

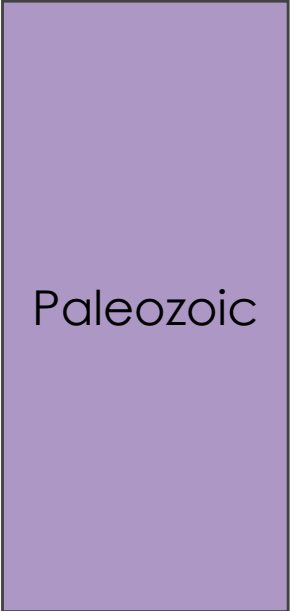
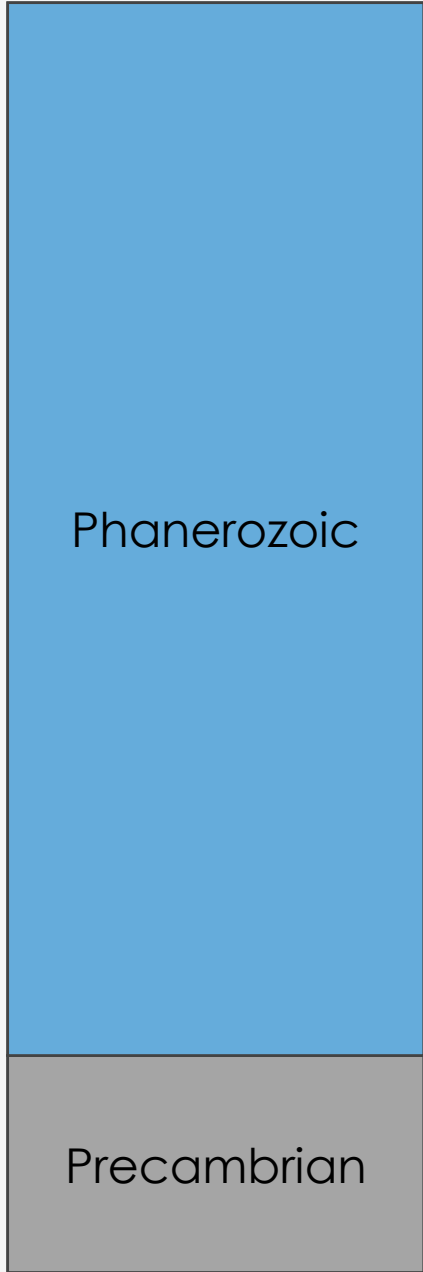
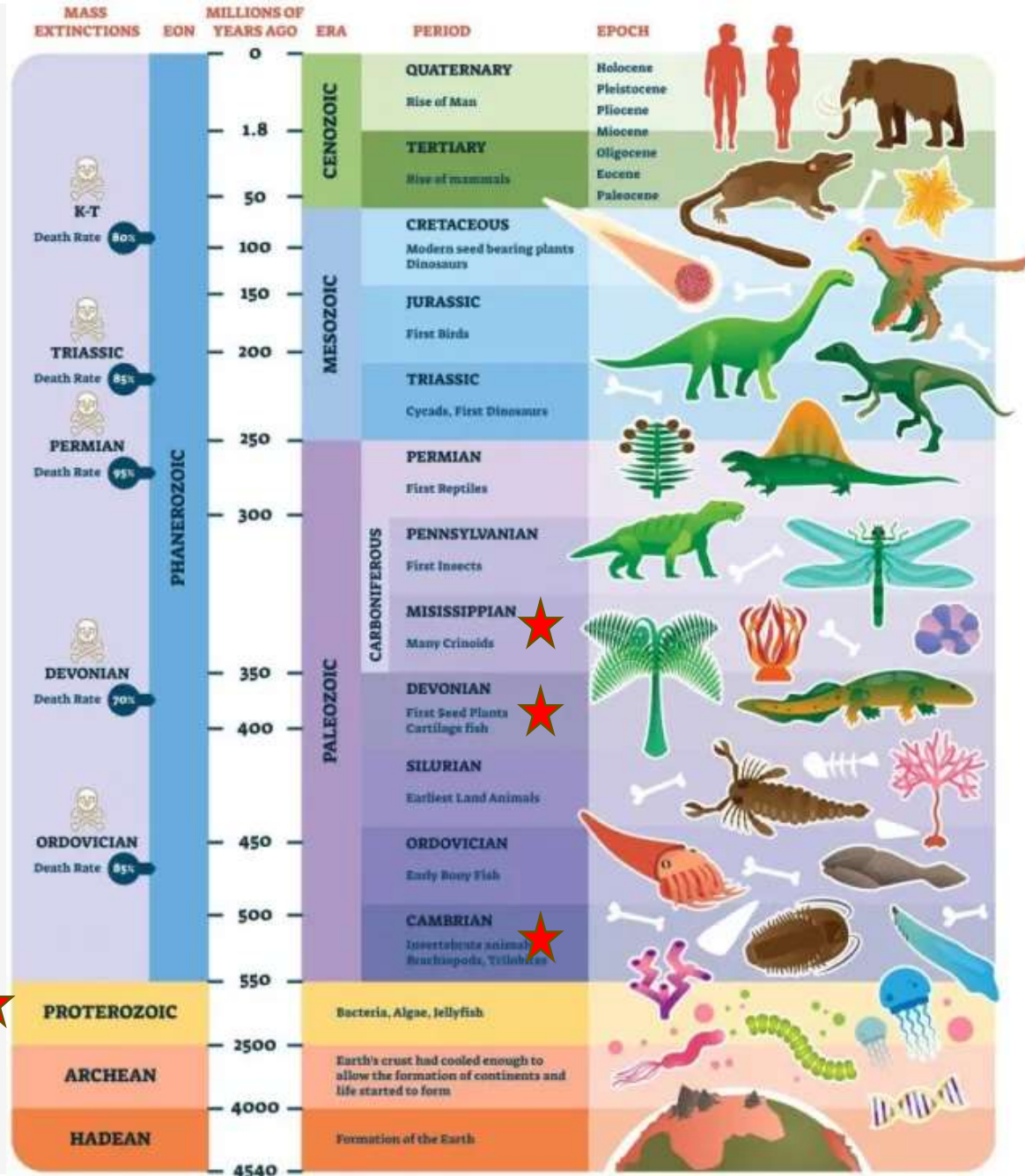
# Early Life in our Rocks

*- the Stromatolites of Dolomite Pass*

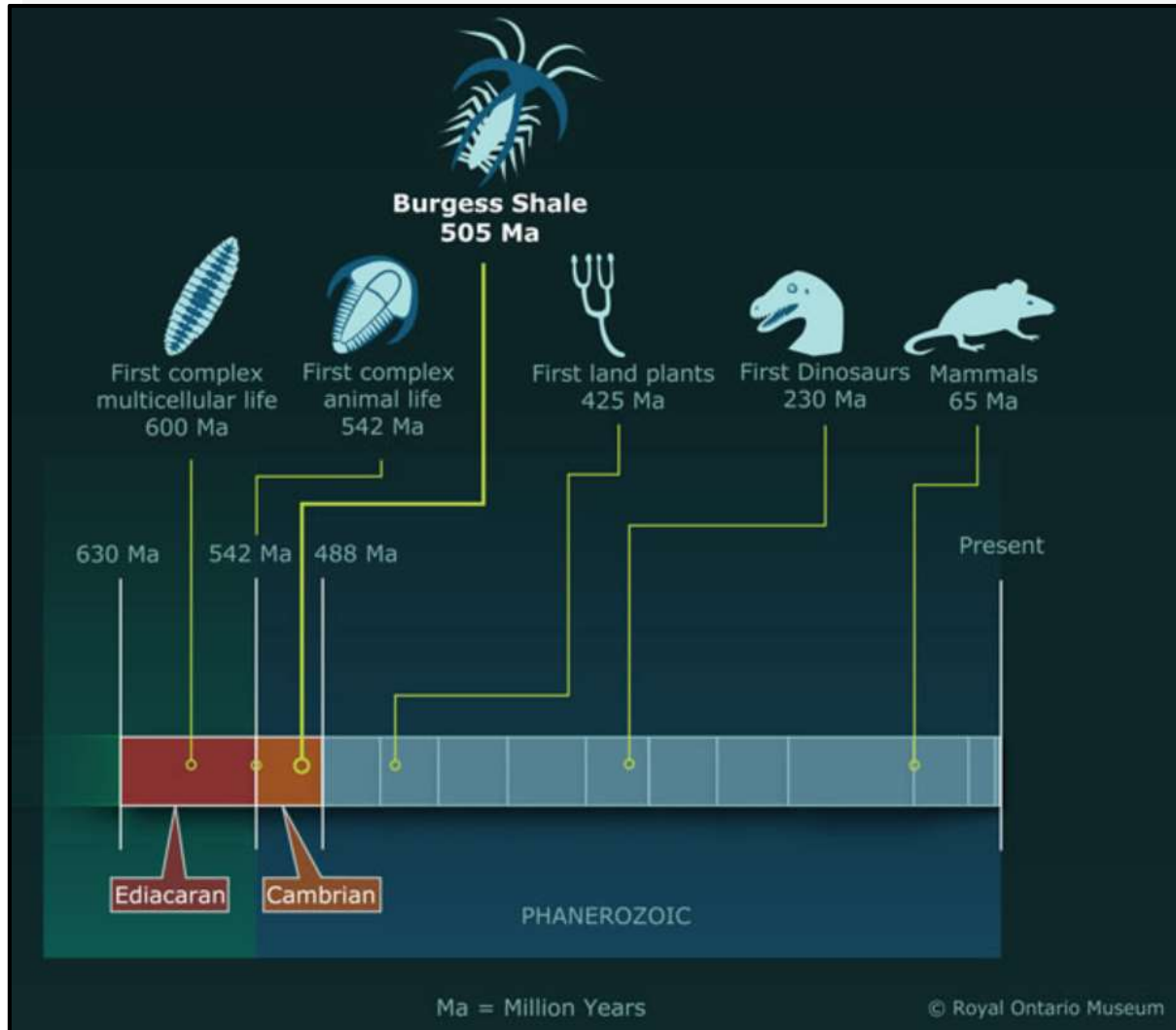
*Astrid Arts*



# Timescale



# Ediacaran Fauna



Smithsonian

Earliest known complex multicellular organisms

bacteria, algae & jellyfish

# Ediacaran Fauna

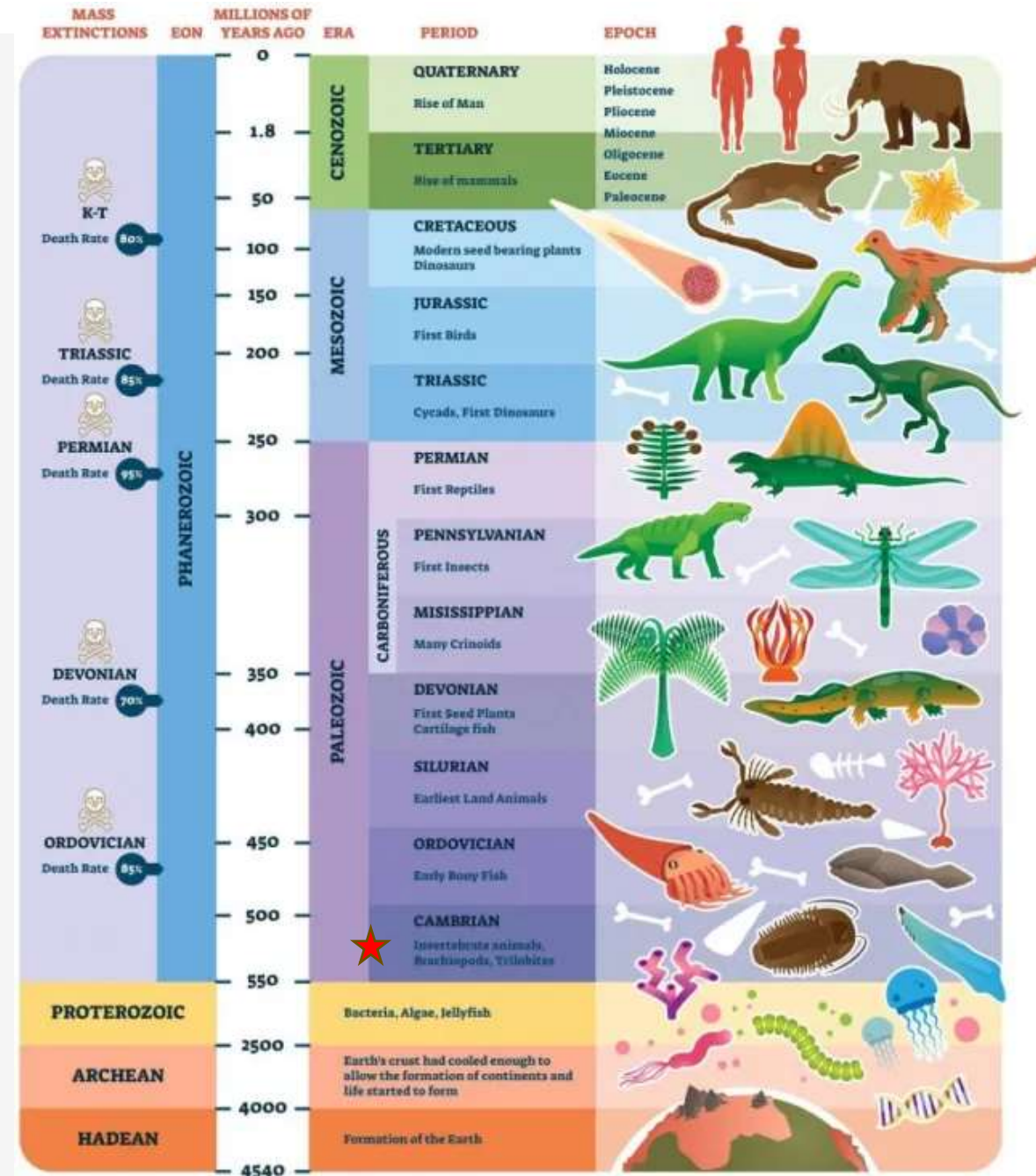
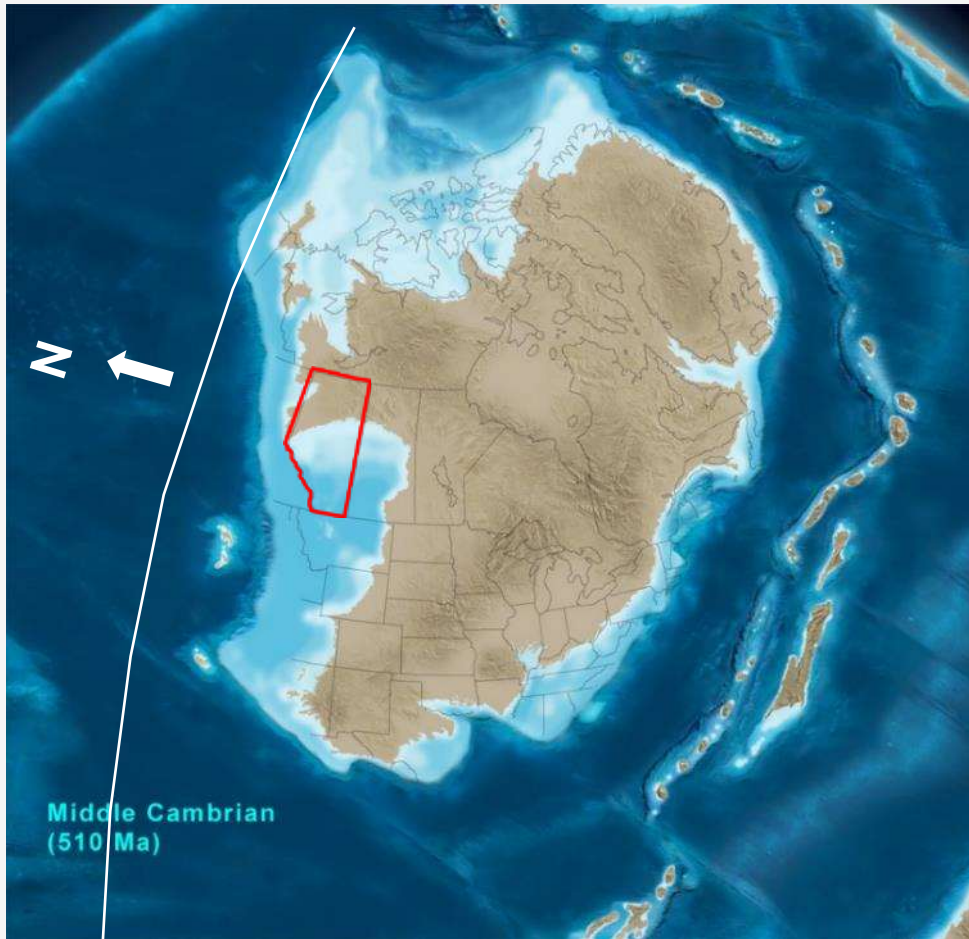
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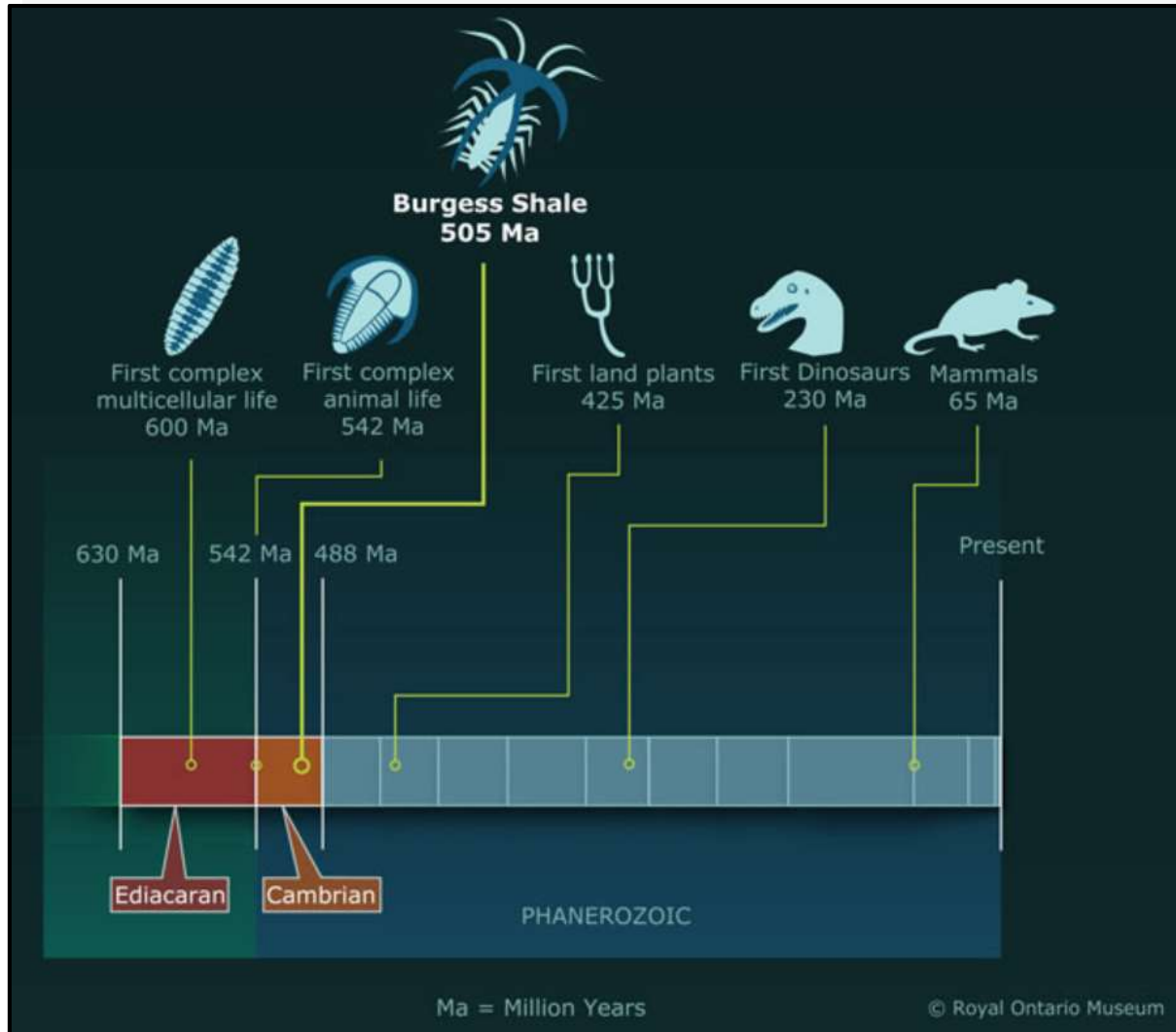
Smithsonian

