Plate Tectonics
Part 1: Exploring Continental Drift

EARTH AND SPACE SCIENCES

QGC | FUTUREMAKERS | QUEENSLAND MUSEUM NETWORK | Queensland Government

Introduction

The Queensland Museum Network has one of the largest and most significant Geosciences Collections in the southern hemisphere. The Geosciences Collection consists of 55,000 geological samples and 27,000 mineral samples, as well as over 7 million fossil specimens!

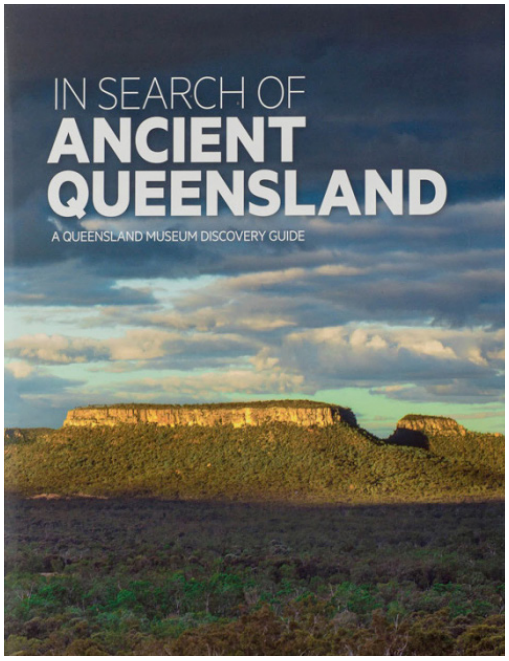
This includes nearly 10,000 primary type specimens (reference specimens used to identify, name and classify fossil plant or animal species).

The Geosciences Collection contains pivotal resources that help scientists to:

- Discover and document past Australasian biodiversity as revealed from the fossil record.
- Interpret the evolutionary history of animals and plants over 3000 million years.
- Understand the geological history of Australia and how that impacted upon both terrestrial and marine ecosystems.
- Understand historical environmental changes in Australia as seen in the fossil record.
- Interpret past climates and understand how living things responded to these climatic and environmental changes.
- Use historical data to predict future trends, and infer how ecosystems may respond to the changing climate and environment.

Resources

This resource may be used individually or with the Queensland Museum online resources *Plate Tectonics Part 1-3*, and *Volcanoes*.



Much of this information has been sourced from the book *In Search of Ancient Queensland* which can be purchased from the Queensland Museum shop in-store or online (ISBN: 9780977594306).

More information and fossils from ancient Queensland can be seen in the Queensland Museum's *Lost Creatures* exhibition, Brisbane.

SparkLab, Sciencentre has a large 360° globe, *Science On a Sphere (SOS)*, that can be used to display changes in global environmental conditions over time. School visits to the Queensland Museum and Sciencentre can be made on our group bookings page.

Future Makers is an innovative partnership between Queensland Museum Network and Shell's QGC project aiming to increase awareness and understanding of the value of science, technology, engineering and maths (STEM) education and skills in Queensland.

This partnership aims to engage and inspire people with the wonder of science, and increase the participation and performance of students in STEM-related subjects and careers — creating a highly capable workforce for the future.

Activity Overview
Exploring Continental Drift

In the following activity you will use fossil evidence from the Queensland Museum to identify how the continents have moved over time.

Recreate Gondwana using the map and fossil evidence provided. Use this map to answer questions.

Teacher Tips

- The map 'Recreating Gondwana' can be laminated for reuse.
- Scientists work collaboratively. Questions and activities can be conducted in groups of 3–4 to maximise learning.
- Question 5 looking at additional evidence for continental drift can be set as a research task. Alternatively, set each group to work on a different piece of evidence and get them to explain it to the class.

Australian Curriculum Links

Year 9 Curriculum focus

Science Understanding

Earth and Space Science

The theory of plate tectonics explains global patterns of geological activity and continental movement (ACSSU180)

Science Inquiry Skills

Use knowledge of scientific concepts to draw conclusions that are consistent with evidence (ACSIS170)

Evaluate conclusions, including identifying sources of uncertainty and possible alternative explanations, and describe specific ways to improve the quality of the data (ACSIS171)

Communicate scientific ideas and information for a particular purpose, including constructing evidence-based arguments and using appropriate scientific language, conventions and representations (ACSIS174)

Critically analyse the validity of information in primary and secondary sources and evaluate the approaches used to solve problems (ACSIS172)

Science as a Human Endeavour

Scientific understanding, including models and theories, is contestable and is refined over time through a process of review by the scientific community (ACSHE157)

Exploring Continental Drift and Plate Tectonics

Fossils, the preserved remains of ancient life, provide evidence for what the world was like in the distant past. In this activity you will use fossil evidence to investigate how scientists developed the theory of continental drift.

