

**January 10, 2022**

## **News and views**

Before going on with some more discussion on the Ordovician, let's look at some news items I thought were interesting.

## **Research**

- [Premature rejection in science: The case of the Younger Dryas Impact Hypothesis](#); when we look at the Quaternary, we'll examine the Younger Dryas Impact Hypothesis.
- [Mind-Blowing New Fossil Site Found in The 'Dead' Heart of Australia.](#)
- From the Geological Society Of America: [New Geology articles published online ahead of print in December Peer-Reviewed Publication](#); lots of neat stuff here.
- [New research questions 'whiff of oxygen' in Earth's early history](#); new research into The Great Oxygenation Event.
- More on the Ediacaran: [Extensive primary production promoted the recovery of the Ediacaran Shuram excursion.](#)
- [Triassic Dinosaur Footprints Discovered in Wales.](#)

## **From Out of this World**

- [China's rover checks out that weird cube on the moon—surprise! It's a rock.](#)
- [Pittsburgh New Year's Day meteor explosion equivalent to 27 tonnes of TNT, says NASA.](#)

## **Volcanoes**

- [Crystals from Popocatepetl volcano reveal the links between magma recharge patterns and eruption style.](#)
- [Galápagos islands volcano erupts spewing lava and clouds of ash.](#)
- Cumbre Vieja volcano, La Palma: [Spain volcano island residents return home to battle ash](#); also [Scientists coolly recall fiery volcano visit.](#)
- [Elderly Man Dies After Falling Into Hawaii's Kilauea Volcano.](#)
- [Into the Inferno: Victims, Families Claim Royal Caribbean Sent Them to Active Volcano.](#)
- [Watch this Indonesian volcano explode in an amazing display.](#)
- [Worldwide Volcano News and Updates.](#)

## **Earthquakes**

- [An explosive component in a December 2020 Milan earthquake suggests outgassing of deeply recycled carbon.](#)
- Near Lima, Peru: [M 5.6 - 3 km N of Cocachacra, Peru.](#)

- [Strong earthquake shakes remote area in western China.](#)
- [Using mortar filled tennis balls to make structures more resistant to earthquakes.](#)
- [4.7 magnitude earthquake recorded off west coast of Vancouver Island.](#)
- [Strong Earthquakes Spell Trouble For America's Oil Heartland](#); may be caused by fracking.
- [Latest Earthquakes from the United States Geological Survey \(USGS\)](#); also [USGS Significant Earthquakes, Past Month.](#)

## Landslides

- From the country formerly known as Burma: [fatal jade mine landslide in Myanmar.](#)
- [Canyon wall falls onto boats in Brazil and kills several people, authorities say](#)

## Mining and Energy

- Batteries: [High Lithium Prices Could Last Well Into 2022.](#)
- [Gas Prices In Europe Are Soaring Again Amid New Cold Snap.](#)
- From the U.S. Energy Information Administration (USEIA): [Crude oil prices increased in 2021 as global crude oil demand outpaced supply.](#)
- [World's biggest uranium miner says unaffected by Kazakh turmoil.](#)
- Natural gas fire: [Turkmenistan plans to close its 'Gateway to Hell'.](#)

## Upcoming Events

<b>GAC- MAC- IAH-CNC- CSPG</b>	<b>AGC- AMC- AIH-SNC- SCGP</b>	
<b>May 15-18</b>	<b>15-18 mai</b>	

Mark your calendars! Join us in Halifax from May 15-18, 2022 for the Annual Meeting of the Geological Association of Canada (GAC), Mineralogical Association of Canada (MAC), Canadian Society of Petroleum Geologists (CSPG) and International Association of Hydrogeologists Canadian National Committee (IAH-CNC). This meeting coincides with the 50<sup>th</sup> anniversary of the Atlantic Geoscience Society, the conference host organization. The conference promises a diverse program including special sessions, field trips, and short courses related to a wide variety of geoscience disciplines.

Please visit our website: <http://ags.earthsciences.dal.ca/Halifax2022/> and follow the conference social media accounts on Facebook (Halifax Geoscience), Twitter (HalifaxGeo2022) and Instagram (halifaxgeo2022) for more information.

See you in Halifax!