# Cambrian

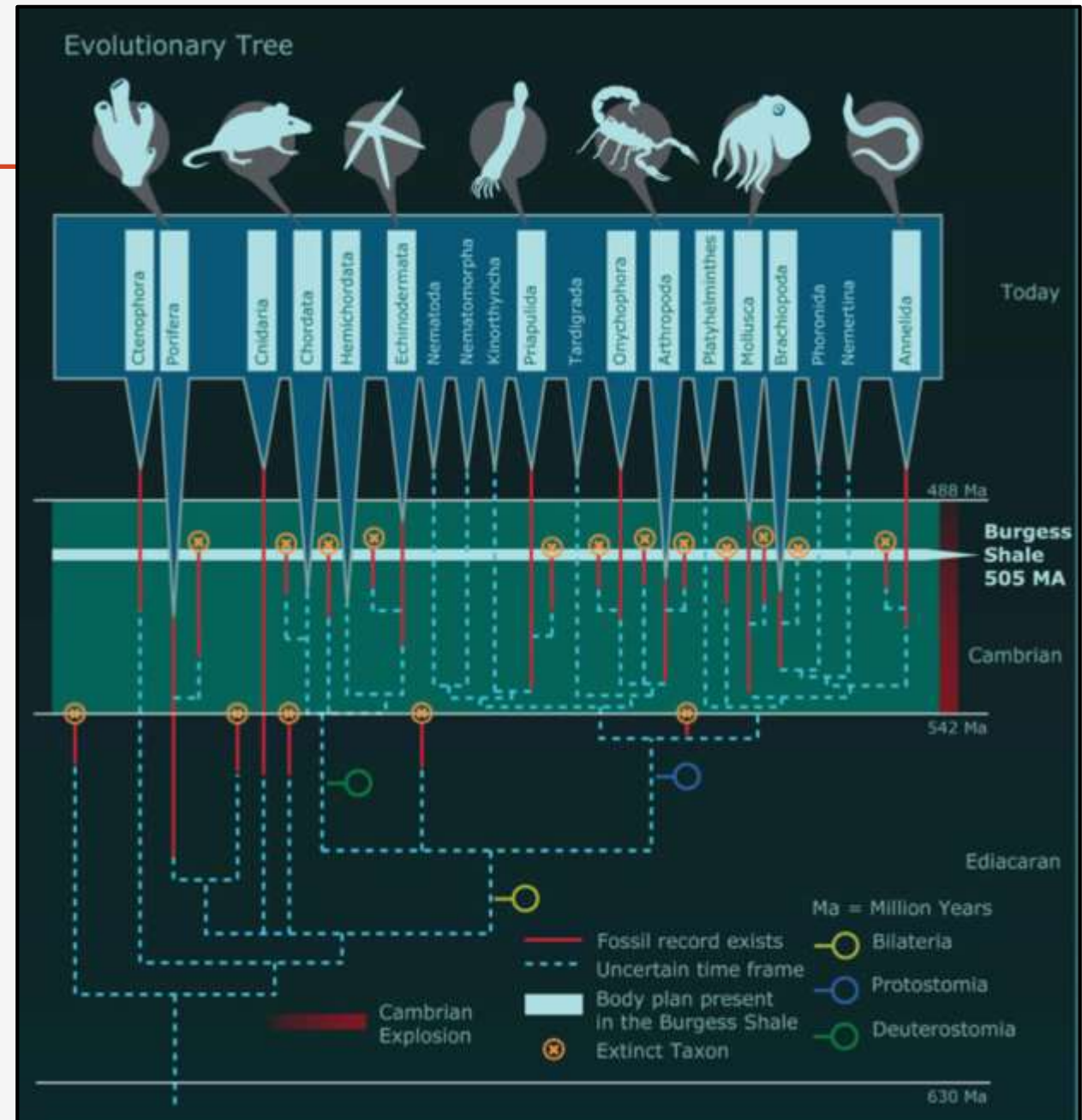
- First complex animal life



# Cambrian Explosion



Royal Ontario Museum (ROM)



Royal Ontario Museum (ROM)

# Burgess Shale – Yoho National Park

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© Royal Ontario Museum (ROM)



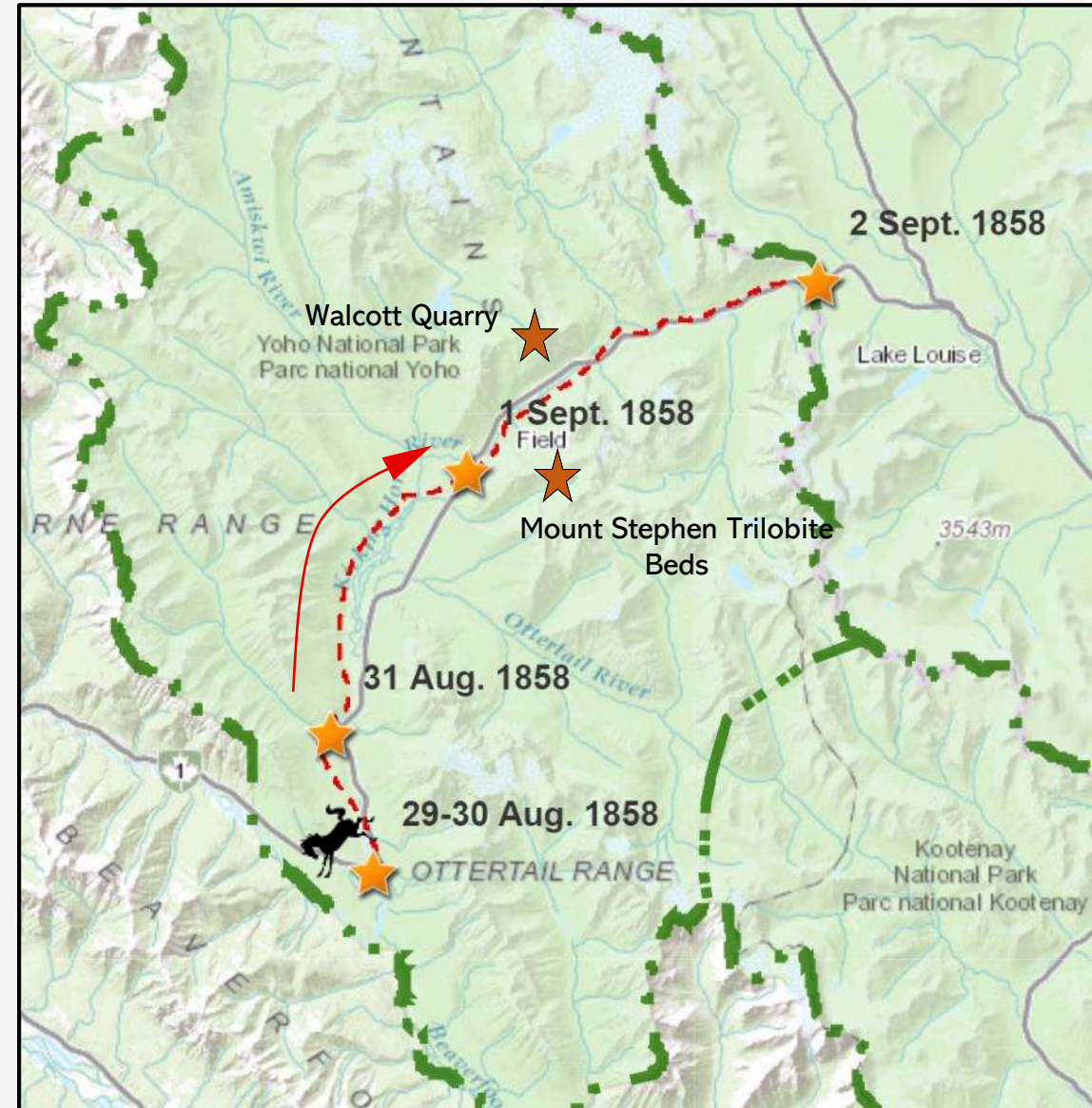
# History of the Burgess Shale

---

- 1858 – Palliser Expedition and James Hector

**LEGEND**

- Hector Route ———
- Hector Camps ★
- National Park ———



Map Courtesy of Wood Environment & Infrastructure Solutions

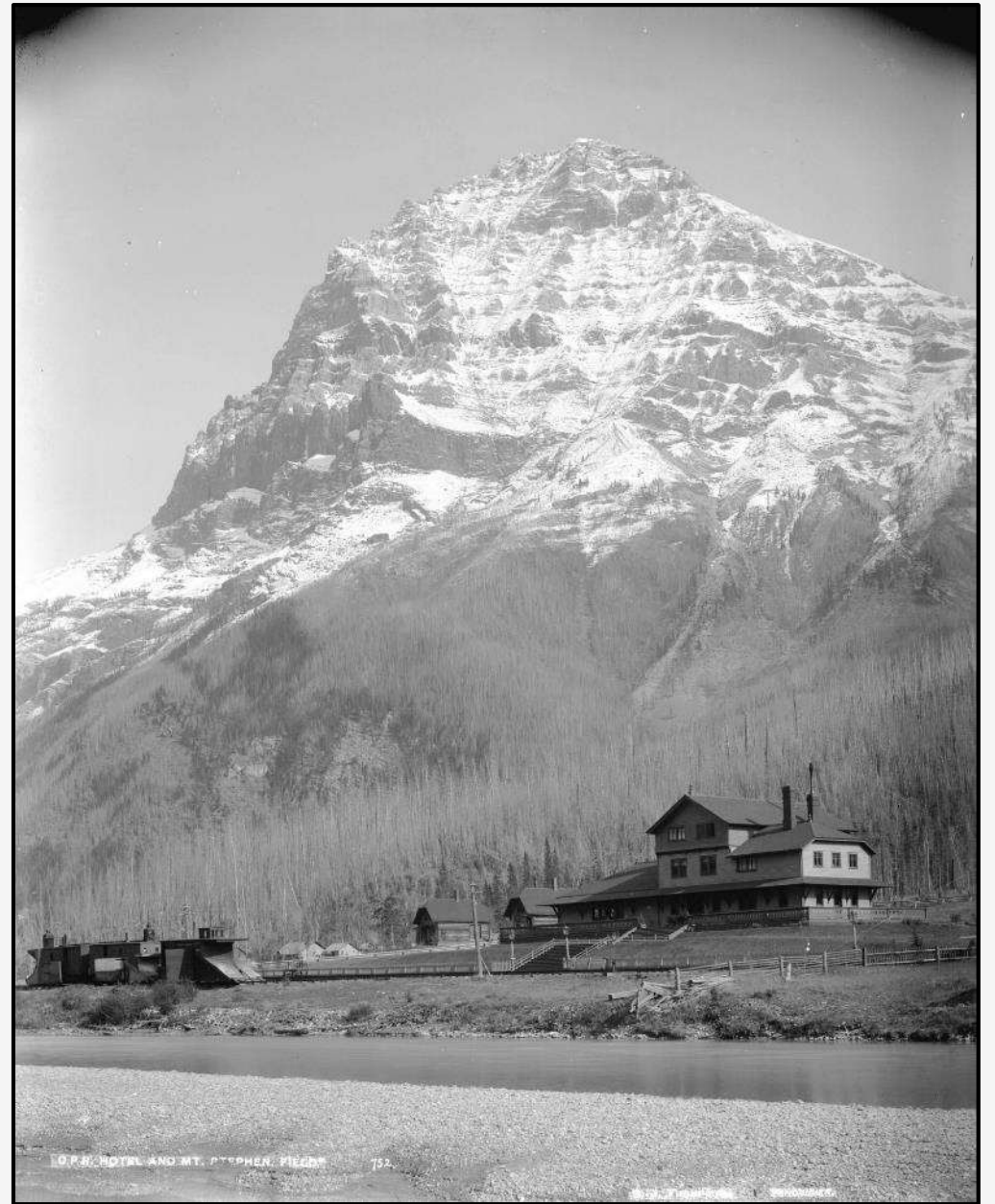


# History of the Burgess Shale

---

- 1858 – Palliser Expedition and James Hector
- 1884 – CPR establishes town of Field

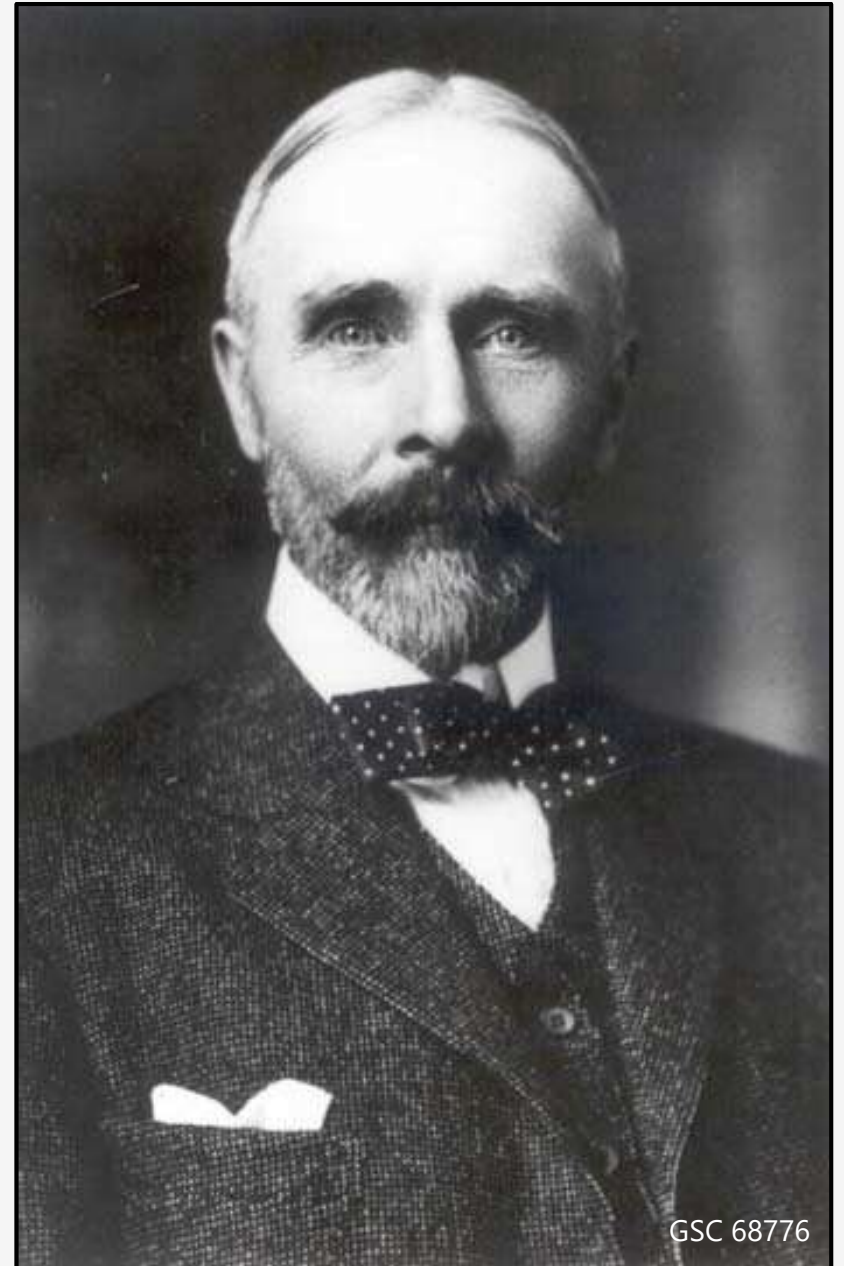
c. 1894  
CPR Mount Stephen House and Mount Stephen, Field  
unknown photographer



# History of the Burgess Shale

---

- 1858 – Palliser Expedition and James Hector
- 1884 – CPR establishes town of Field
- 1886 – R.G. McConnell (GSC Geologist) discovers  
Mount Stephen Trilobite Beds



