ordovician-Middle Devonian	
10	0255KM	OD	Corals (Halysites and Favistella), Brachiopod	K. Marlowe	-	-	Ordovician	
11	12-TOA-029	Dl	2-hole Crinoid	R. Blodgett	-	-	Devonian, Emsian-Eifelian	
12	12-MC-157-1	Pl	Crinoid	R. Blodgett	-	-	Mississippian	
13	0227`JM	Pl	Crinoid, Brachiopod	J. Milton	Neostreptognathodus pequopensis, Meogondolella	P. A. Zippi	Permian, Artinskian	
14	0494KM	ODl	2-hole Crinoid, Corals (Favosites), Bryozoan	K. Marlowe	Caud. culicellus, Po. costatus partitus, Po. costatus costatus, Po. bultyncki?	P. A. Zippi	Devonian, Emsian	
15	0363`JM	OD	Crinoid, Coral	J. Milton	Polygnathus dubius, Po brevis, Po samueli, Icriodus subterminus	P. A. Zippi	Devonian, Frasnian-Famennian*	
16	0454KM	ODl	Crinoid, Coral (Rugose)	K. Marlowe	Pe. glenisteri, Pand. exiguua phillipi/exiguua, Po. foveolatus, Po. dehiscens?, Po. gronbergi?, Crit. sp.	P. A. Zippi	Devonian, Emsian	
17	0426KM	ODl	Crinoid	K. Marlowe	Pand. exiguua phillipi, Crit. miae, Bel. resima, Bel. triangularis	P. A. Zippi	Devonian, Pragian-Emsian	
18	0509KM	ODl	Crinoid, Coral (Rugose and Halysites)	K. Marlowe	Pel. sp., Oz. excavata excavata?, Po. pireneae/dehiscens	P. A. Zippi	Devonian, Pragian-Emsian	
19	12-TOA-026-1, 12-TOA-026-2	ODl	Coral (Saffordophyllum, Heliolitid tabulate coral Stelliporella, Favositid coral), Brachiopod (Pentameroid brachiopod Tcherskidium)	R. Blodgett	Oulodus?	C. Henderson	Ordovician, Ashgillian (macrofossils), Early-middle Silurian (conodonts)	
20	0506KM	OD	Crinoid, Coral (Rugose), Brachiopod	K. Marlowe	Crit. miae?, Po. deshicens, Po. cf. dehiscens, Po. Pireneae, Pelekysgnathus sp.	P. A. Zippi	Devonian, Pragian-Emsian*	
21	0192KM	DEu	Crinoid	K. Marlowe	Palmatolepis, Polygnathus	P. A. Zippi	Devonian, Famennian	
22	17MC-49	ODl	Stromatoporoid, Coral (Rugose and Streptelasma)	Y. Zaika, R. Blodgett	-	-	Ordovician, Caradocian-Ashgillian	
23	0502KM	ODl	Star crinoid, Coral (Halysites and Rugosa)	K. Marlowe	Ozarkodina? boucoti?, Ozarkodina eleanorae?	P. A. Zippi	Silurian, Ludlovian-Lochkovian	
24	17MC-48	ODl	Brachiopod (Proconchidium sp., Eoconchidium sp.), Corals (Rugose and Tabulate)	Y. Zaika, R. Blodgett	-	-	Ordovician, Ashgillian	
25	12-TOA-033-1	ODl	-	-	Aspelundia? sp., Walliserodus? sp.	C. Henderson	Early Silurian	
26	0333KM	ODl	Coral (Favosites), Crinoid, Brachiopod	K. Marlowe	Ancryodelloides sp., Panderodus sp.	P. A. Zippi	Devonian, Lochkovian	
27	0196KM	ODl	Crinoid	K. Marlowe	Carminate Pa elements, Pb elements, ramiform fragments, Belodella	P. A. Zippi	Silurian, Wenlockian-Lochkovian	
28	0197KM	ODl	Crinoid, Brachiopod, Coral	K. Marlowe	Po. pireneae, Pando. exiguua phillipi, Crit. miae, Bel. sp.	P. A. Zippi	Devonian, Pragian-Emsian	