The geographic distribution of fossils around the world can help us understand species distribution and their evolution. However, early scientists had trouble explaining how some plant fossils like *Glossopteris* (Figure 1) could be found in what is now tropical Queensland, as well as 7000 km away in Antarctica (and also in Africa and South America)!

The past distribution of plants, on what are now widely separated continents, was one piece of evidence that led to the development of the theory of continental drift by Alfred Wegener in 1912. This theory proposed that all continents had once been part of a giant landmass called Pangaea, which split into Laurasia in the north and Gondwana in the south. These landmasses continued to move and separate over time to form the continents as we know them today.

Figure 1: Fossilised *Glossopteris* leaves and the jointed stems of horsetails found in the Permian deposits of the Bowen Basin, Queensland *QMF58633, QM, Gary Cranitch.*

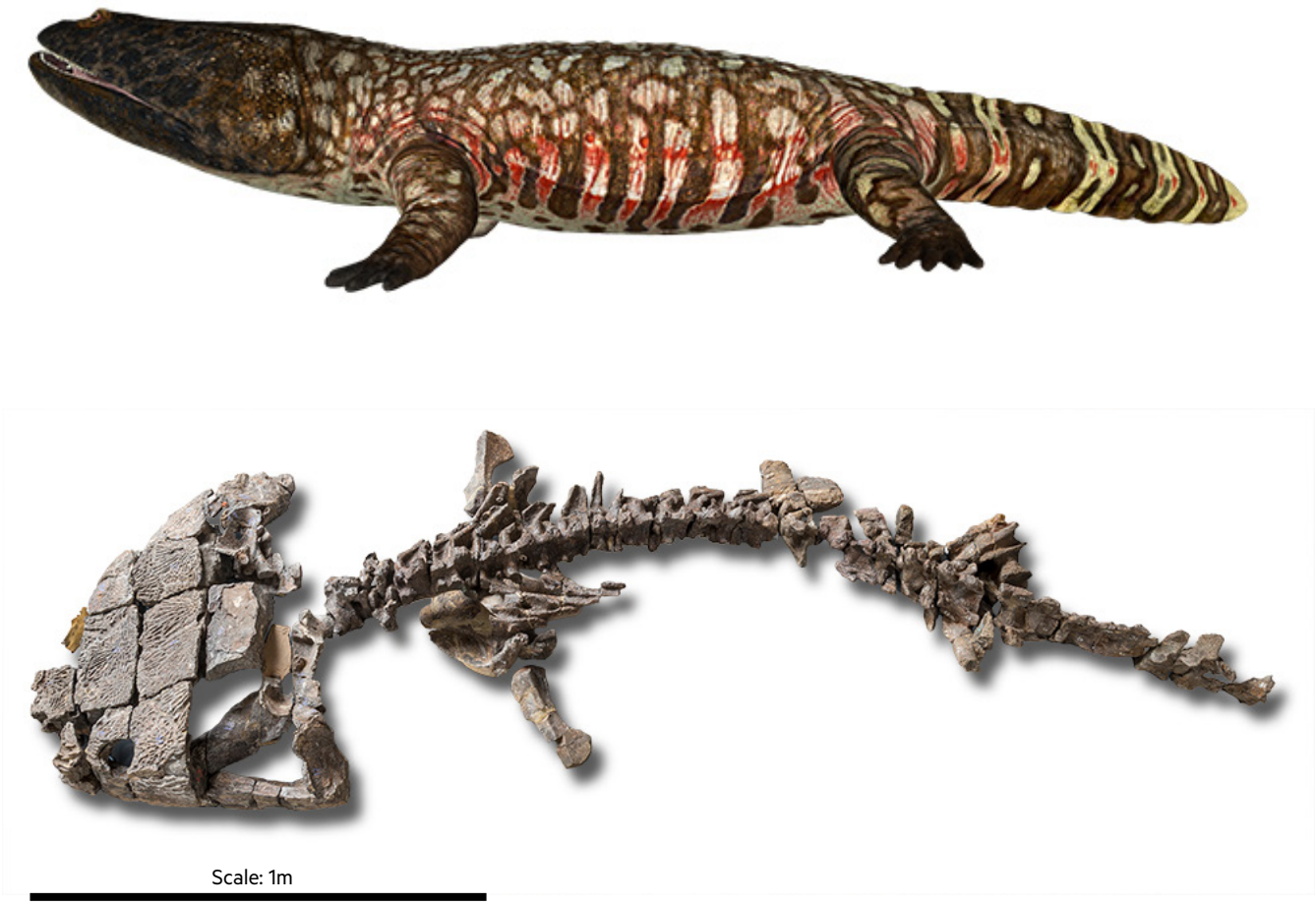


Figure 2: Reconstruction of *Siderops kehli* (top). *QM, Vlad Konstantinov, Andrey Atuchin, Scott Hocknull.*