# History of the Burgess Shale

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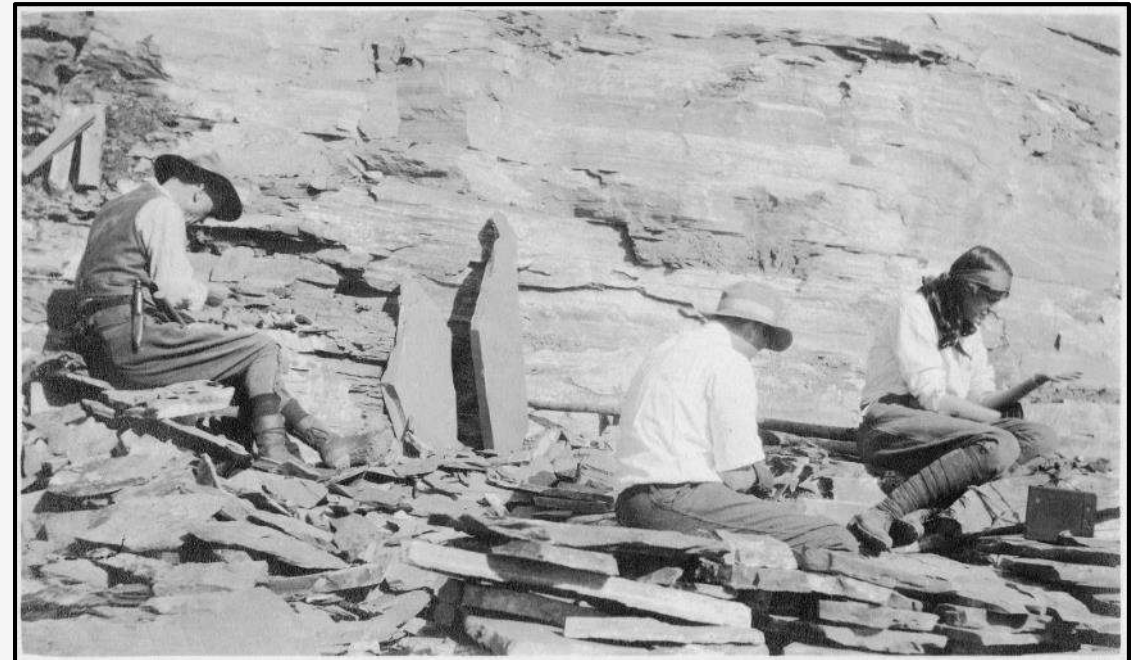
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- 1909 – Charles Doolittle Walcott discovers the Fossil Ridge fossil beds (Walcott Quarry)

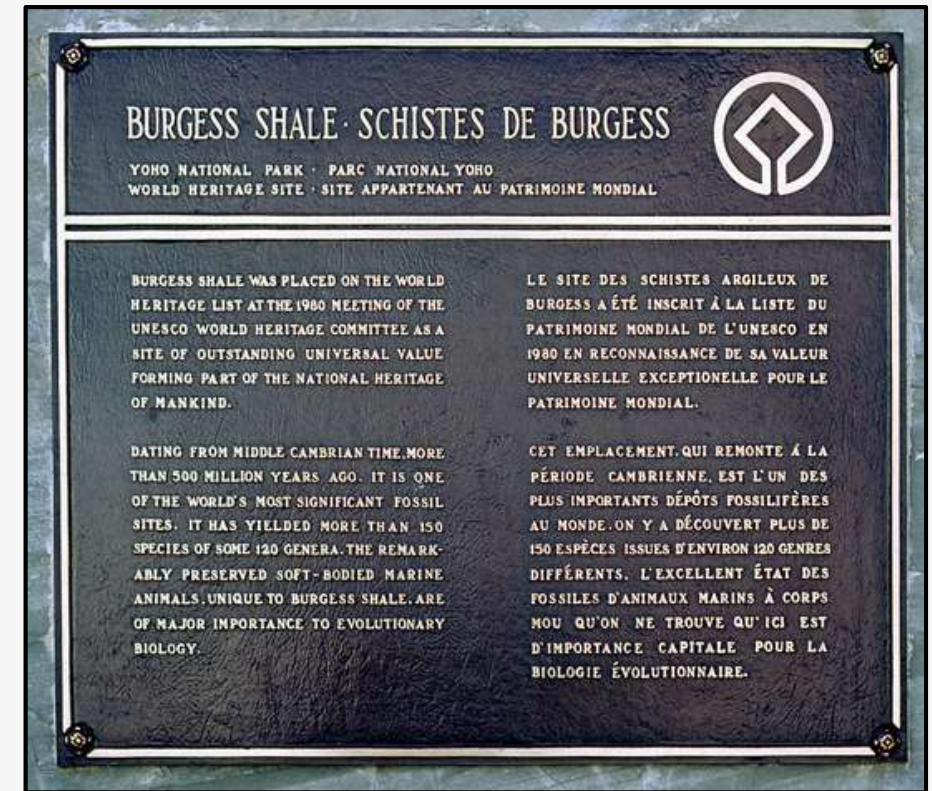


Charles Walcott with son Sidney and daughter Helen  
© Smithsonian Institution  
c.1913

# History of the Burgess Shale

---

- 1858 – Palliser Expedition and James Hector
- 1884 – CPR establishes town of Field
- 1886 – R.G. McConnell (GSC Geologist) discovers Mount Stephen Trilobite Beds
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- 1980 – Burgess Shale designated an UNESCO World Heritage Site



# History of the Burgess Shale

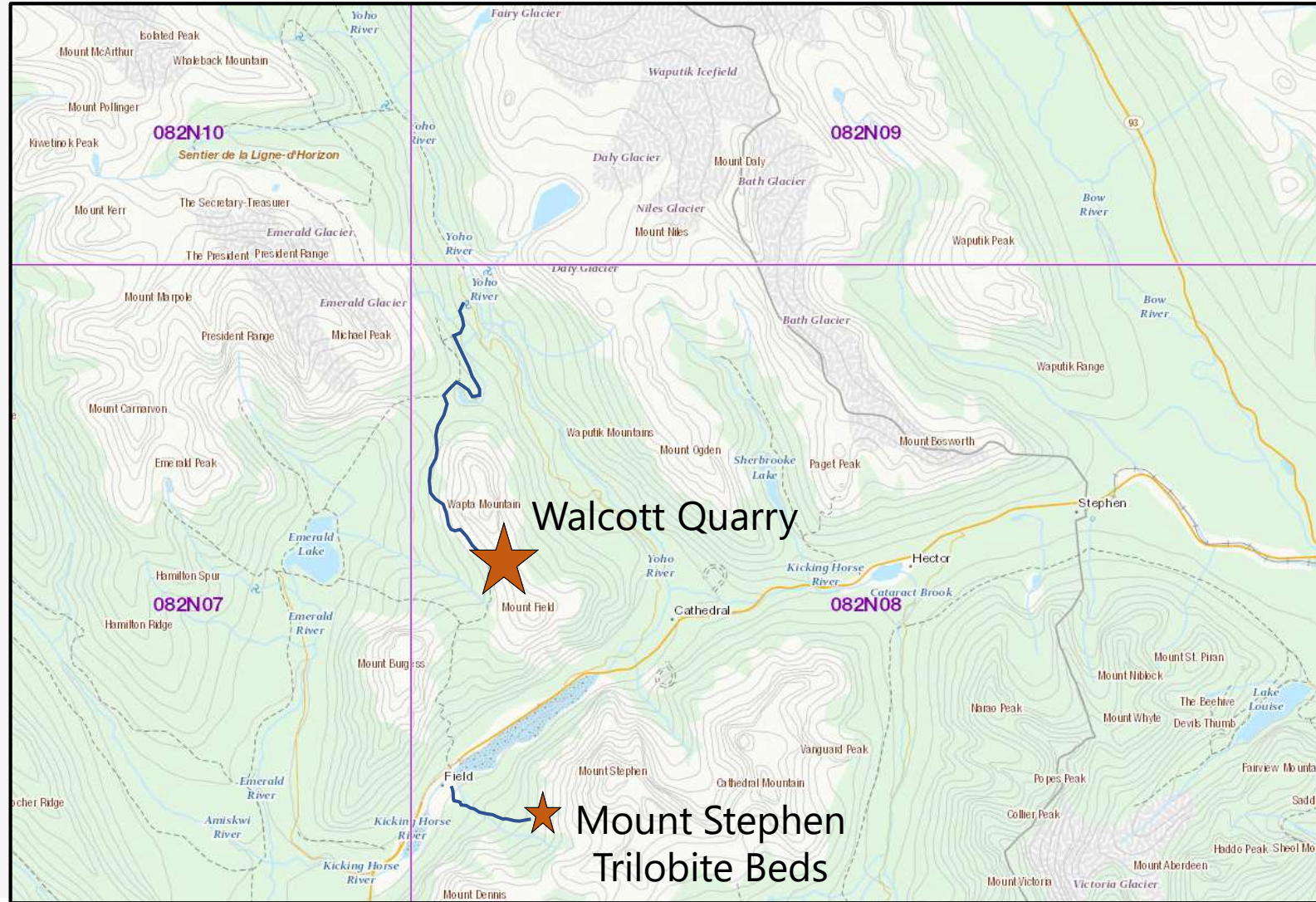
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- 1886 – Yoho National Park was established
- 1909 – Charles Doolittle Walcott discovers the Fossil Ridge fossil beds (Walcott Quarry)
- 1980 – Burgess Shale designated an UNESCO World Heritage Site
- 1984 – Canadian Rocky Mountain Parks were listed as a UNESCO World Heritage Site



cc Pethrus

# Burgess Shale – Walcott Quarry & Mountain Stephen Trilobite Beds



Guided Hikes available through:



# Burgess Shale – Mount Stephen Trilobite Beds

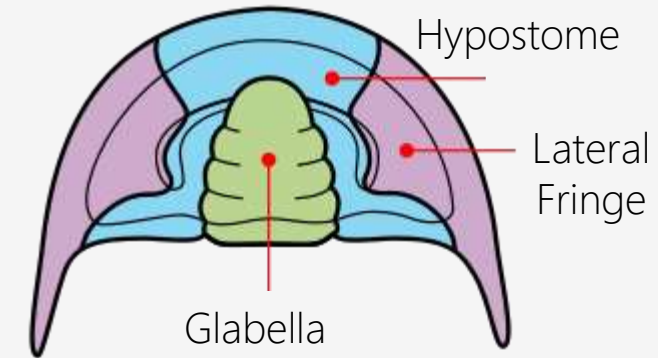
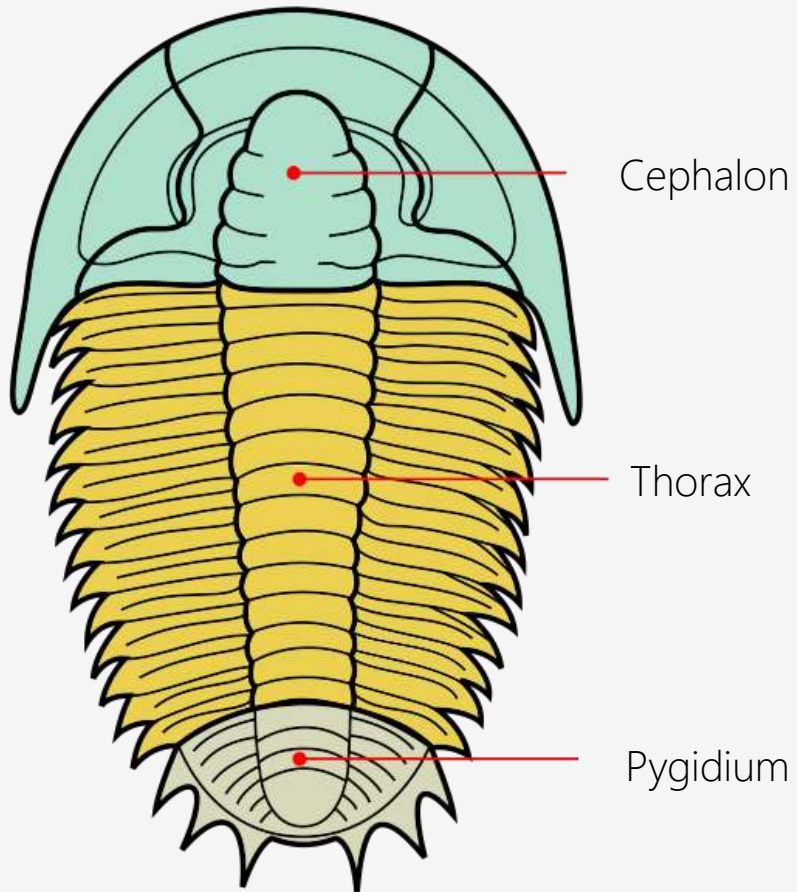
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# Trilobite Body Parts

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# Trilobites of the Burgess Shale

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# Trilobites of the Burgess Shale

---



Animation by Phlesch Bubble © Royal Ontario Museum (ROM)

# Anomalocaris

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- Anomalocaris means 'unusual looking shrimp'
- For many years, the feeding appendage was misidentified as a headless shrimp
- Entire animal could be up to 1 metre in length
- Largest predator of the Cambrian



# Anomalocaris

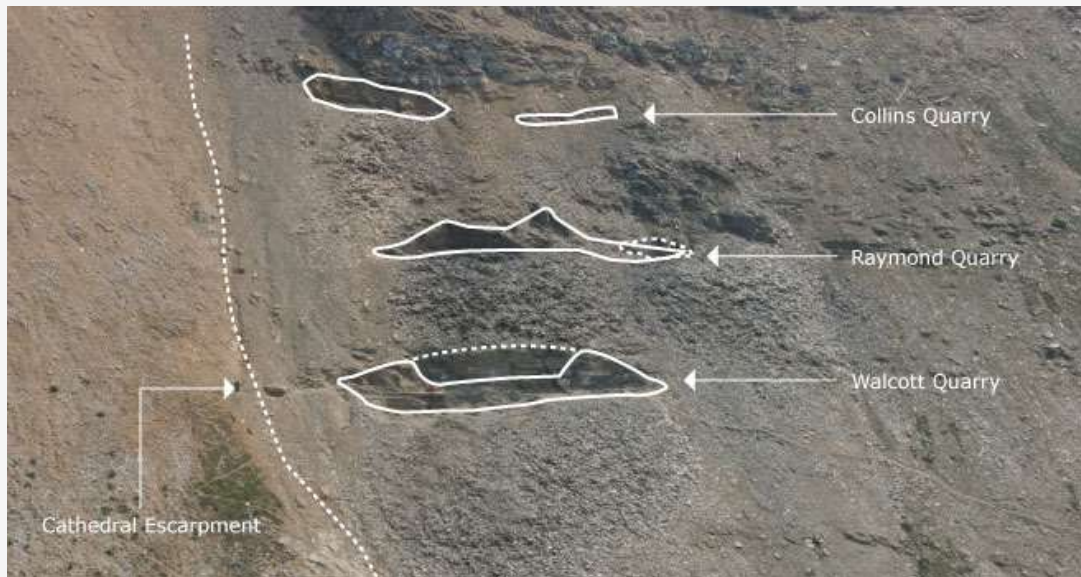
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Animation by Phlesch Bubble © Royal Ontario Museum (ROM)

# Burgess Shale – Walcott Quarry

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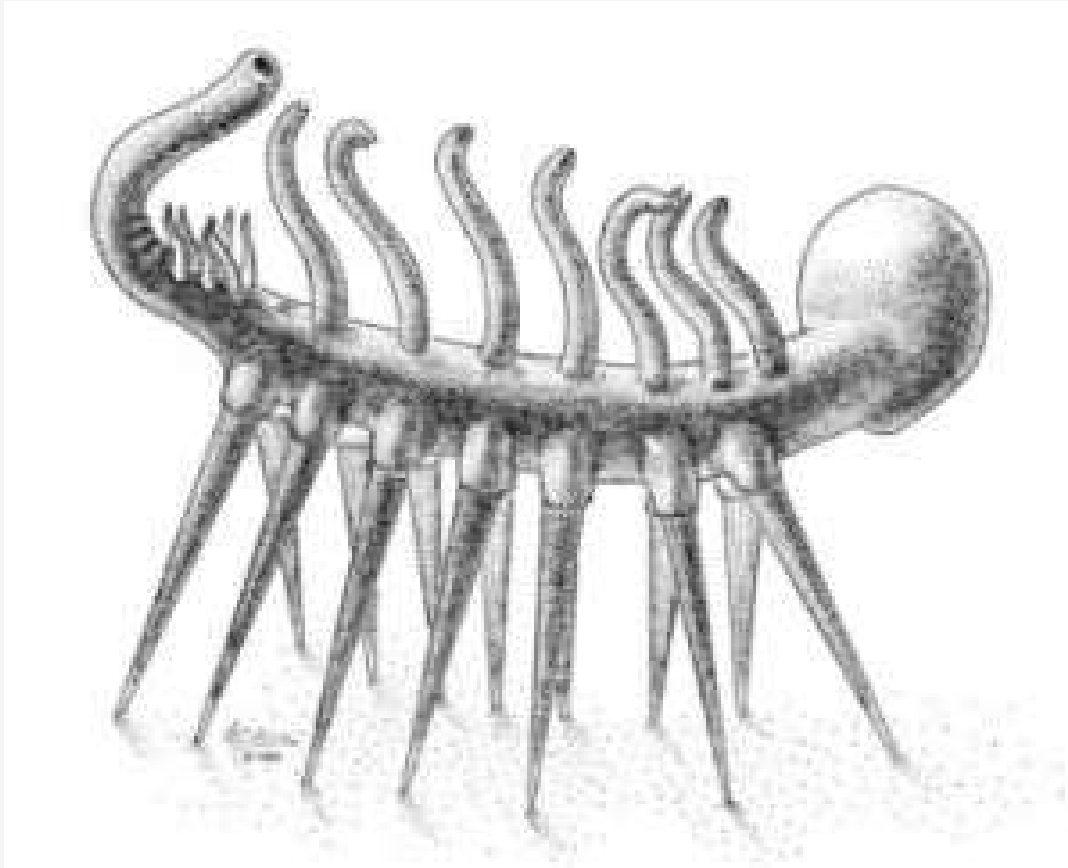


Royal Ontario Museum

Royal Ontario Museum

# Hallucigenia

max size: 30 mm



palaeos.com © Marianne Collins



ROM 61513



ROM 83935

# Hallucigenia

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A prickly worm that turns out to have legs



Animation by Phlesch Bubble © Royal Ontario Museum (ROM)