29	0681`JM	ODl	-	-	Caud. culicellus, Po. partitus, Po. costatus?, Po. bultyncki?, Po. parawebbi?	P. A. Zippi	Devonian, Emsian	
30	12-TOA-021-2	Pl	Crinoid, Bivalve, Brachiopod	R. Blodgett	-	-	Mississippian	
31	0604`JM	Ps	Crinoid	J. Milton	Idiognathoides sulcatus sulcatus?	P. A. Zippi	Pennsylvanian, Morrowan	
32	0119KM	ODl	2-hole Crinoid, Coral	K. Marlowe	-	-	Devonian, Emsian-Eifelian	
33	0466KM	ODl	2-hole Crinoid	K. Marlowe	-	-	Devonian, Emsian-Eifelian	
34	0094`NE	ODl	2-hole Crinoid	N. Eck	Po. serotinus, Po. bultyncki?, Po. patulus?, Po. partitus?	P. A. Zippi	Devonian, Emsian-Eifelian	
35	12-TOA-047-1	Pl	-	-	Lochriea commutatus, Gnathodus cf texanus, Idiognathoides minutus declinatus, I. sulcatus	C. Henderson	Mississippian-Pennsylvanian	
36	0291`JM	Pl	-	-	Neostreptognathodus pequopensis, Neostreptognathodus ruzhencevi, Meogondolella	P. A. Zippi	Permian, Artinskian	
37	0276`JM	Ps	Brachiopod, Bryozoan	J. Milton	Pseudopolygnathus multistriatus, Gnathodus cuneiformis, G. pseudosemiglaber	P. A. Zippi	Mississippian, Osagean	
38	12-MC-062-1	DEl	Brachiopods, Bivalve	R. Blodgett	Rhynchonellid, Smooth spirifiroid, and Terebratuloid? Brachiopods	R. Blodgett	Devonian, Fammenian-Mississippian	
39	0464KM	ODl	Corals (Rugose and Favosites), Stromatoporoids (Amphipora)	K. Marlowe	Pandorinellina sp.?	P. A. Zippi	Devonian, Emsian	
40	0216KM	OD	Graptolite, Radiolaria	K. Marlowe	-	-	Ordovician, Arenigian-Caradocian	Churkin and Carter, 1972
41	0483KM	ODl	Coral (Rugose), Crinoid, Brachiopod	K. Marlowe	Criteriognathus?	P. A. Zippi	Silurian, Ludlovian-Lochkovian	
42	0213KM	ODl	Trilobite, Brachiopod	K. Marlowe	Ozarkodina confluens, Wurmiella excavata, Oulodus siluricus, Panderodus	P. A. Zippi	Silurian, Ludlovian	
43	0479KM	OD	Graptolite (Didymograptus, Dicranograptus, Tetragraptus)	K. Marlowe	-	-	Ordovician, Arenigian-Caradocian	Churkin and Carter, 1972
44	0210KM	ODl	Crinoid	K. Marlowe	Phragmodus?, Plectodina?	P. A. Zippi	Ordovician, Katian	
45	0480KM	OD	Coral (Halysites and Rugose), Stromatoporoid (Amphipora), Brachiopod	K. Marlowe	-	-	Ordovician, Upper	
46	0208KM	OD	Graptolite (Dicranograptus, Didymograptus, Phyllograptus?)	K. Marlowe	-	-	Ordovician, Arenigian-Caradocian	Churkin and Carter, 1972
47	0204KM	ODl	Crinoid, Brachiopod	K. Marlowe	Pe. serratus, Ozarkodina? optima, Po. dehiscens (lenzi)	P. A. Zippi	Devonian, Emsian	
48	12-MC-053	Dl	2-hole Crinoid	R. Blodgett	-	-	Devonian, Emsian-Eifelian	
49	12-TOA-034	OD	Graptolite (Tetragraptus)	R. Blodgett	-	-	Early Ordovician	
50	12-MC-041-1	ODl	Coral, Brachiopod (Pentamerid or Atrypid), Bivalve	R. Blodgett	-	-	Silurian, Wenlock-Ludlow	
51	12-MC-032	ODl	Coral (Favosites)	R. Blodgett	-	-	Silurian	