Link: <https://gac.ca/gac-mac-halifax2022/>

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## Ordovician Period, Part 2, Life in the Ordovician

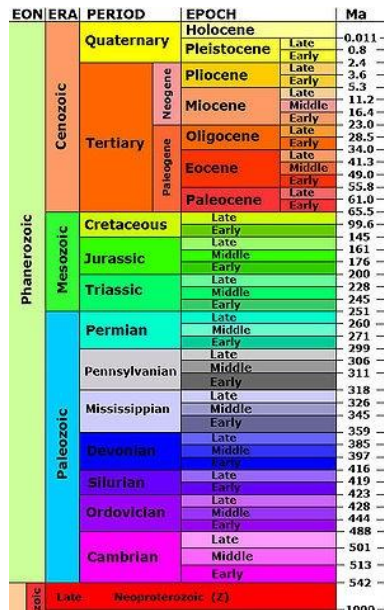


Figure 1 - Phanerozoic Time Scale

Credit: Modified from File: [Geologic time scale.jpg](#),  
[United States Geological Survey](#), public domain

This week we'll look at life during the Ordovician. We'll look at the mass extinction event at the Cambrian/Ordovician boundary, the [Great Ordovician Biodiversification Event](#), and the mass extinction event at the end of the Ordovician. But first, do we mean by a "mass extinction event"?

### Mass Extinction Events



Figure 2 - Cretaceous–Paleogene Boundary, Drumheller, Alberta  
Credit: [Glenlarsen](#), public domain

Extinction events are marked in the fossil record by a change in the kinds of fossils found in deposits below and above the event boundary, as in Figure 2, above. These changes in fossil assemblages are used to delineate the various eons, eras, periods and epochs of the geological timescale, as in Figure 1, and indicate the extinction of the old species together with the rise of new ones. When a large percentage of the organisms go extinct, it is called a [Mass Extinction Event](#).

We've noted in previous blog postings ([here](#) and [here](#)) that there were at least two mass extinctions in the [Proterozoic Eon: The Great Oxygenation Event](#) and the [Ediacaran-Cambrian Transition](#). Within the present [Phanerozoic Eon](#), there have been at least 5 great mass extinctions:

1. The [Ordovician Mass Extinction](#), at the end of the Ordovician Period, when Up to 85% of all living species went extinct;
2. The [Late Devonian Mass Extinction](#), when nearly 80% of all living species went extinct;
3. The [Permian–Triassic Mass Extinction](#), when an estimated 96% of all living species went extinct;
4. The [Triassic-Jurassic Mass Extinction](#), when more than half of all living species went extinct; and
5. The [Cretaceous–Paleogene Mass Extinction](#) when nearly 75% of all living species went extinct.

Some people are proposing that we are currently living through a sixth mass extinction, often called the [Anthropocene Extinction](#).

So what causes extinction events? In general, changing conditions, but this can include many causes, such as:

- Changing climate brought about by things like plate tectonics and volcanic activity, as suggested for the Permian-Triassic Extinction;
- Proliferation of novel organisms as in the arrival of burrowing organisms at the end of the Ediacaran Period, or the explosive growth in the number of human beings in the Anthropocene Extinction;
- Extraterrestrial impacts, such as the one thought to have initiated the Cretaceous–Paleogene Mass Extinction; or
- A combination of any of the above.

Let's look at the mass extinctions that bracket the Ordovician Period and what happened in between.

## Cambrian–Ordovician Extinction Event

The [Cambrian–Ordovician extinction event](#) marked the end of the Cambrian Period and the beginning of the Ordovician Period. This extinction event eliminated many [brachiopods](#) and [conodonts](#), as well as severely reducing the number of [trilobite](#) species. Proposed causes for the Cambrian–Ordovician extinction event include:

- Glaciation;
- Depletion of oxygen in marine waters; and
- The deposit of flood basalts in the Kalkarindji large igneous province, Australia.

## The Great Ordovician Biodiversification Event



Depicted organisms include a straight-shelled nautiloid cephalopod, *Isotelus* & *Flexicalymene* trilobites, *Grewingkia* horn corals, colonial corals, bivalves, gastropods, brachiopods, bryozoans, crinoids, edrioasteroids, starfish, and algae.

**Figure 3 - Diorama of a Late Ordovician Seafloor**

**Credit: [James St. John, Creative Commons Attribution 2.0 Generic](#) license**

The Ordovician Period was marked by the evolutionary radiation of animal life into hundreds of new evolutionary niches, this has been called the [Great Ordovician Biodiversification Event](#). Just as there were many causes proposed for the extinction event at the beginning of the Ordovician, there have been many causes proposed for subsequent biodiversification event. These include:

- Changes in paleogeography or tectonic activity, creating many new opportunities for organisms;
- A warm climate with high CO<sub>2</sub> levels, also creating many new opportunities in the nutrient-rich environment; and
- [The Ordovician meteor event](#).