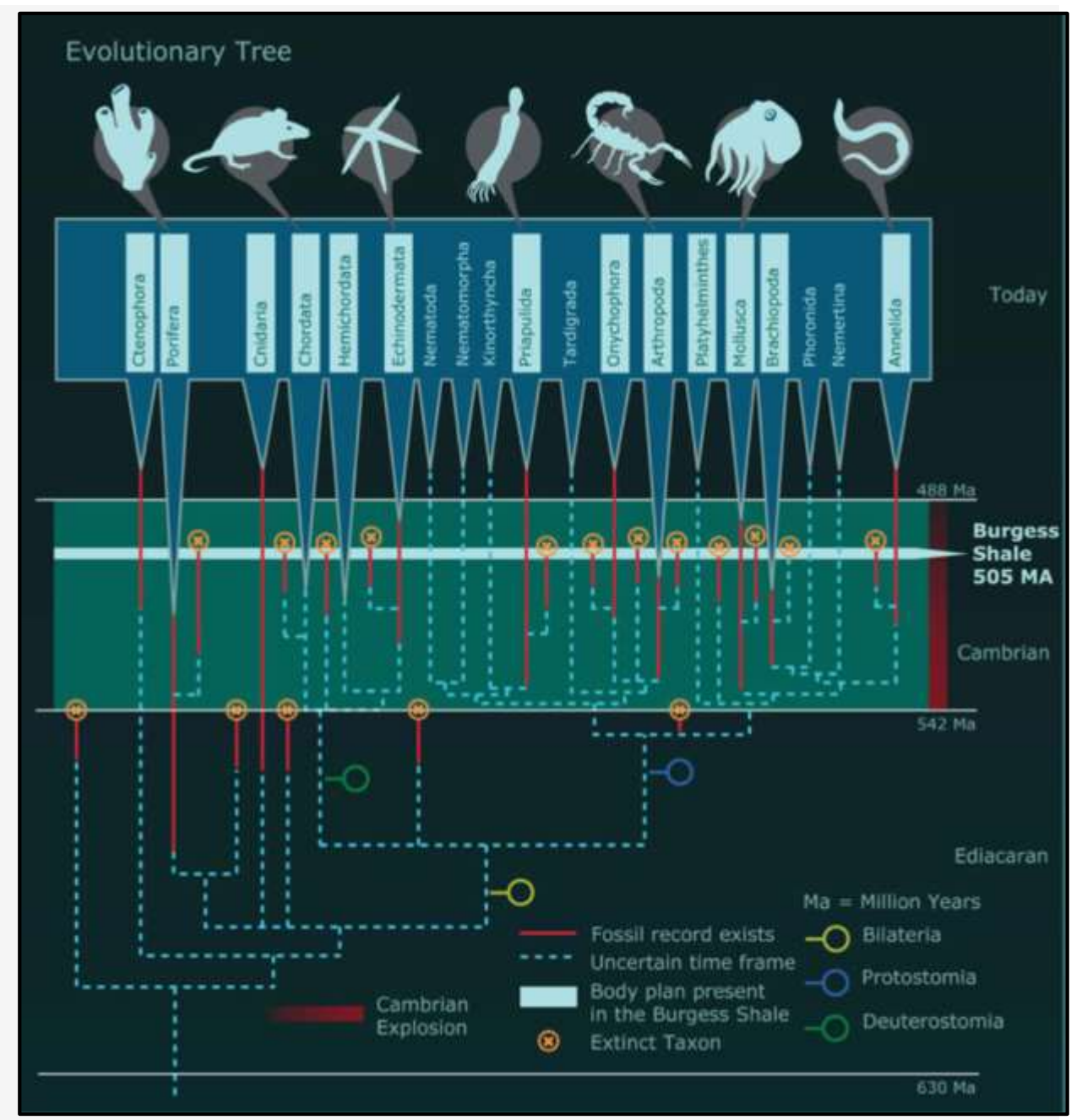
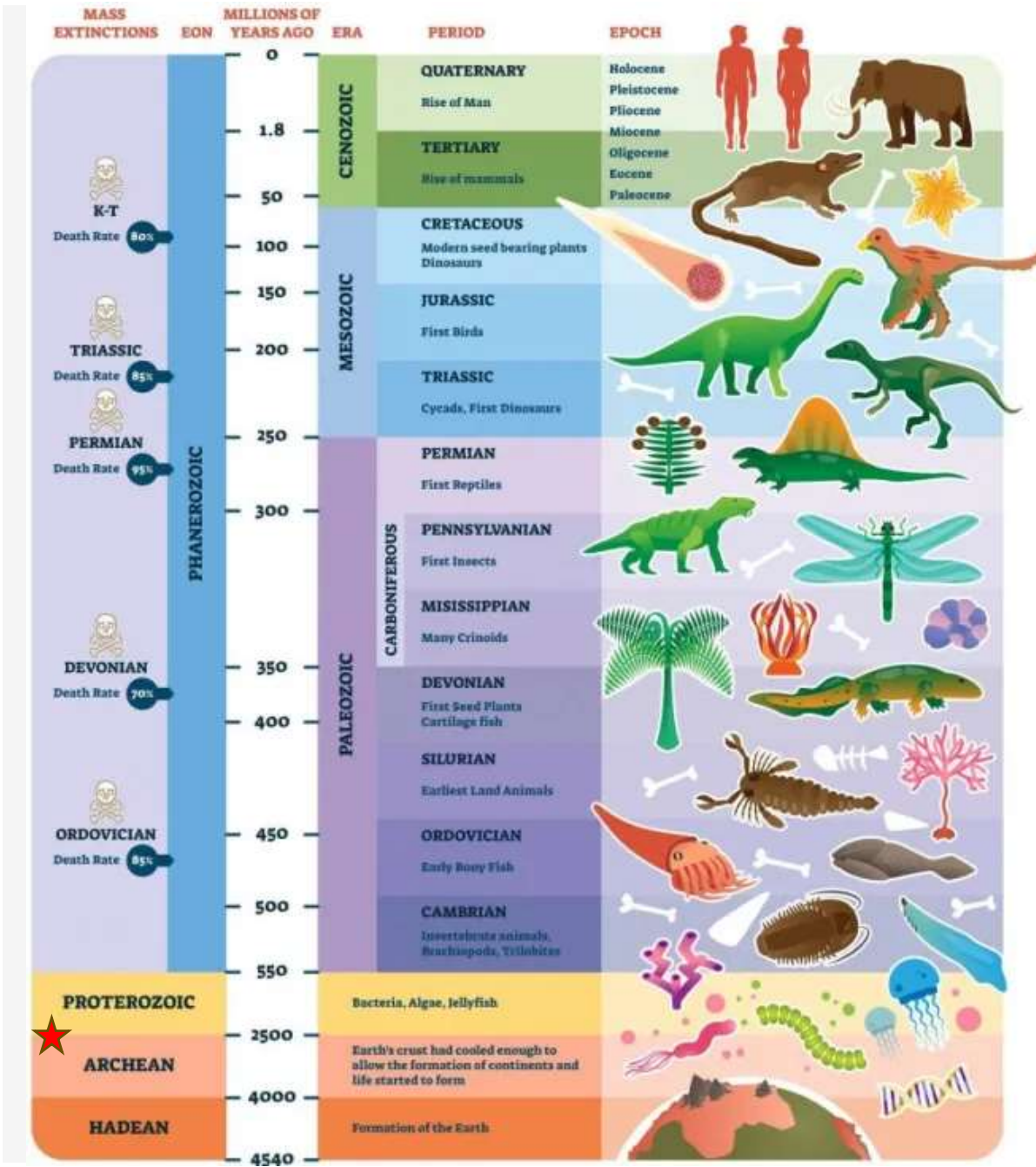


ROM 61513



ROM 83935





© normaals

Royal Ontario Museum (ROM)

# Stromatolites

---

- Earth's oldest "fossil" (~3.5 billion years old)
  - Trace Fossil



Stromatolite Pilbara Craton, W. Australia – 3.6 to 3.2 Billion years old  
Muséum de Toulouse, CC BY-SA 4.0

# Stromatolites

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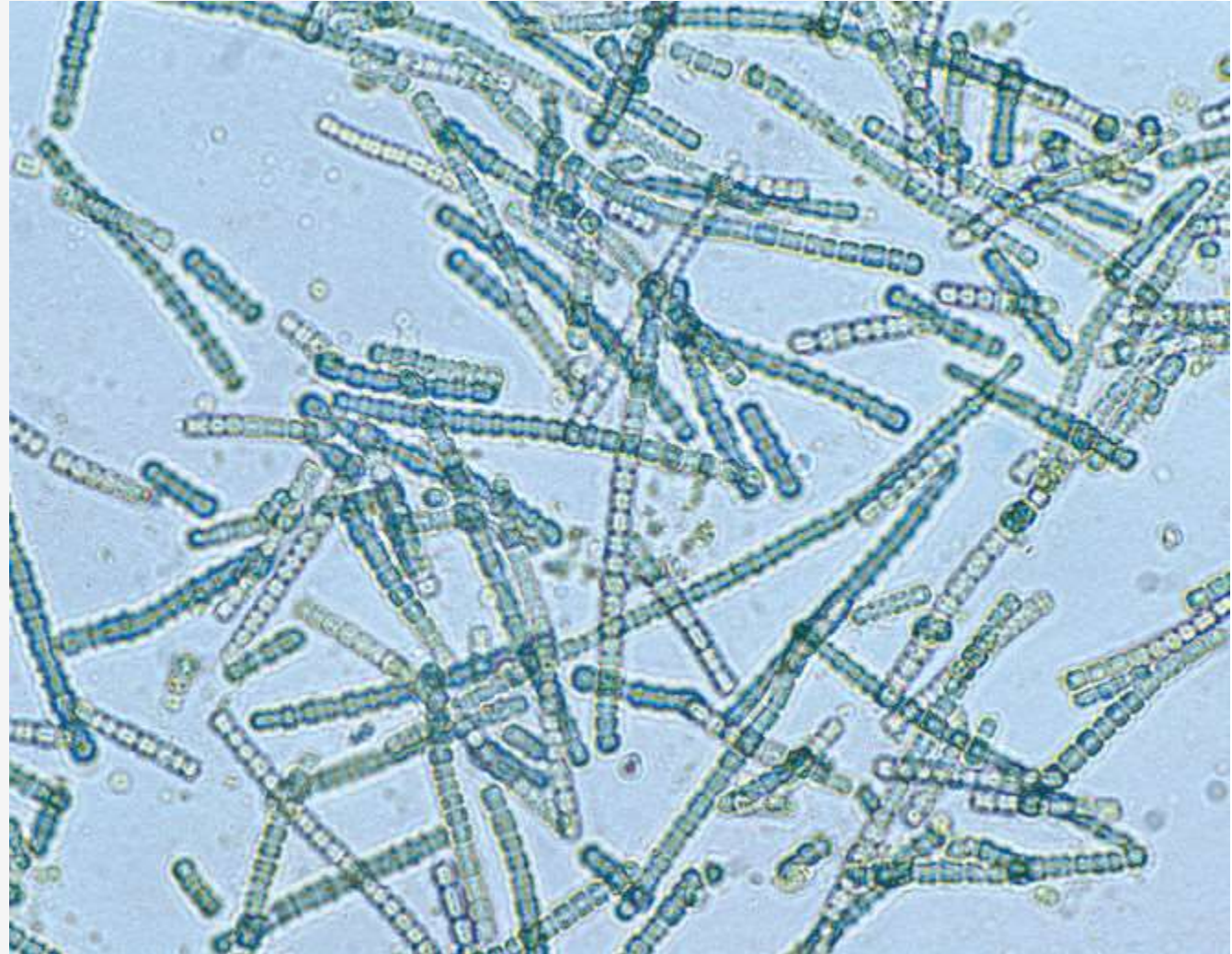
- Earth's oldest "fossil" (~3.5 billion years old)
  - Trace Fossil
- Term Stromatolite coined in 1908
  - Greek:
    - **Stroma:** bed, mattress or layer
    - **Lithos:** stone



# Stromatolites

---

- Earth's oldest "fossil" (~3.5 billion years old)
  - Trace Fossil
- Term Stromatolite coined in 1908
  - Greek:
    - **Stroma:** bed, mattress or layer
    - **Lithos:** stone
- Organisms that can form stromatolites
  - Bacteria



# Stromatolites

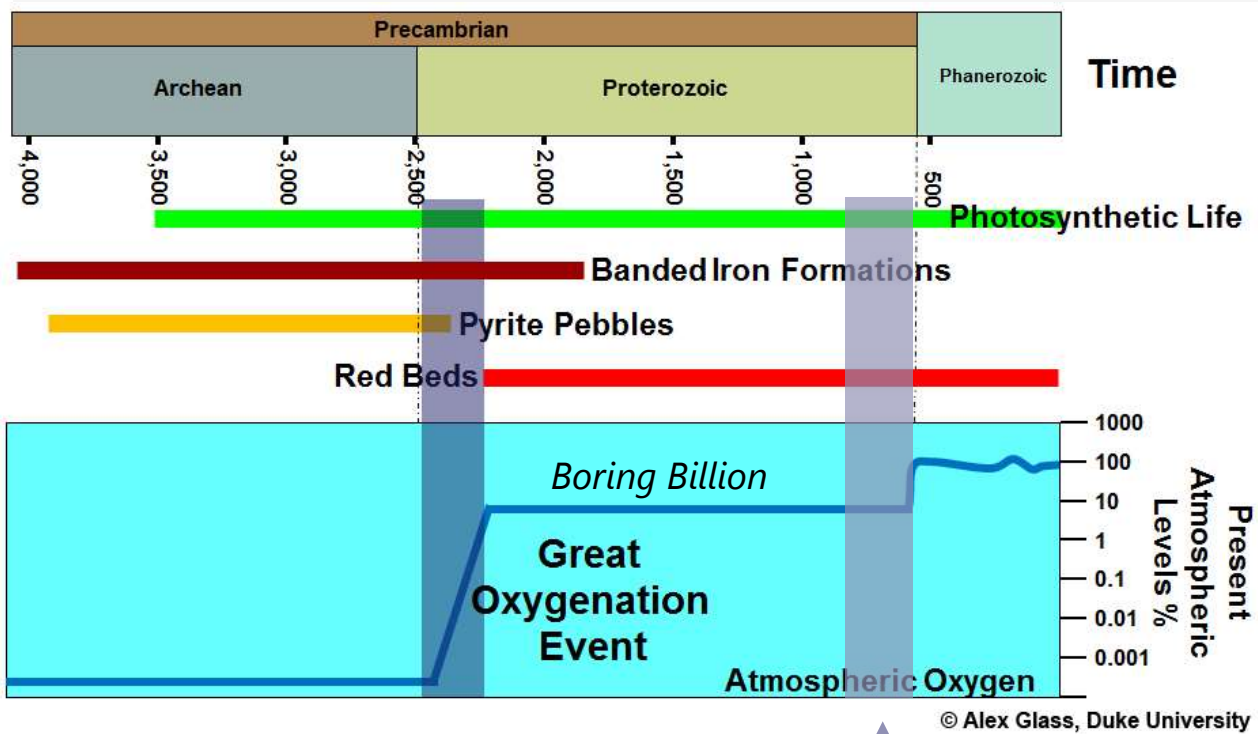
---

- Earth's oldest "fossil" (~3.5 billion years old)
  - Trace Fossil
- Term Stromatolite coined in 1908
  - Greek:
    - **Stroma:** bed, mattress or layer
    - **Lithos:** stone
- Organisms that can form stromatolites
  - Bacteria
  - Algae

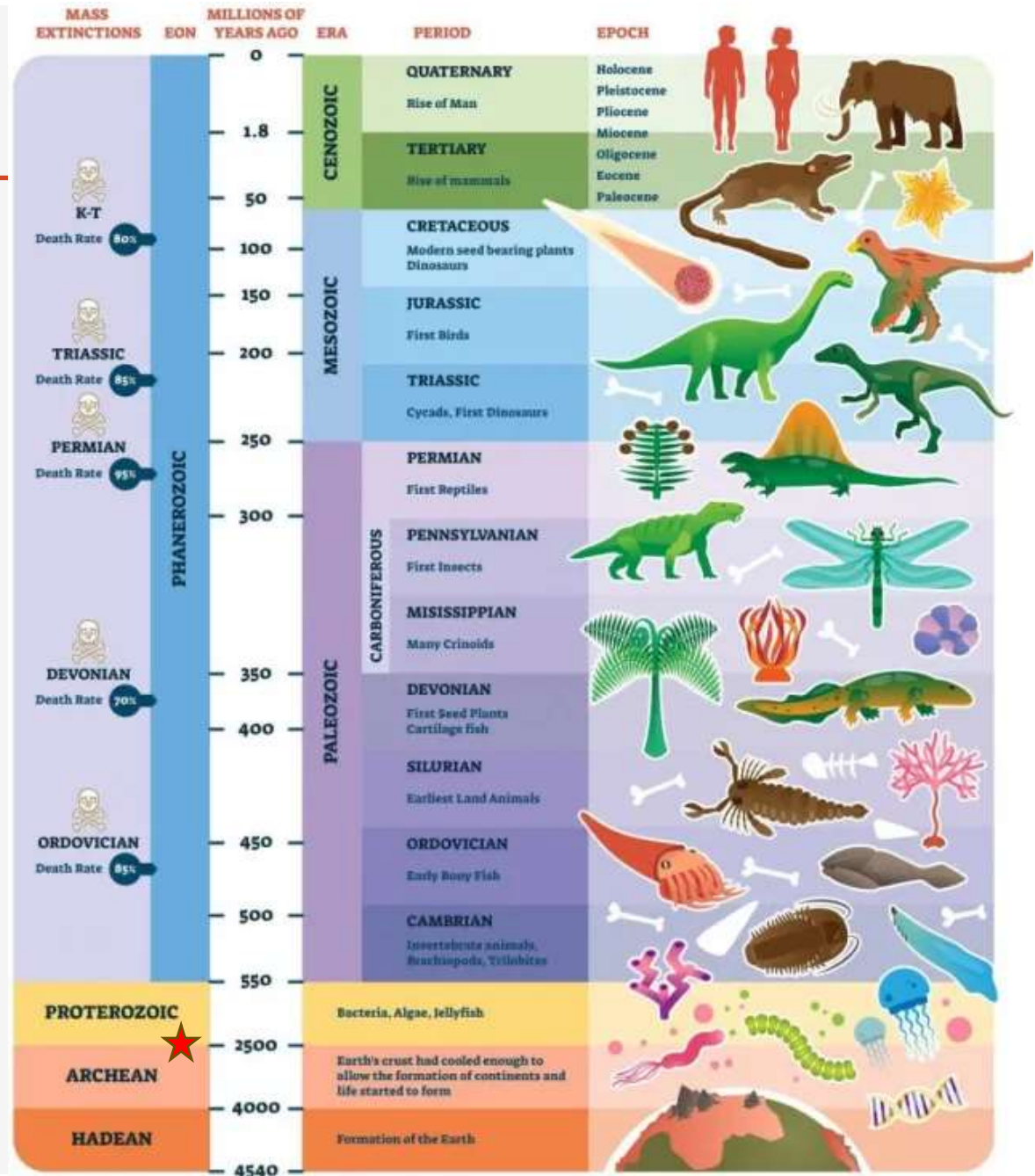


Rhodolith - Derek Keats from Johannesburg, South Africa, CC BY 2.0

# Great Oxygenation Event



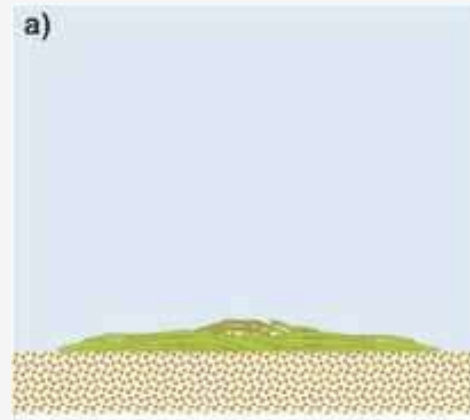
↑  
Ediacaran Fauna  
multicellular life