Note that resedimented older fossils are common fragmentary components in younger rocks.

* These interpreted paleostratigraphic ranges are much younger than the mapped unit suggesting that the outcrops they were sampled from were not *in situ*.



Contacts, faults and folds

Stratigraphic contact (observed, approximate, inferred)

Fault unknown movement (observed, approximate, inferred)

Thrust movement (observed, approximate, inferred)

Strike-slip thrust, dextral offset shown (observed, approximate, inferred)

Fold (synform, antiform)

Measurements

37 Strike and dip of inclined bedding

Strike of vertical bedding

37 Strike and dip of cleavage

Strike of vertical cleavage

37 Plunge and trend of bedding-cleavage intersection lineation

37 Strike and dip of minor fold axial plane

Strike vertical minor fold axial plane

37 Plunge and trend of minor fold axis

Measurements made by Barrick are shown in italics and those by YGS are underlined or indicated with an asterix.

Other symbols

Location of fossil sample. Number references to the table above

Location and field of view (if applicable) of photograph displayed above. Numbers reference to photograph number above

Location of data collection station (measurement or exposure). Black dots from this study. Green dots collected by geologists from Barrick Gold Corporation. Red dots collected by Colpron *et al.*, (2013).

Exposure (1:10 000 inset map only).

Permian

Ps — **Permian shale:** Shale and siltstone with interbeds of crinoidal wackestone and packstone. Limestone is commonly silicified.

Pl — **Permian limestone:** Resistant, light grey, thickly bedded limestone comprising dominantly crinoidal packstone and rudstone. Karst features and silicified beds are common.

Mississippian - Permian

MPs — **Mississippian-Permian shales:** Blue-grey to black shale with abundant interbeds of lime mudstone, crinoidal packstone and rudstone, chert packstone, and chert-clast conglomerate.

Devonian

EARN GROUP

DEu — **UPPER EARN GROUP:** Blue-grey shale with interlayered chert-arenite and rare chert pebble-conglomerate. Laterally transitions into chert-arenite and chert pebble-conglomerate dominated facies.

DEl — **LOWER EARN GROUP:** Black carbonaceous shale, lime mudstone and siltstone. Interbeds of fossiliferous wackestone and rudstone debris flows with two-hole crinoids in the lower half of the unit.

Dl — **Devonian limestone and dolostone:** Grey-tan, thickly bedded to massive lime mudstone, bioclastic wackestone and packstone containing rugose and colonial corals (favosites), brachiopods, bryozoans, trilobites and crinoids (including two-hole crinoids and star crinoids). The middle sequences of the unit comprise dolostone with burrows and fenestral texture. The lower sequences of the unit are characterized by dark grey to black calcareous mudstone and bioclastic wackestone that is variably dolomitized. This lower sequence is commonly slump folded and brecciated. Time-equivalent to Earn Group shales. Possibly equivalent to the Grizzly Bear Formation (Colpron *et al.*, 2013).

Ordovician - Devonian

ODl — **Ordovician-Devonian limestone:** Light grey, thickly bedded bioclastic rudstone comprising fragmental rugose and colonial corals (halysites and favosites), bryozoans, stromatoporoids, brachiopods and crinoids (including star crinoids). The upper sequence of the unit comprises graded, medium-bedded to laminated lime mudstone and wackestone. Two-holed crinoids present rarely in upper parts of the unit. Possibly equivalent to Bouvette Formation (e.g., Morrow, 1999).

Ordovician

Ot — **Calcareous tuff:** Orange-weathering, laminated brown calcareous siltstone and calcareous tuff. The upper sequence comprises bioclastic-lithic rudstone with fragmental fossils of halysites, amphipora, rugose corals and brachiopods. Possibly correlatable to volcaniclastic units mapped by Ambrose (2020) and around the Tiger deposit (Colpron *et al.*, 2013).

ROAD RIVER GROUP

OD — **DUO LAKES FORMATION:** Graptolite-bearing black chert and carbonaceous mudstone with lensoidal white chert interlayers. Graptolites include Isograptus, Tetragraptus, Didymograptus, Phyllograptus and Dicranograptus. Locally, the base of the unit comprises a thickly bedded to massive lithic rudstone comprising clasts of lime mudstone, carbonaceous mudstone, chert and fragments of crinoids and brachiopod sheels in a lime mudstone matrix.

Og — **Osiris gabbro:** Altered hornblende-rich gabbro intrusion. Green colour when fresh, black weathering. Dated at 465.6 ± 4.4 Ma (U-Pb apatite dating), 452 ± 31 Ma (Ar-Ar hornblende), and 409 ± 32 Ma (Ar-Ar hornblende; Tucker *et al.*, 2018).