Probably all these causes acted together. Regardless, the effect of the biodiversification event was to increase the number of species around the world, as evidenced in the fossil record. Here are some examples of life in the Ordovician:

## Life in The Ordovician

## Trilobites



**Figure 4 - *Ceraurus* sp. - Fossil Trilobite, Ordovician, Picton, Ontario**  
**Credit: [James St. John](#), [Creative Commons Attribution 2.0 Generic](#) license**

While there were plenty of trilobites in the Cambrian, the Ordovician trilobites often developed spines and nodules and other defenses against predators such as [eurypterids](#) and [nautiloid molluscs](#). Some, such as *Aeglina prisca* evolved into free swimming forms to better escape predators. Others, such as trinucleid trilobites developed a broad pitted margin around their head shields. *Asaphus kowalewski* evolved long eyestalks, presumably to better detect predators.

## Brachiopods



**Figure 5 - Brachiopods, Upper Ordovician Waynesville Formation, Ohio**  
**Credit: [James St. John](#), [Creative Commons Attribution 2.0 Generic](#) license**

[Brachiopods](#), also called "lamp shells", are bivalves that are totally unrelated to mollusc bivalves. They were abundant during the Ordovician and formed reefs. One brachiopod that first appeared in the Ordovician, of the genera [Lingula](#), persists to this day.



Figure 6 - *Lingula sp.*, Devonian

Credit: [Adrignola](#)



Figure 7 - *Lingula anatina*, Holocene

Credit: [Drow male](#)

for both figures: [Creative Commons Attribution-Share Alike 3.0 Unported, 2.5 Generic, 2.0 Generic & 1.0 Generic](#) license

## Reef-Forming Corals

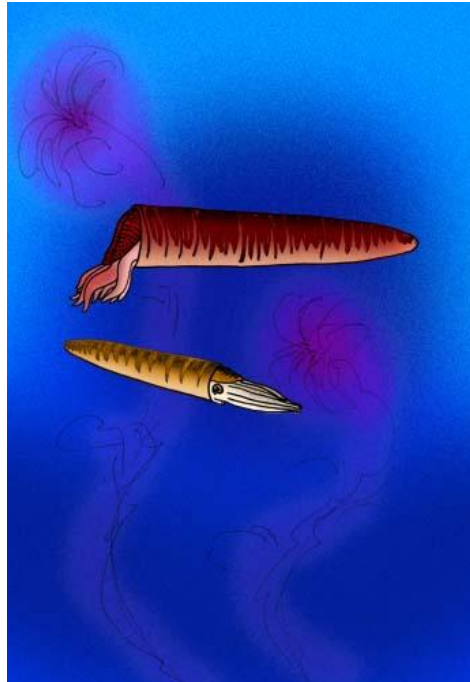


Figure 8 - *Calapoecia huronensis*, Upper Ordovician Waynesville Formation, Ohio

Credit: [Wilson44691, Creative Commons CC0 1.0 Universal Public Domain Dedication](#)

Although solitary corals occur as early as the Ediacaran in the fossil record, reef building tabulate corals, such as *Calapoecia huronensis*, above, first appeared in the Ordovician.

### Nautiloid Cephalopods



**Figure 9 - Artist's Depiction of *Buttoceras adami* (top), and *Oxfordoceras billingsly***  
**Credit: [Apokrytaros](#), [Creative Commons Attribution-Share Alike 4.0 International](#) license**

Related to modern day cephalopods, squids, octopus, and cuttlefish, [nautiloid cephalopods](#) evolved during the Cambrian and became numerous in the Ordovician. Some species of nautiloids have survived to this day. They were and are predators.

### Graptolites



**Figure 10 - *Leptograptus* graptolites, Ordovician Viola Formation, Oklahoma**  
**Credit: [James St. John](#), [Creative Commons Attribution 2.0 Generic](#) license**

Looking like pencil marks on the rock, [graptolites](#) fossils are remains of a colonial [hemichordate](#) animals. The fossils are found from the Upper Cambrian to the Lower Carboniferous (Mississippian). Graptolites appear to have thrived during the Ordovician.

## Crinoids



**Figure 11 - *Xenocrinus baeri*, Ordovician Crinoids, Ohio, USA**  
Credit: [James St. John](#), [Creative Commons Attribution 2.0 Generic](#) license

Also called sea-lilies, [crinoids](#) are [echinoderms](#), related to starfish and sea urchins. Crinoids are sedentary filter feeding creatures that first appeared in the Ordovician. Crinoids continue to persist to modern times.



**Figure 12 - Modern Crinoid, Pandan Is., The Philippines**  
Credit: [Dr. Dwayne Meadows](#), [Creative Commons Attribution 2.0 Generic](#) license.

## **Standard Caveat**

The purpose of my weblog postings is to spark people's curiosity in geology. Don't entirely believe me until you've done your own research and checked the evidence. If I have sparked your curiosity in the subject of this posting, follow up with some of the links provided here. If you want to, go out into the field and examine some rocks on your own with the help of a good field guide. Follow the evidence and make up your own mind.

In science, the only authority is the evidence.