# Formation

---

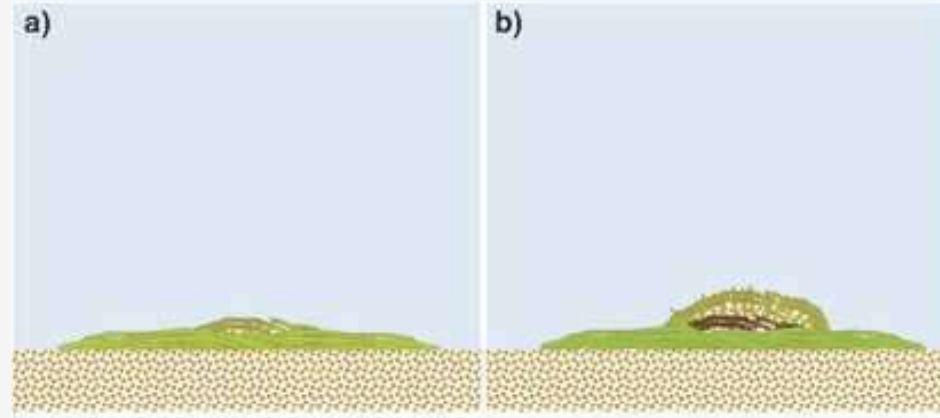
a) Bacterial filaments with sticky mucus layer



# Formation

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- a) Bacterial filaments with sticky mucus layer
- b) Trap & bind sediment

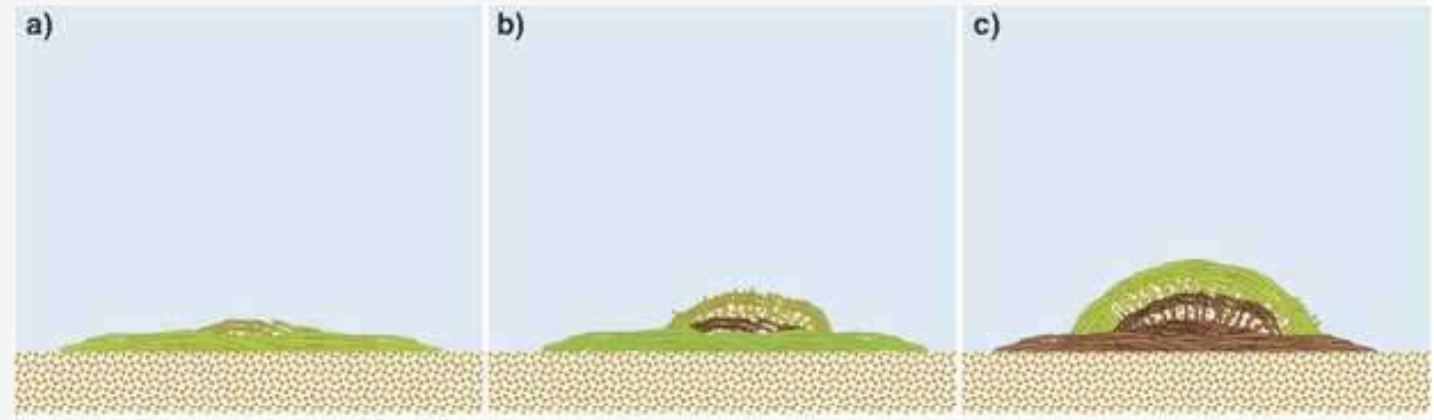




# Formation

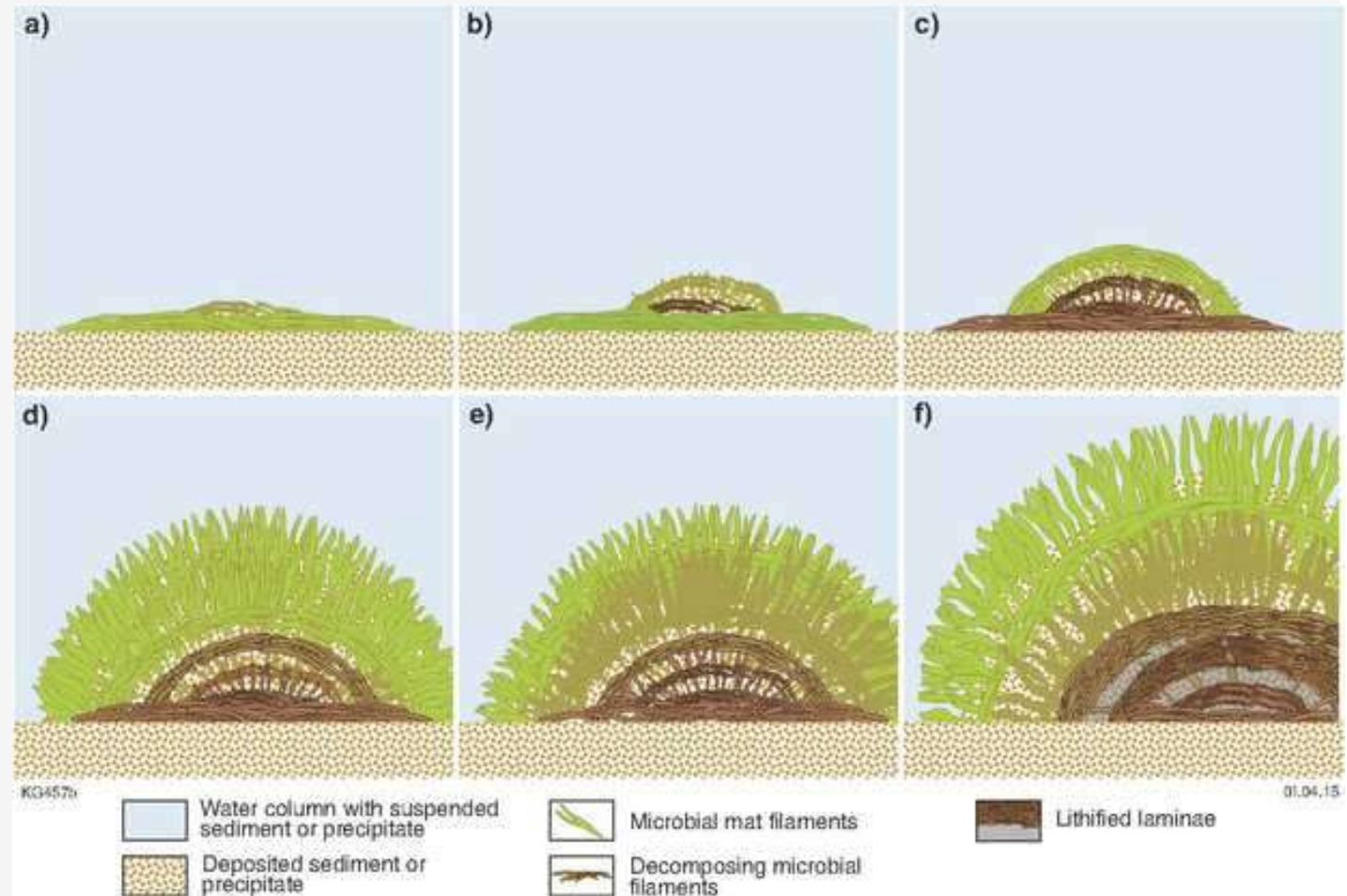
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- a) Bacterial filaments with sticky mucus layer
- b) Trap & bind sediment
- c) Bacteria is photosynthetic, will move up through deposited layer (forms new layers)



# Formation

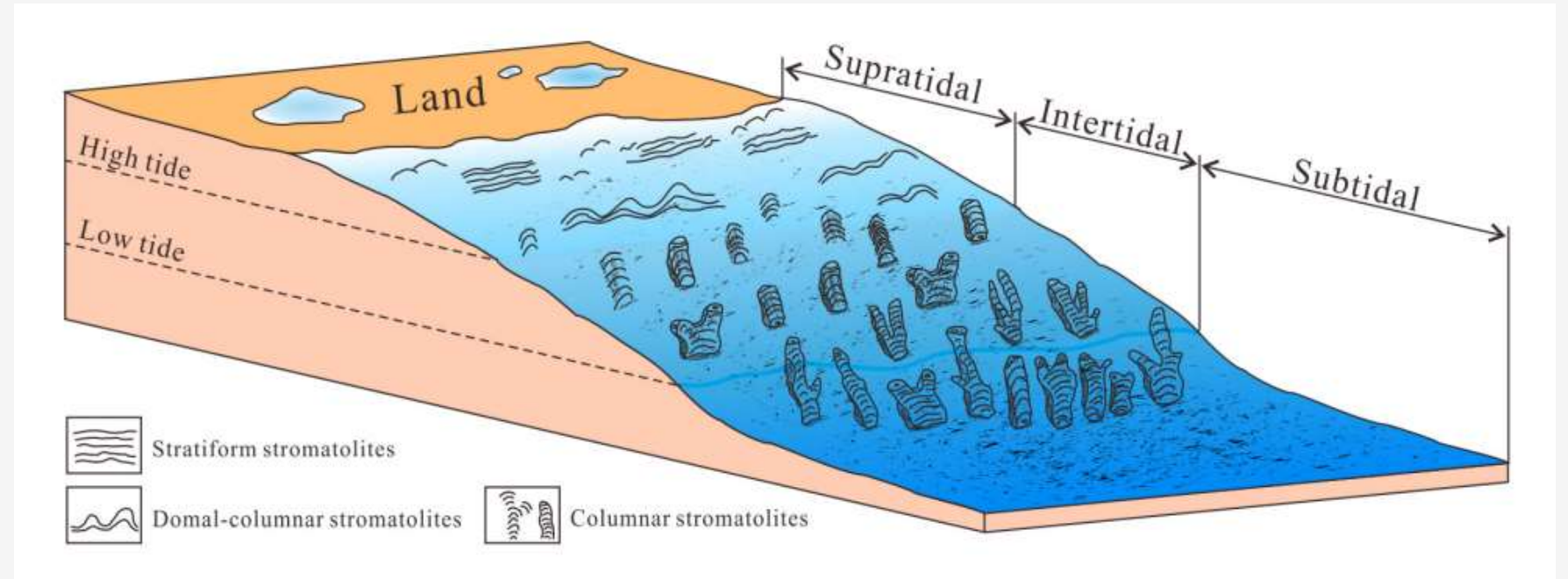
- a) Bacterial filaments with sticky mucus layer
- b) Trap & bind sediment
- c) Bacteria is photosynthetic, will move up through deposited layer (forms new layers)
- d) Over time develop flat, domal, columnar, conical, branching structures



# Environments of Deposition & Morphology

## Controls on Morphology

- Water depth
- Wave energy
- Light
- Species

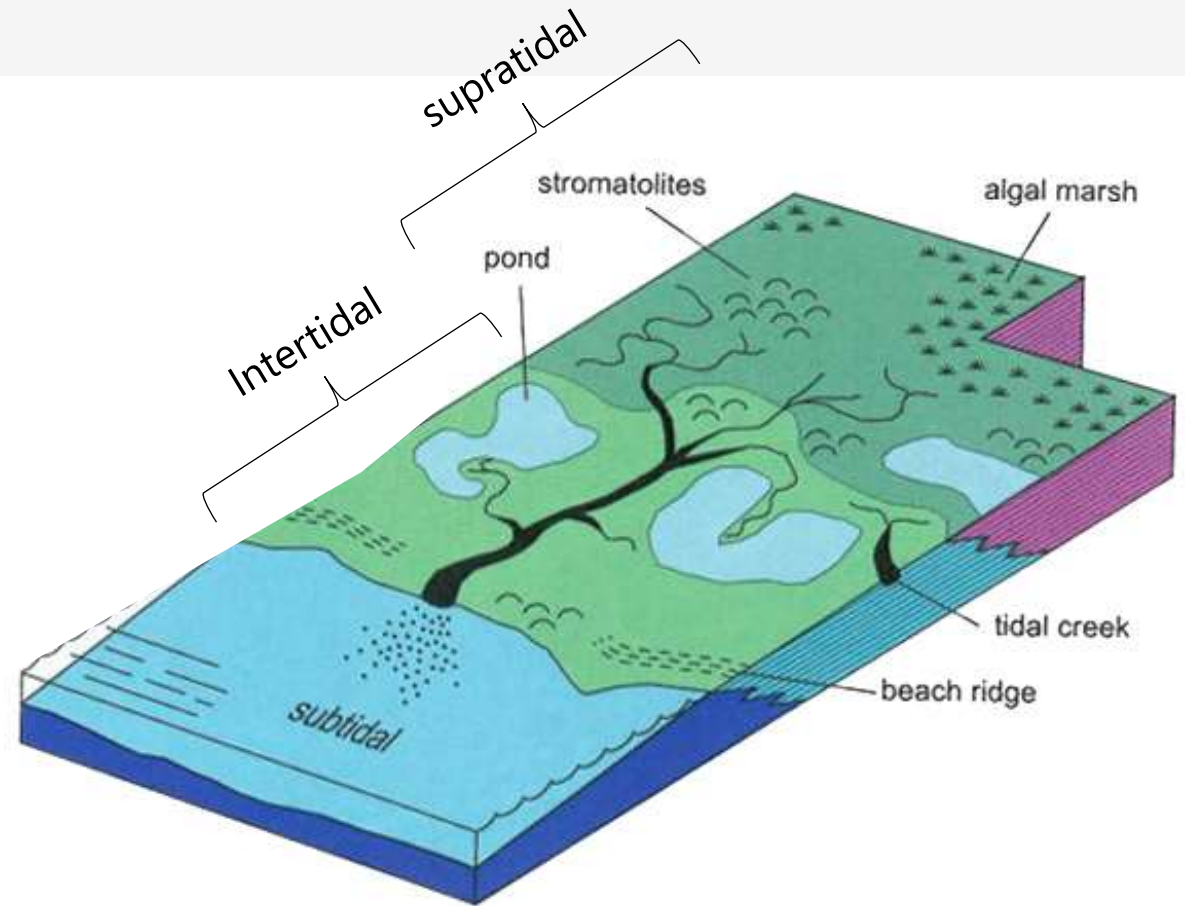


Zhang et al 2022

Supratidal = above high tide  
Intertidal = between low and high tide  
Subtidal = below low tide (underwater)

# Tidal Flat Stromatolites

---



# Supratidal Stromatolites - North Caicos, Turks & Caicos

---



Schizothrix

Scytonema

*Schizothrix*

Can handle frequent sedimentation

*Scytonema*

Dies with minimal sediment coverage

# Supratidal Stromatolites - North Caicos, Turks & Caicos

---



*Schizothrix*  
Can handle frequent sedimentation



*Scytonema*  
Dies with minimal sediment coverage

# Supratidal Cyanobacteria - West Caicos, Turks & Caicos

---



# Intertidal Stromatolites – Ambergris Cay, Turks & Caicos

---





# Intertidal Stromatolites – Shark Bay Australia

---



High tide



Low tide

# Subtidal Stromatolites – Exumas, Bahamas Islands

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**Subtidal stromatolites in the southern Exumas, Bahamas Islands. This bioherm is made up of "club-shaped" stromatolites in 6 m of water. Maximum measured height was 2 m.**



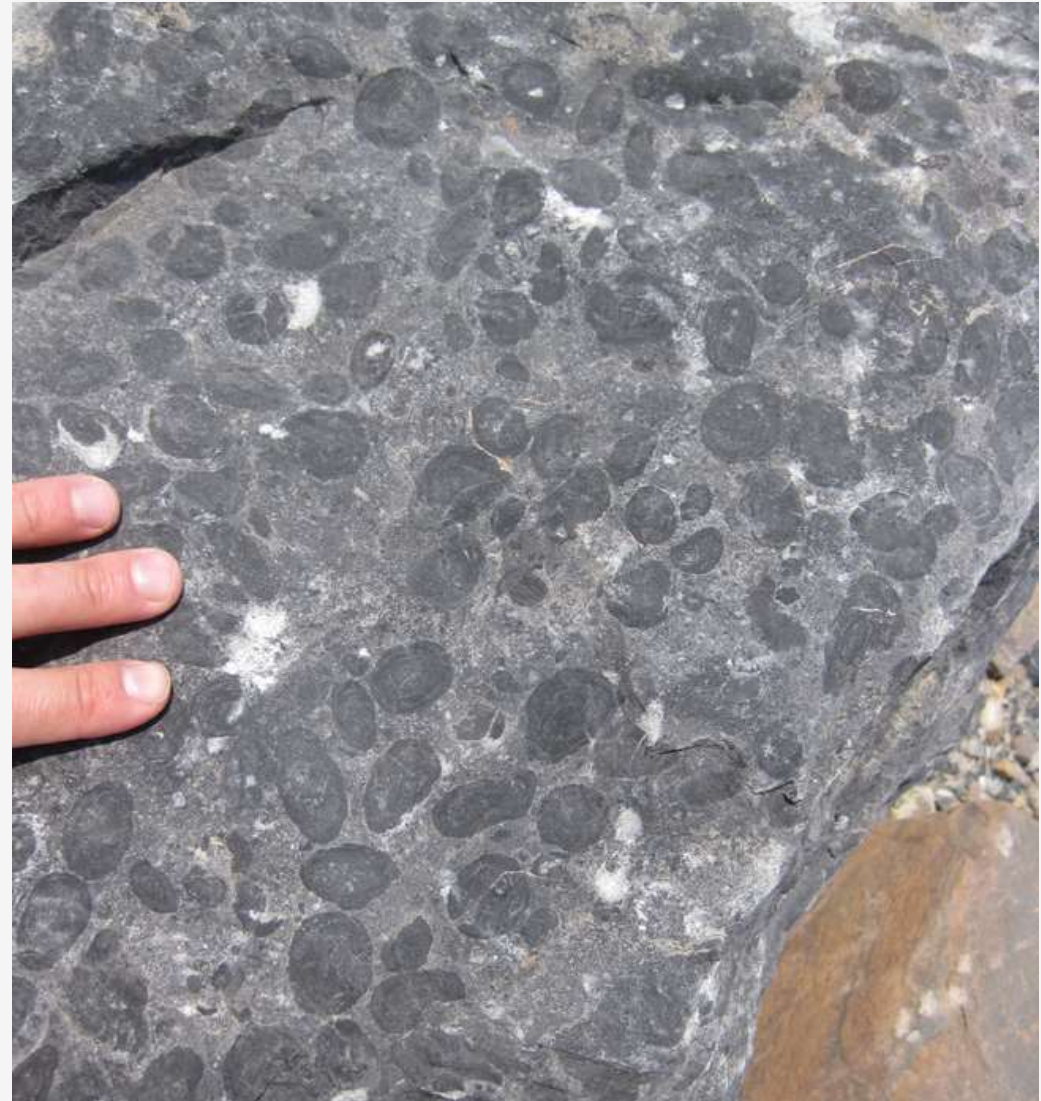
# Subtidal Stromatolites (Oncoids) – West Caicos, Turks & Caicos