Cambrian - Ordovician

ЄOl — **Orange-weathering limestone:** Orange-weathering, thinly bedded lime mudstone and packstone. Dark grey coloured when fresh. Possibly equivalent to upper carbonate of the Sekwi Formation (Martel *et al.*, 2011).

Cambrian

ЄGs — **GULL LAKE FORMATION, sandstone:** Brown-weathering quartz arenite interbedded with mudstone and siltstone. Bioturbation and thalassinoides trace fossils present locally.

ЄGa — **GULL LAKE FORMATION, argillite:** Grey to maroon-coloured shale and siltstone.

ЄGb — **GULL LAKE FORMATION, Basal Member:** Well-bedded, beige to grey coloured calcareous breccia. Poorly sorted subrounded to rounded clasts of grey-coloured limestone in a lime mudstone matrix. Clasts up to 1 m in size. Elsewhere present as grey-green and maroon-weathering calcareous siltstone to coarse-grained sandstone.

ЄGl — **GULL LAKE FORMATION, limestone:** Dark grey limestone interbedded with poorly sorted rudstone with clasts of laminated mudstone and limestone in a lime mudstone matrix. Beds are commonly dolomitized. Localized interbedded medium-grained sandstone beds.

Ediacaran - Cambrian

HYLAND GROUP

PЄNa — **NARCHILLA FORMATION, Arrowhead Member:** Grey and maroon thinly bedded mudstone with thicker interbeds of siltstone and fine-grained sandstone.

Ediacaran

RACKLA GROUP

uPA — **ALGAE FORMATION, dolostone:** Cream to light grey lime dolostone to dolomitized packstone with minor dolomitized rudstone interbeds. Zebra dolomite texture common.

uPAl — **ALGAE FORMATION, limestone:** Thinly bedded to laminated black limestone. Brown-weathering colour.

uPBu — **BLUEFLOWER FORMATION, Upper Member, fine-grained facies:** Mudstone, siltstone; thin-bedded silty limestone (Moynihan, 2016).

uPBm — **BLUEFLOWER FORMATION, Middle Member:** Thinly bedded to laminated brown siltstone with interbedded sandy limestone and rare dolostone or limestone. Brown weathering.

uPBl — **BLUEFLOWER FORMATION, Lower Member:** Thinly bedded sandy limestone with rudstone, mudstone, and sandstone interbeds. Distinctive terracotta brown colour.

uPGr — **GAMETRAIL FORMATION, rudstone:** Orange weathering, generally recessive, poorly sorted rudstone with up to several metre-sized angular clasts of dolostone and limestone supported in a lime mudstone matrix which is locally dolomitized.

uPG — **GAMETRAIL FORMATION:** Variably bedded and laminated limestone, flat-pebble clast-supported rudstone and angular matrix-supported granule to pebble rudstone, often partially dolomitized. Interbedded mudstone is common in the lower part of the unit. Distinctive buff-orange weathering colour. Dark grey when fresh with extensive stylolites. Abundant soft-sediment deformation. Rare maroon-coloured alteration.

uPNgs — **NADALEEN FORMATION, Green Siliclastic member:** Grey, thinly bedded mudstone and siltstone. Commonly altered to a maroon or green colour along bedding planes. Often pencil fractured and internally folded.

uPNuc — **NADALEEN FORMATION, Upper Carbonate Member:** Interbedded rudstone, limestone and black siliclastic shale. Rudstone comprises gravel to cobble-sized limestone clasts that fine upwards in a lime mudstone matrix. Bedding-parallel fibrous calcite veins are common.

uPNbs — **NADALEEN FORMATION, Black Shale Member:** Recessive grey to black shale with abundant small scale folds.

uPNh — **NADALEEN FORMATION, Heterolithic Member:** Chaotic, interbedded sandstone, mudstone, siltstone, limestone, dolostone and gravel conglomerates. Conglomerate is matrix supported, irregular and lensoidal. Sandstone often has calcareous cement. Abundant soft-sediment deformation. The top of the unit is locally marked by a bed of pale grey silica dolostone or limestone cut by abundant black quartz veins.

uPNhc — **NADALEEN FORMATION, Heterolithic Member, marker carbonate:** Distinctive pale grey dolostone cut by abundant black quartz veins which locally acts as a marker bed. In places, this bed is not dolomitized, where it has an buff-weathering limestone.

uPNlc — **NADALEEN FORMATION, Lower Carbonate Member:** Laterally-variable, thinly bedded silty limestone. Abundant calcite veins and stylolites. Dark-grey weathering and black when fresh. Abundant soft-sediment deformation. Minor dolomitized zones. Characteristic bedding-parallel fibrous calcite veins with cone-in-cone texture. In the northeast corner of the map, this unit is present as a diamictite, conglomerate; clasts of carbonate and quartzite, pebble to boulder; matrix locally sandy; grey limestone; calcareous sandstone and grit (Moyhnihan, 2016).

uPS — **SHEEPBED FORMATION:** Recessive, jet-black shale and siltstone with sandstone and siltstone and minor calcareous sandstone at the top of the unit.