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# Subtidal Stromatolites (Oncoids) – West Caicos, Turks & Caicos

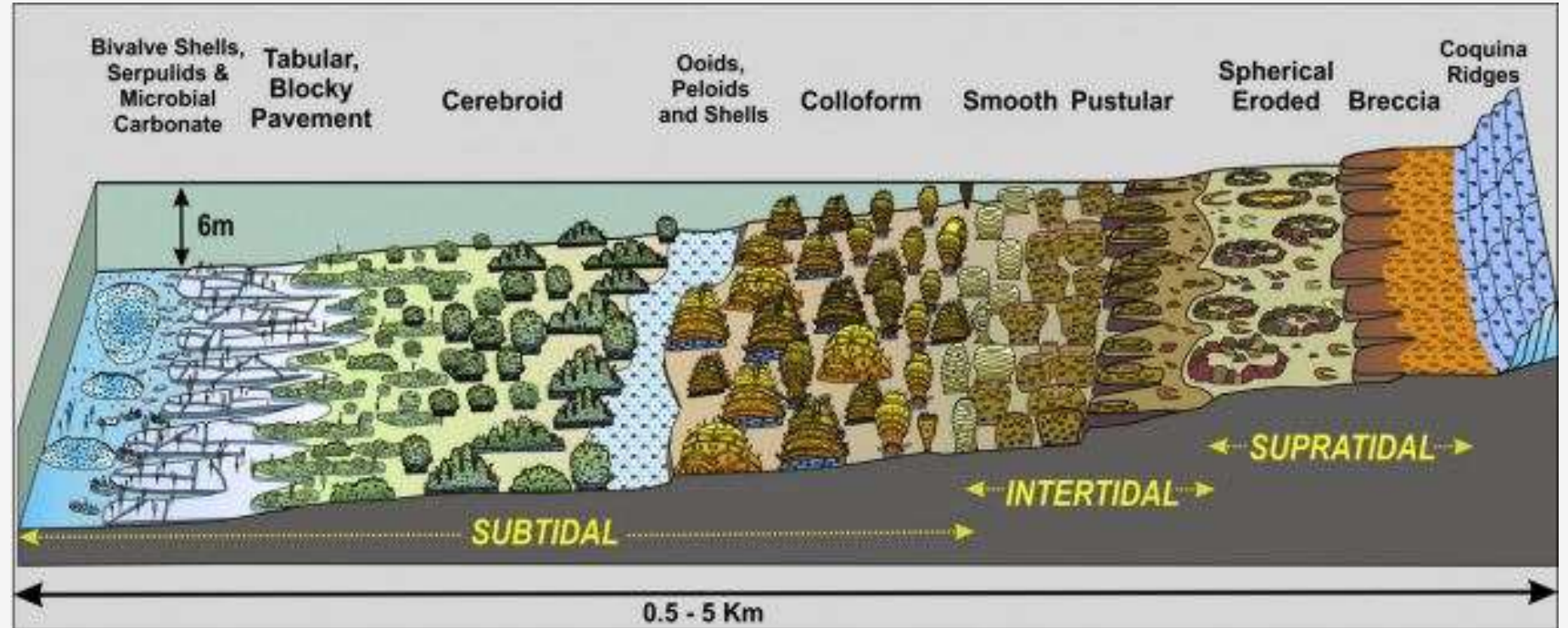
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# Environments of Deposition & Morphology

## Controls on Morphology

- Water depth
- Wave energy
- Light
- Species



Shark Bay Australia - Jahnert & Collins 2011

Supratidal = above high tide

Intertidal = between low and high tide

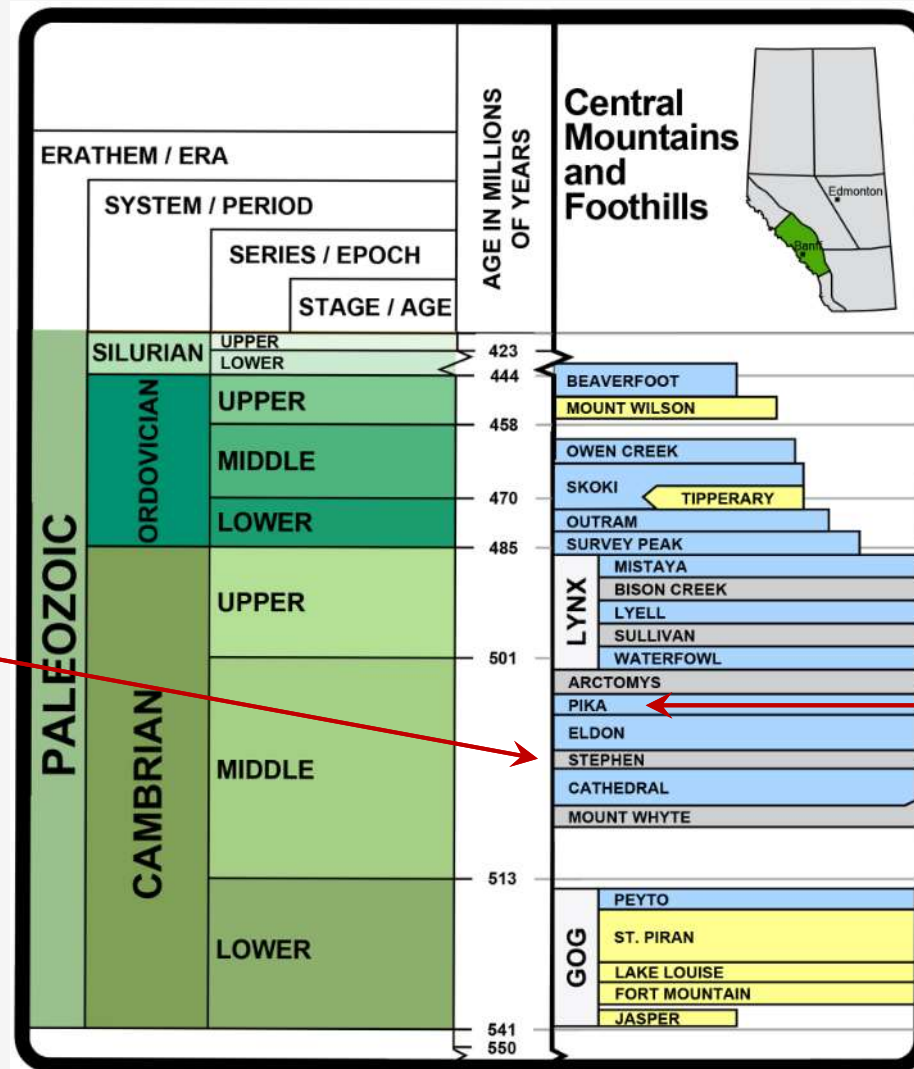
Subtidal = below low tide (underwater)

*Stromatolites of Dolomite Pass*



# Stratigraphy

Burgess Shale



Dolomite Pass/Helen Lake Stromatolites



**Recent Discovery of an Extensive Stromatolite Outcrop in the  
Middle Cambrian Pika Formation, Lake Helen-Lake Katherine Area,  
Banff National Park**

James Allan Dolph\*  
Gulf Canada Resources (retired), Calgary, AB  
ddolph@talisman-energy.com

and

David Gibson  
Geological Survey of Canada (retired), Calgary, AB, Canada

### Summary

The presence of minor stromatolite outcrops in the Lake Helen-Lake Katherine area, Banff National Park, have been known for several years, however, there does not appear to exist any published data on them. In 2004, David Gibson and Jim Dolph discovered an extensive outcrop (~800m by 10m) of exhumed, and well-preserved Stromatolite reef in the Middle Cambrian Pika Formation. A special feature of the outcrop is it allows an excellent view of the reef in three dimensions.

Fossil stromatolites represent the oldest form of life on earth, extending back some 3.7 billion years. They are considered to be accretionary microbial mats, commonly domal in habit. Stromatolites are still living today, most well known in Shark Bay, Western Australia.

In the Lake Helen-Lake Katherine area, the Pika Formation Stromatolites are generally 30 to 40cm in both height and diameter. They are elliptical in plan view which likely indicates the major paleocurrent directions. They are insitu, gently dipping, and fully exhumed. Both vertical and bedding plane sections are well exposed.

The stromatolite exposure is located on the east side of the unnamed ridge above Lake Helen on the north side of the hiking trail to Lake Katherine and Dolomite Pass. The beautiful 7km hike, with a 650m elevation gain, takes approximately 2.5 hours (one way). The purpose of this poster is to document and publicize the presence of this outcrop. The authors hope interested persons will enjoy seeing and examining them.

### Acknowledgements

The Seniors' Outdoor Club of Calgary organized the hike to the Lake Helen and Dolomite Pass area. Dave Gibson remarked that we should keep our eyes open for stromatolites. We did, and we discovered this extensive outcrop.



Figure 1: Bedding plane view of Middle Cambrian, Pika Formation Stromatolites



Figure 2: Sectional view of Middle Cambrian, Pika Formation Stromatolites

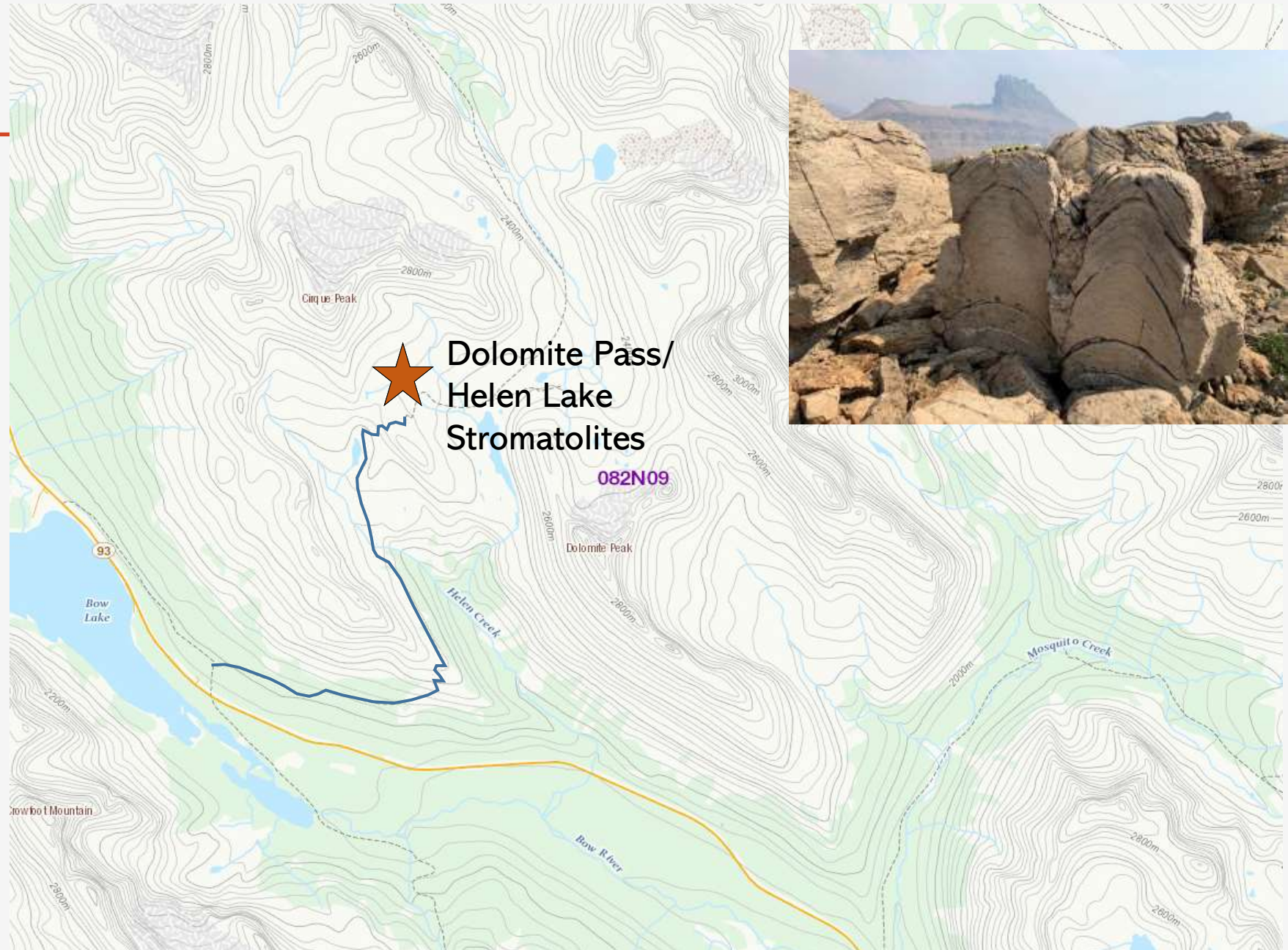


# Helen Lake

---

Distance: ~16 km

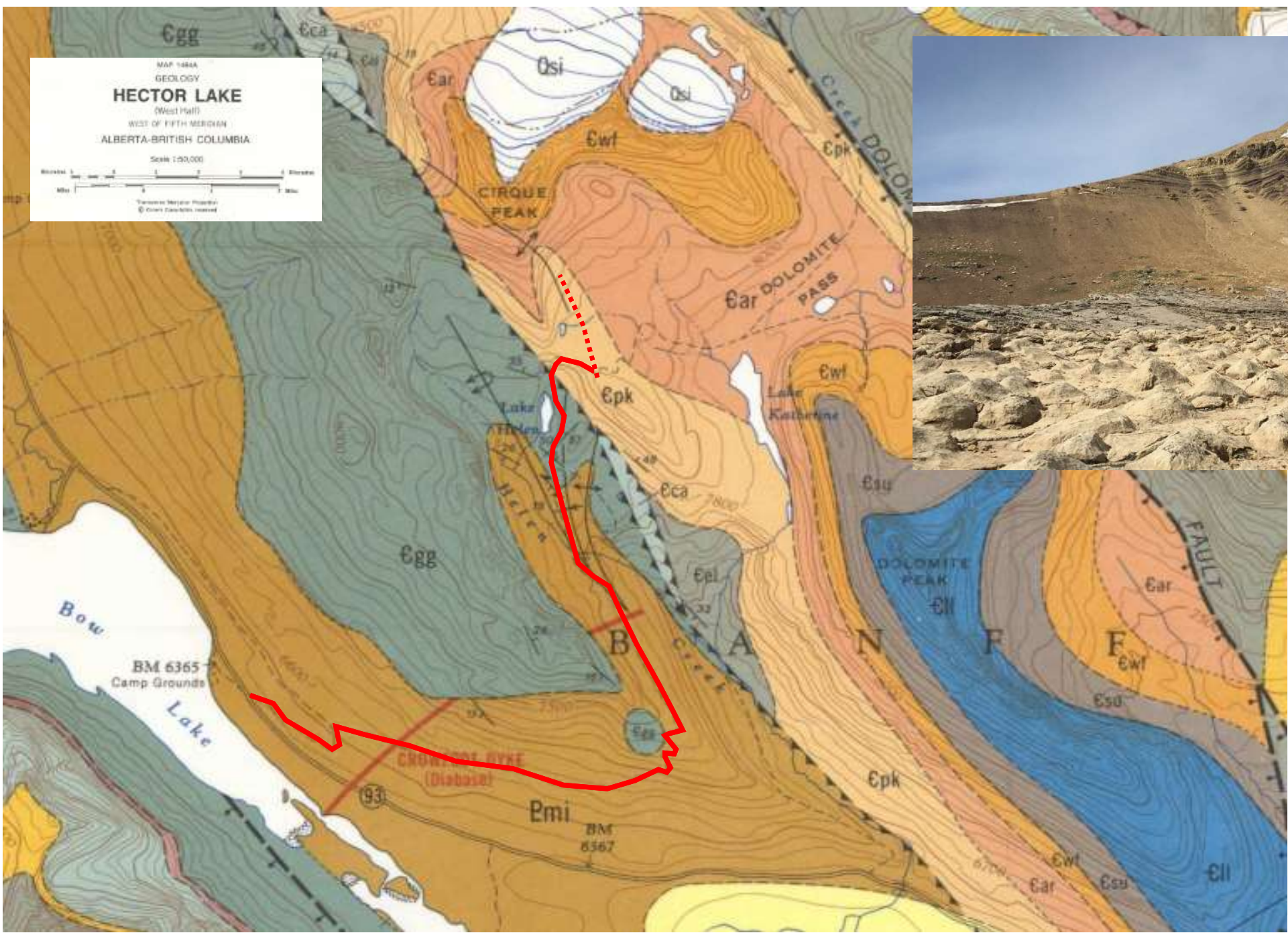
Elevation: 620 m



MAP 1484A  
GEOLOGY  
**HECTOR LAKE**  
(West Hill)  
WEST OF FIFTH MERIDIAN  
ALBERTA-BRITISH COLUMBIA

Scale 1:50,000

© Crown Intellectual Property  
© Queen's Printer, 2004



QUATERNARY

**Legend**

- Eat** STEPHEN FORMATION: shale, gray to green, interbedded with limestone, partly dense, fuggy with abundant pebbles, partly fragmental, minor pebbles
- Eca** CATHEDRAL FORMATION: limestone, mainly dense, massive, dolomite-mottled, dolomitized equivalents, mainly modified
- Ewf** MOUNT WYATTE FORMATION: shale, greenish-grey, interbedded with siltstone, green to grey, and limestone, mainly fragmental, partly siltite

LOWER CAMBRIAN

- Egl** BOG GROUP: mainly sandstone and quartzite, white, grey and red, thick-bedded, minor thinly interbedded siltstone and grey shale

PROTEROZOIC

- UPPER PROTEROZOIC (HADRYMAN)
- WANDERERS SUPERGROUP
- Ewi** WIETTE GROUP: grey silt and siltstone, poorly sorted grey and greenish-grey lithopatic, quartz sandstone and pebble and granule conglomerate, green and purple slate, dense limestone and sandy limestone (argillaceous)

**Stromatolites** (indicated by a red dashed line)

**Hiking trail** (indicated by a red solid line)

## Modern Stromatolites: Shark Bay in Western Australia

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# Helen Lake: Stromatolites

---

- laminated internal structure
- Height:
  - average 30-40 cm, up to 1 m
- Diameter:
  - average 30-50 cm, up to 1 m
- Domal Shape:
  - Circular (south)
  - Oblong (north)
- Exposure:
  - 10 m wide x 800 m long



## Helen Lake: Stromatolites

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## Helen Lake: Stromatolites