Cryogenian

HAY CREEK GROUP

uPIB — **ICE BROOK FORMATION:** Interbedded mudstone and siltstone with minor sandstone. Large rafts of dolostone and conglomerate. Abundant soft-sediment deformation. Local polymict breccia with clasts of sandstone, mudstone and limestone supported in a blue-grey mud matrix.

uPl — **Cryogenian limestone:** Dominantly grey granular limestone with isolated coarse quartz clasts. Buff-weathering. Interbedded with trough cross-bedded siltstone and black mudstone.

uPT — **TWITYA FORMATION:** Brown-red quartz pebble conglomerate and sandstone. The underlying brown-grey mudstone sequence is rarely exposed in the map area, but is described by Aitken (1991).

Interpretation Notes

The authors interpret the geology of the map area to represent a steepened imbricate forethrust system in which the Dawson and Sunrise faults are the main forethrusts. The steep nature of all structures and bedding suggests additional forethrusts exist to the north of the mapping area upon which structures in the mapping area were back-rotated. Steeply-plunging folds in the east of the study area appear to pre-date forethrusting based on fault crosscutting relationships. Such geometric constraints are most evident on the Sunrise fault, which switches in apparent offset from sinistral to dextral moving west. Such a configuration is only possible with thrust dip-slip motion cutting pre-existing folds. Initially, the folds likely had SE-dipping axial planes and shallow fold axes (similar to the folds in the north-central part of the mapping area), before being rotated to their current steep-geometry by the forethrust sequence. Shallow-plunging folds with axial surfaces parallel to thrust faults may have also formed early and been rotated to their current geometry, or they may have formed during thrusting.

The Nadaleen and Anubis faults are likely two segments of the same reverse fault, offset by a well-constrained jog in the centre of the mapping area. Motion on the Nadaleen-Anubis fault post-dates the movement and steepening of the forethrusts. Steep reverse faults in the north of the mapping area either formed as synthetic faults to the Nadaleen-Anubis fault, or were early normal faults that were back-rotated so that they now dip steeply to the north and have an apparent reverse displacement.

A locally-developed pressure-solution fabric cuts map-scale steeply plunging folds as evidenced by cleavage measurements highly oblique to the overall axial surface in the core of the anticline at the Ibis deposit. However, this fabric is axial planar to steeply plunging folds with approximately vertical, E-striking axial surfaces. This relationship is prominent in minor folds in the hinges of steeply plunging, ~E-striking folds between the Conrad and Sunrise deposits. We suggest that this fabric formed in response to flattening, and that existing steeply plunging folds with NE-striking axial surfaces were transposed towards the fabric, so that their axial surfaces strike east and the fabric appears axial planar. This flattening event may have occurred coevally with slip on the Nadaleen-Anubis fault, resulting in its steepening. The initiation of the Nadaleen-Anubis fault and associated flattening could have occurred as a result of continued shortening against a backstop that impeded translation towards the hinterland. The adjacent southern boundary of the Yukon Stable block may well be such a backstop.

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Digital cartography and drafting by Andrew Steiner, University of British Columbia

Any revisions or additional geological information known to the user would be welcomed by the Yukon Geological Survey.

A PDF (Portable Document Format) of this map may be downloaded free of charge from the Yukon Geological Survey website: https://yukon.ca/en/science-and-natural-resources/geology.

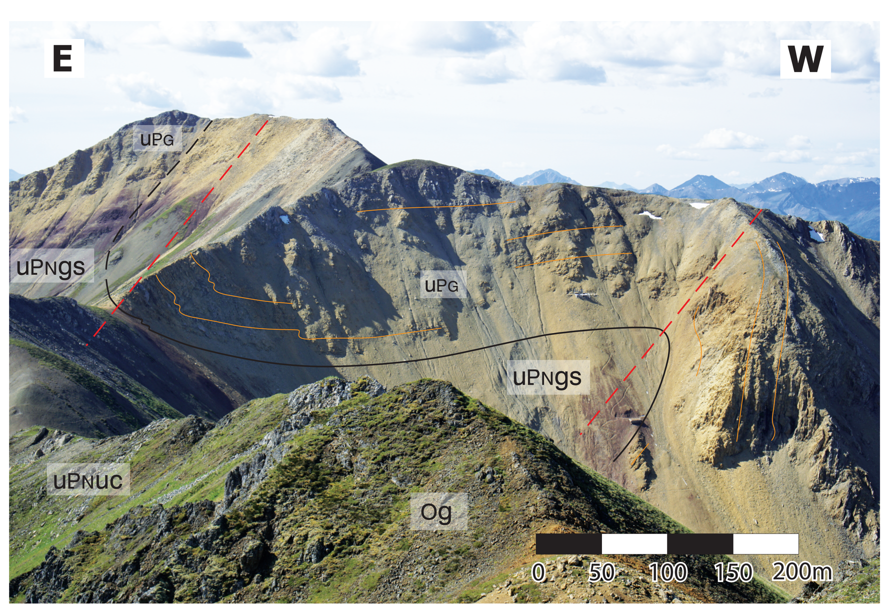

Photo 1. Steeply plunging syncline-anticline pair that host the Osiris and Sunrise deposits. Note the distinctive buff-orange weathering of the Gametrail Fm and the maroon and grey-green weathering of the Green Siliciclastic mbr of the Nadaleen Fm. The foreground shows the Osiris Gabbro within the Upper Carbonate mbr of the Nadaleen Fm. Axial traces are shown in red, contacts in black and bedding formlines in orange.

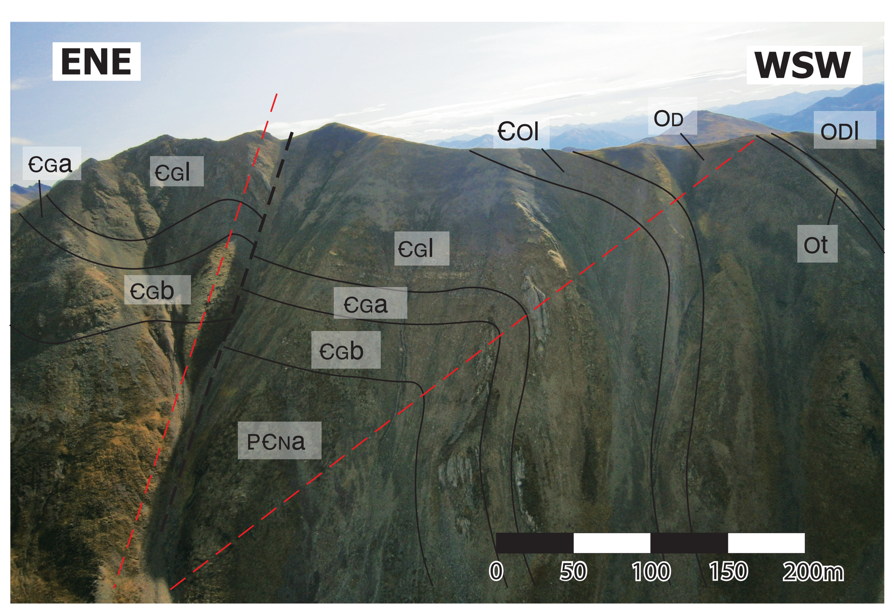

Photo 2. Steeply plunging box fold showing the fully exposed stratigraphic sequence from the Cambrian to the Silurian. Note the black outcrops of the Duo Lake Fm on the ridge. Axial traces are shown in red, contacts in black and faults in thick dashed black.

Photo 3. Pressure-solution cleavage developed in the Gametrail Fm. Occurrences of this cleavage in carbonate are rare, although it is common in argillaceous units, where it often forms axial-planar to parasitic folds. Bedding formlines are shown in orange, fabric in blue.

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Energy, Mines and Resources
Government of Yukon

Open File 2021-1

Bedrock geology map of the Nadaleen-Anubis fault corridor, eastern Rackla belt (parts of NTS 106C/1,2) scale 1:20 000

by

Andrew Steiner and Kenneth Hickey

Sheet 2 of 2