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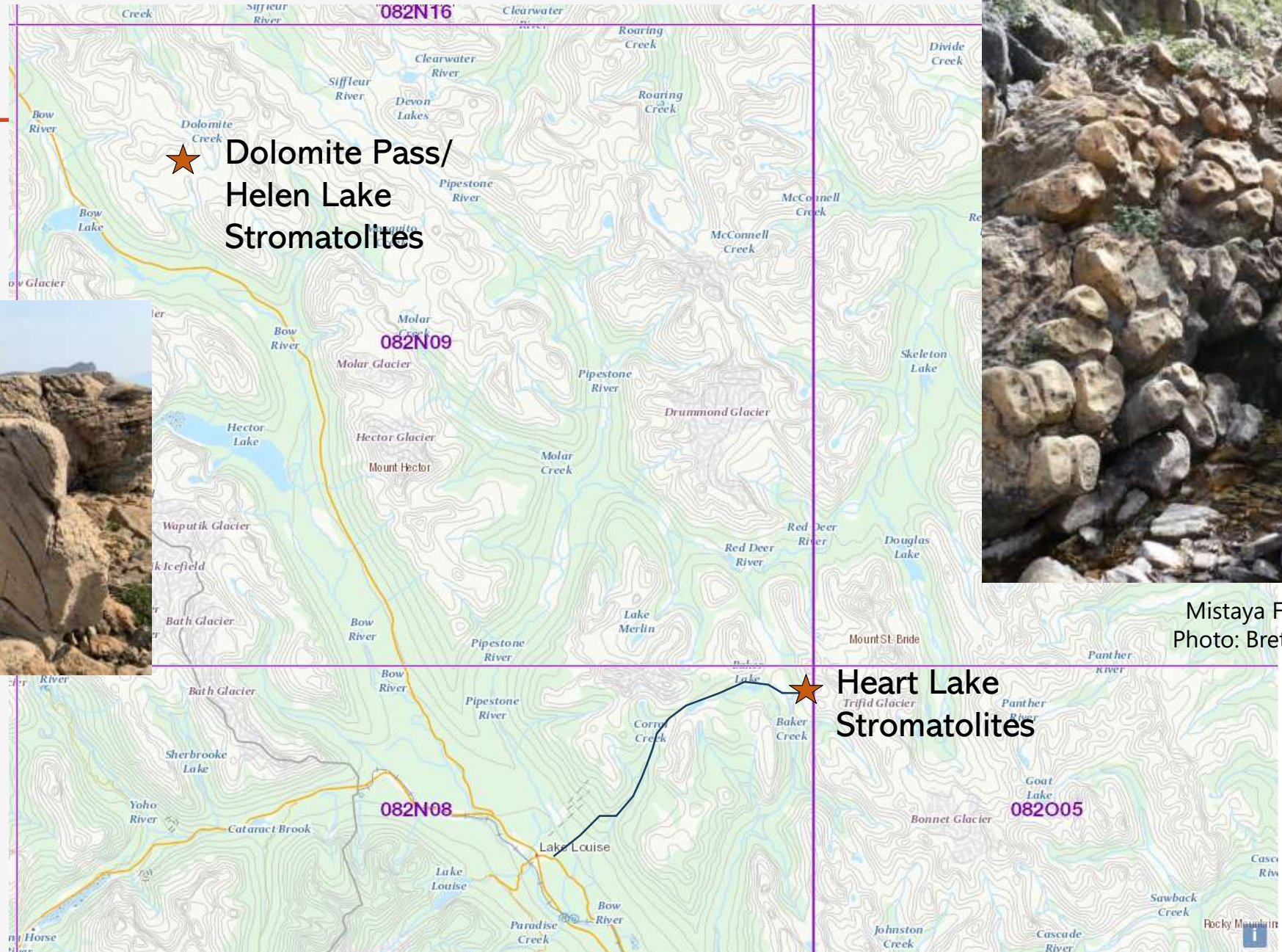
# Skoki Area

★ Dolomite Pass/  
Helen Lake  
Stromatolites



Mistaya Formation  
Photo: Brett Frostad

★ Heart Lake  
Stromatolites



# Skoki – Heart Lake Stromatolites

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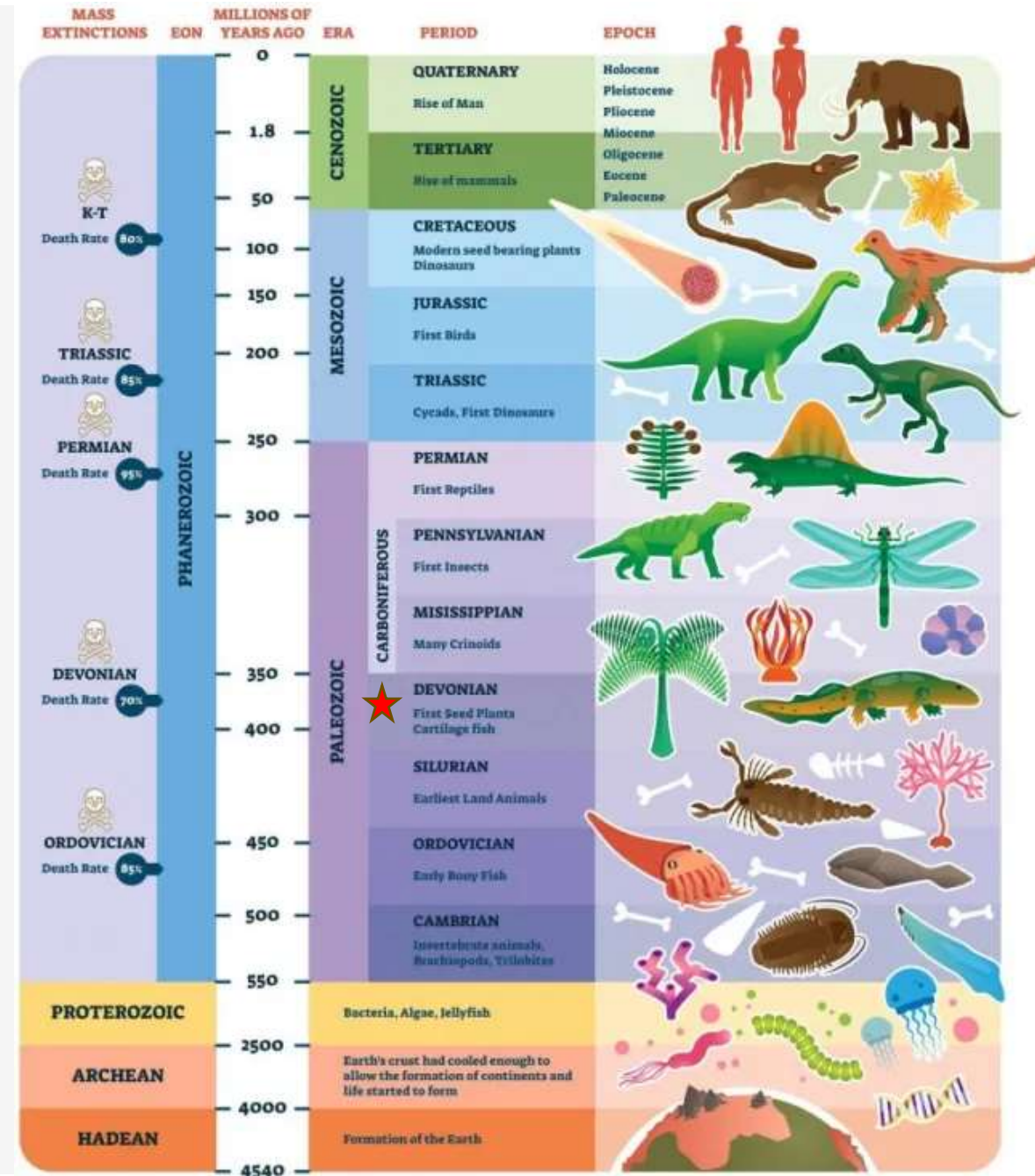


# Devonian

- First land plants
- Alberta was tropical and had reefs on the scale of the Great Barrier Reef



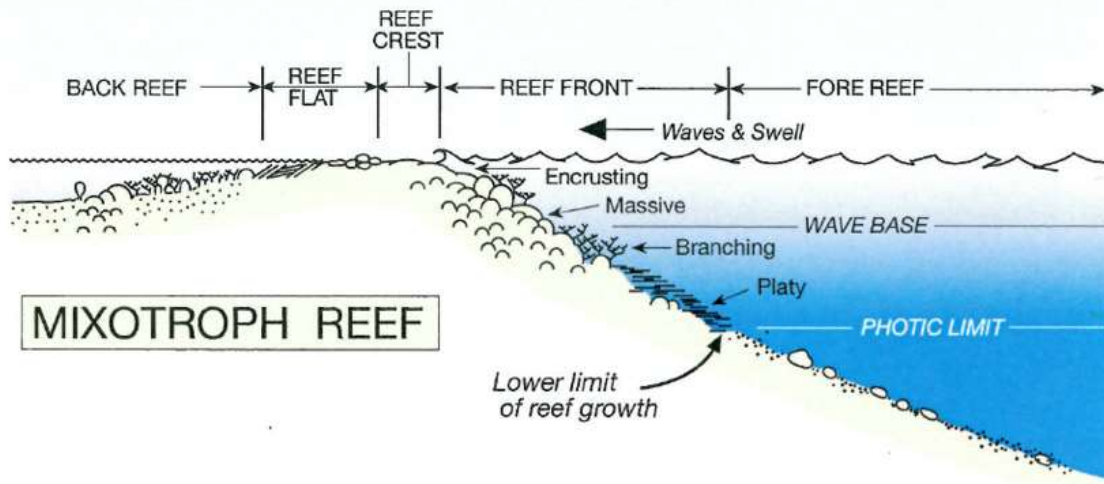
© Blakey



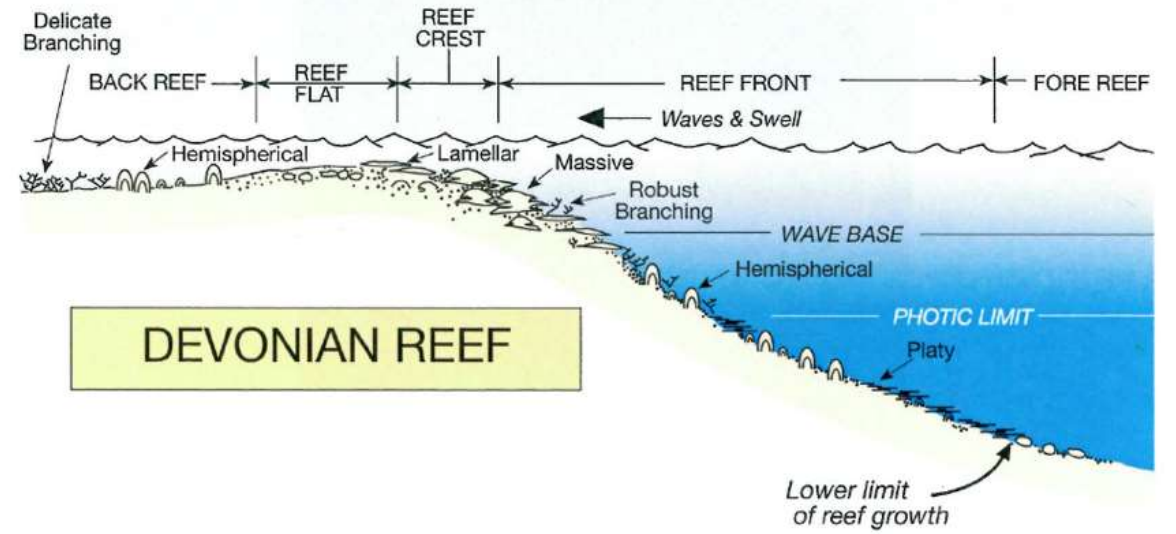
© normaals

# Modern vs Devonian

## ZONATION OF A SKELETAL REEF



## ZONATION OF A SKELETAL REEF



# Modern vs Devonian

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Corals

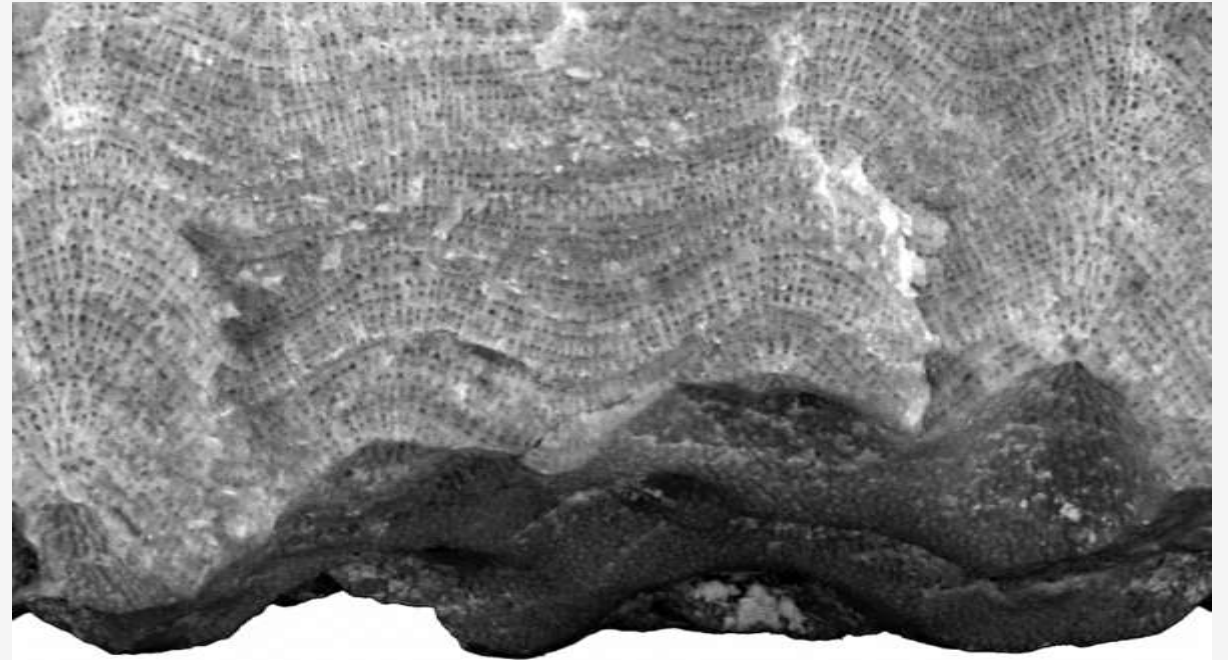


Stromatoporoids

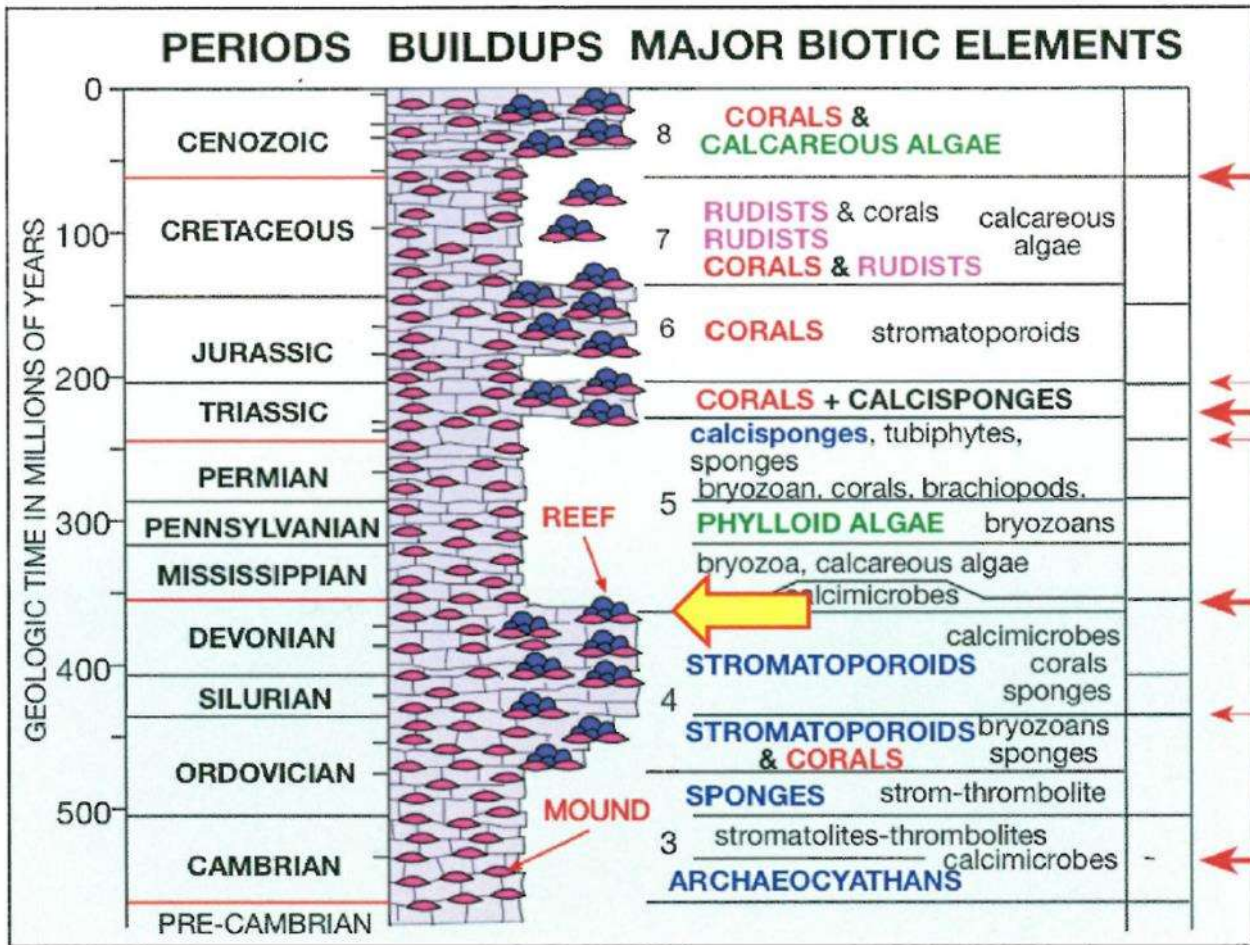
The critters are different, but the niches and morphologies are the same

# Stromatolite vs Stromatoporoid

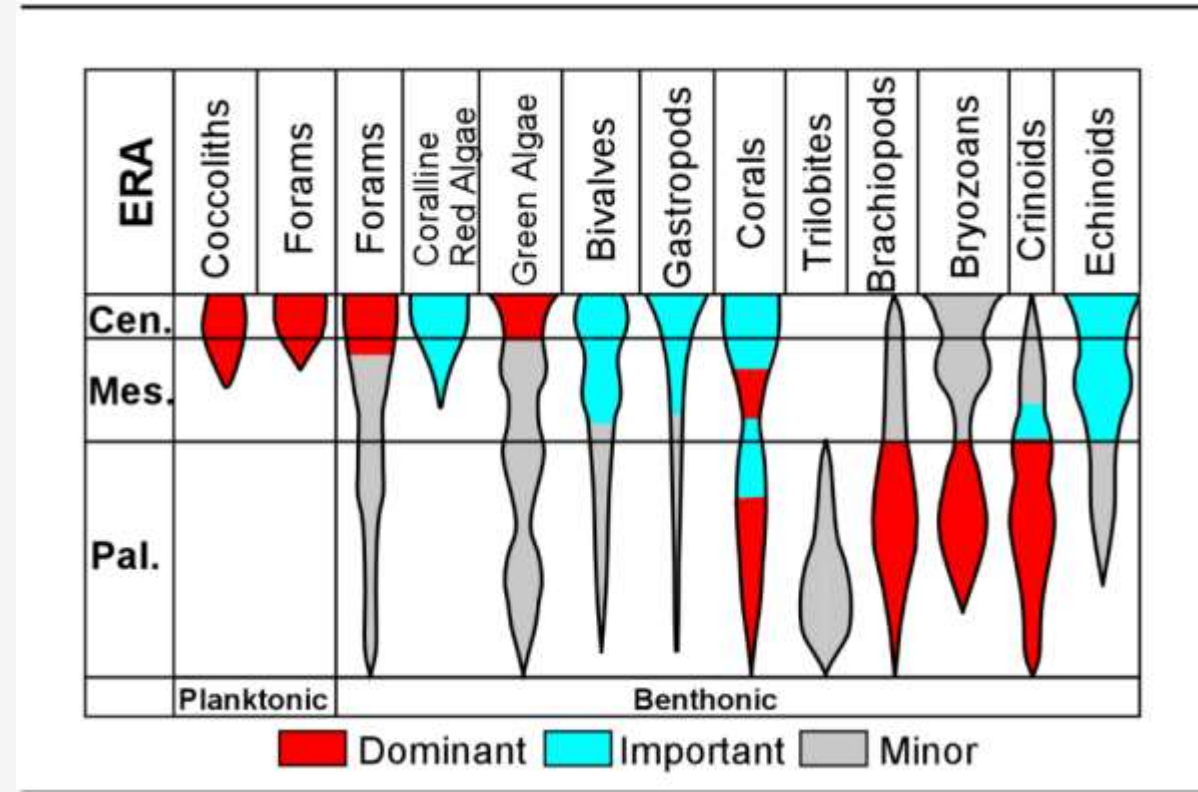
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# Reef Builders & Fossils



James, 1983



Wilkinson, 1982

# Devonian

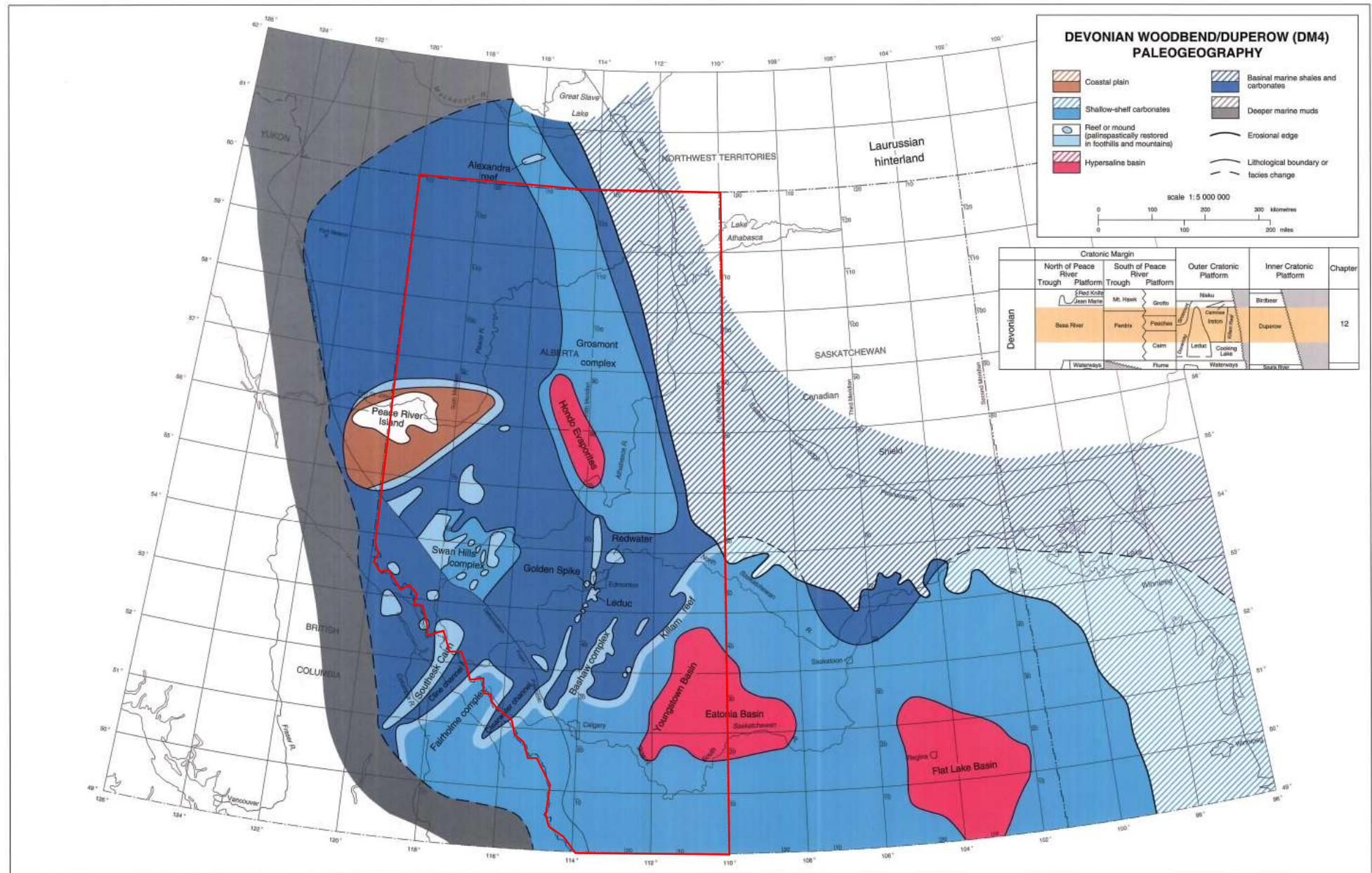


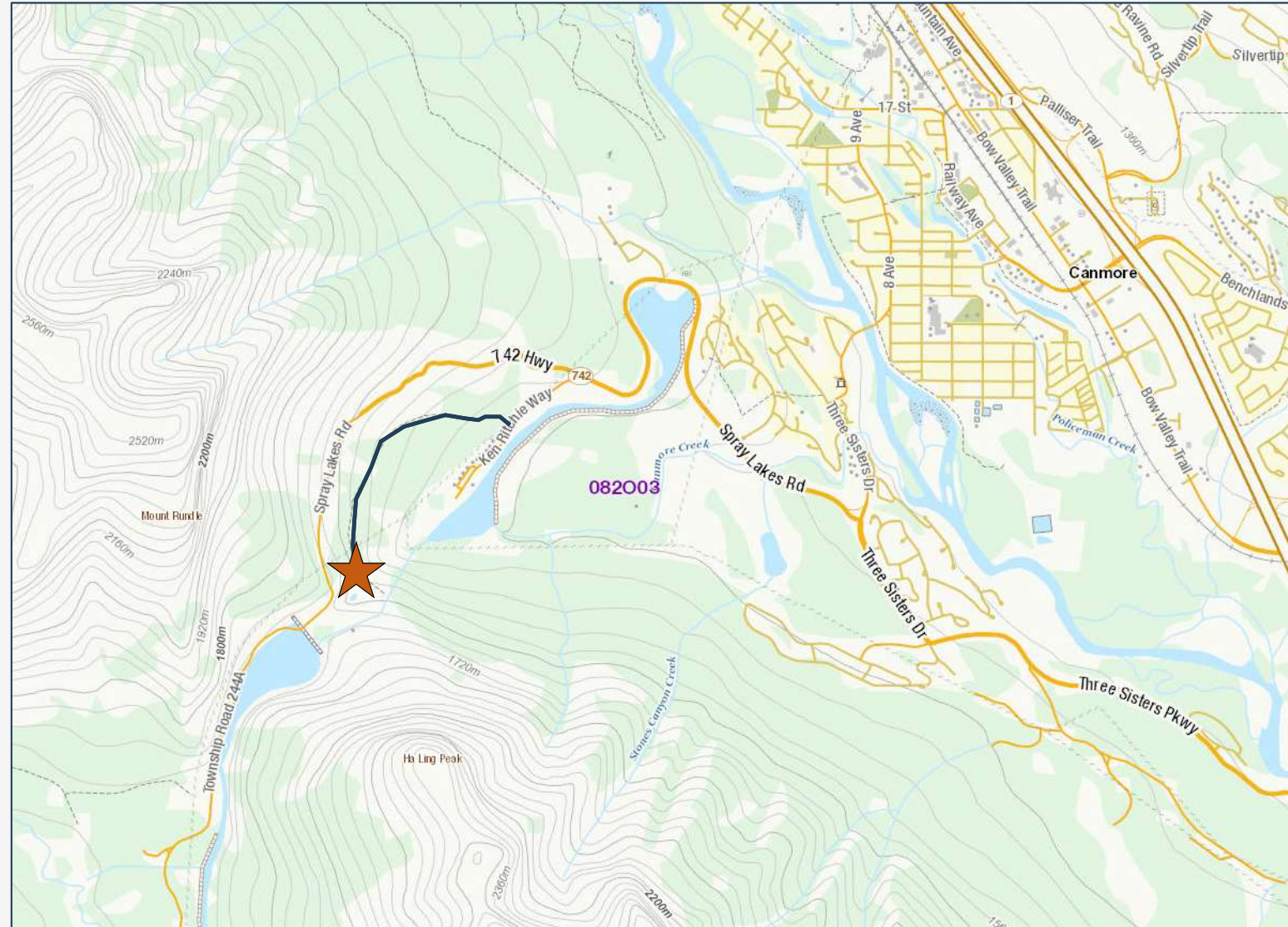
Figure 7.9 Paleogeography of the cratonic platform and margin during subinterval DM4. The outline of reefs on the cratonic margin is based largely on Moore (1989). Palinspastic restoration of their positions stems from Mountjoy (1980). The hypersaline basins on the eastern platform have some anhydrite but contain mainly halite. Thicknesses of the evaporites are in the order of 30 m (Kent, 1968b; Durn, 1976).



# Devonian - Grassi Lakes

Distance: 3.4 km

Elevation: 158 m



# Devonian – Grassi Lakes

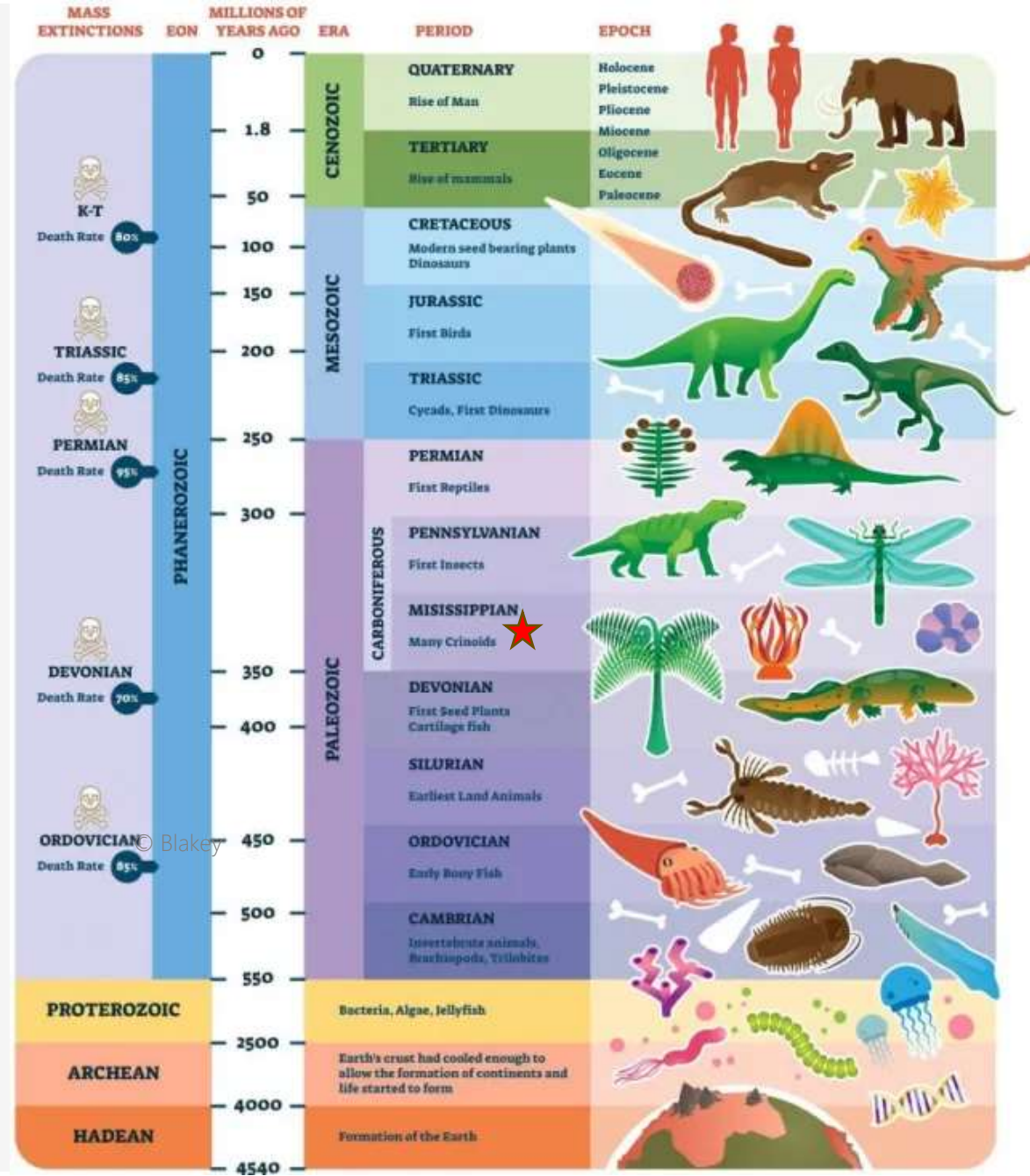
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# Timescale



© Blakey



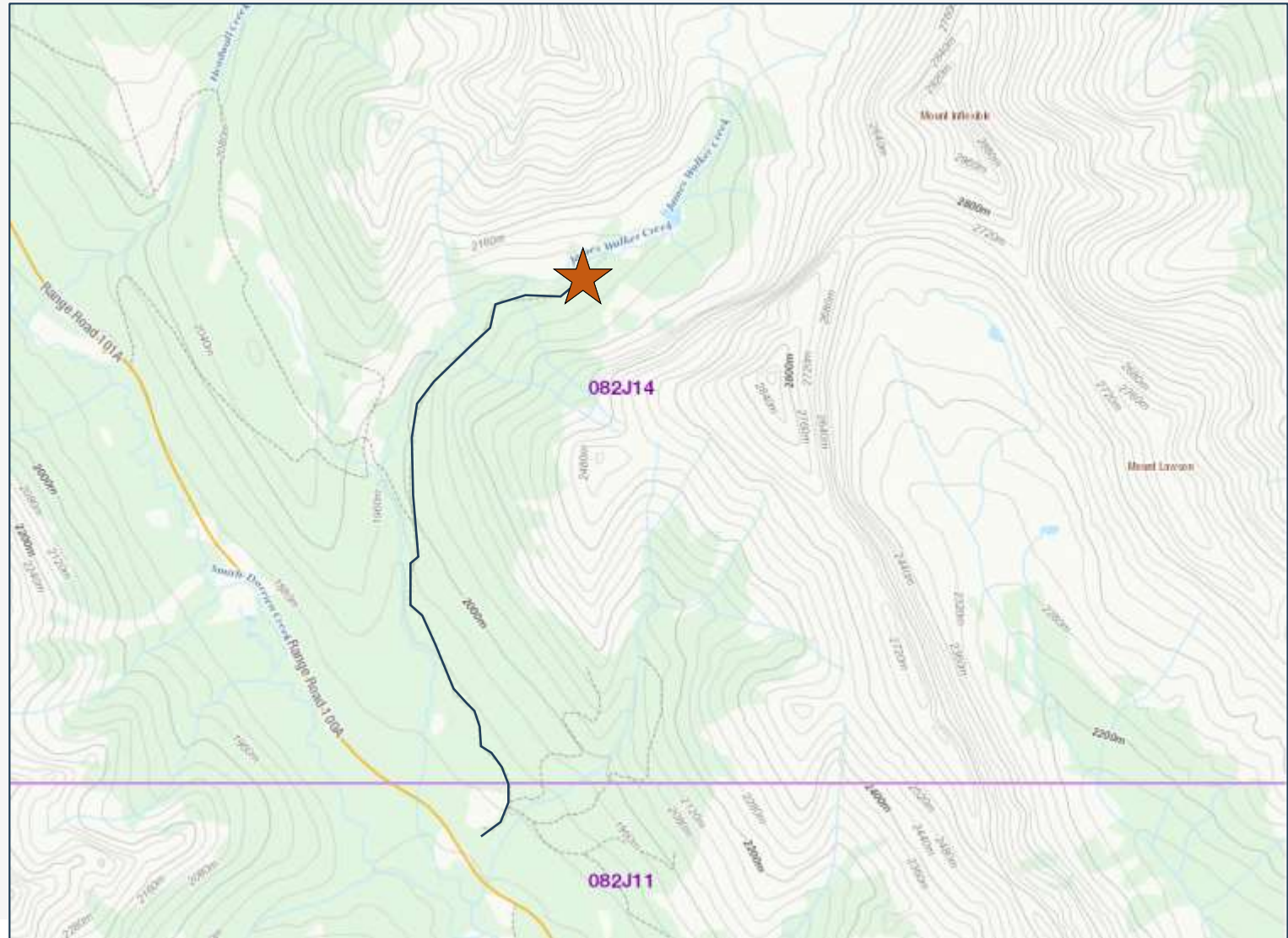
© normaals

# Mississippian - James Walker Creek

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Distance: 13 km

Elevation: 644 m



# Mississippian - James Walker Creek

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