Figure 2: The fossilised remains of *Siderops kehli* which can be seen at the Queensland Museum, Brisbane (bottom). *QMF7882, QM, Peter Waddington.*

Temnospondyls, which include *Siderops* (Figure 2), have been found on all Gondwanan landmasses. Scientists use fossils and our understanding of past and present environments to create reconstructions of these ancient amphibians. This particular temnospondyl, *Siderops kehli,* was found near Taroom, Queensland. This specimen, and the others shown in this activity, can be seen in the *Lost Creatures* exhibition at the Queensland Museum, Brisbane.

Fossils from *Glossopteris,* Temnospondyls, as well as *Dicroidium,* have been found in Australia and on other Gondwana landmasses. Learn more about these in Table 1, and then work through the activity - *Exploring Evidence of Continental Drift.*

THINK

If all continents were once joined together, what impact would this have had on flora and fauna?

Table 1: Fossils that have been found on many different continents.

Name	*Glossopteris*	*Dicroidium*	Temnospondyls
Picture	 Figure 3: *Glossopteris* leaf. *QMF58636, QM, Peter Waddington.*	 Figure 4: *Dicroidium dubium.* *GSQF329, QM, Rochelle Lawrence.*	Figure 5: Coprolites (fossilised faeces). *QML78, QM,* *Peter Waddington.*   Figure 6: Reconstruction of *Xenobrachyops allos.* *QM, Vlad Konstantinov, Andrey Atuchin, Scott Hocknull.*
Description	A tree up to 30 m in height, *Glossopteris*' tongue-shaped leaves could grow up to 1 m in length! The dominant vegetation in Gondwana during the Permian Period, this tree lived in swampy environments had specially adapted aeration roots to survive the swamp (similar to mangroves). *Glossopteris* were deciduous, dropping their leaves during winter, which has resulted in many leaf deposits being found. This plant flourished 290-245 million years ago and has been found on every continent of Gondwana.	There were many species of *Dicroidium* and they can also be found on all of the Gondwana continents, particularly in the coal basins of south-eastern Queensland. These 'seed ferns' had leaves similar to those of modern ferns; however, instead of reproducing from spores (like ferns today) they had separate seed and pollen-bearing organs, which suggests closer links to flowering plants. *Dicroidium* grew in the warm temperatures of the Triassic 252-201 million years ago.	Temnospondyls, like *Xenobrachyops allos* (Figure 6) and *Siderops kehli* (Figure 2) resemble modern salamanders and newts in their body form and habit; however, these amphibians could grow up to 3 m long! Most lived in freshwater, although it seems that some also made the transition to life on land, returning only to the water to breed. Temnospondyls had sharp teeth and were likely ambush predators similar to crocodiles. They were very diverse throughout Gondwana, and fossils from the families of Lydekkerina, Rhytidosteidae and Brachyopidae (which includes *Xenobrachyops allos*) are shown on the map.

Activity
Exploring Evidence of Continental Drift

Objectives

To understand how the Earth has changed over time, and to investigate how scientists developed the theory of continental drift using fossil evidence.

Materials

- A copy of *Recreating Gondwana: world map and fossil evidence of continental drift* (page 12).
- Scissors
- Glue

Activity

1. Recreate a map of Gondwana by following the instructions below.

a. Using the dotted lines, cut around the landmasses on the map *Recreating Gondwana* (the dotted lines outline the landmasses that made up Gondwana).

b. Fit the pieces together like a puzzle.

c. Check to see if the landmasses are in the correct position by lining up areas where similar fossils are found.

Figure 7: Scientists can learn from imprint fossils as well. The temnospondyl footprint above was found in Albion, Brisbane. This amphibian was 3 m long – imagine that walking past your classroom window! *UQF26279, QM, Peter Waddington.*

2. **Explain why fossils provide evidence that the landmasses were once connected as a supercontinent.**

* Hint: You may want to think about climate, distance and how these organisms travel and reproduce.

3. **Explain how the separation of the landmasses would have affected the flora and fauna.**

4. **The fossil evidence on your map does not always align precisely. Give possible reasons for this, and justify whether you have enough information to make a valid conclusion.**

5. **Fossil evidence is not the only evidence that supports continental drift. Research three more pieces of evidence that support the theory of continental drift.**

STEM Careers in real life: Dr Andrew Rozefelds, Palaeobotanist

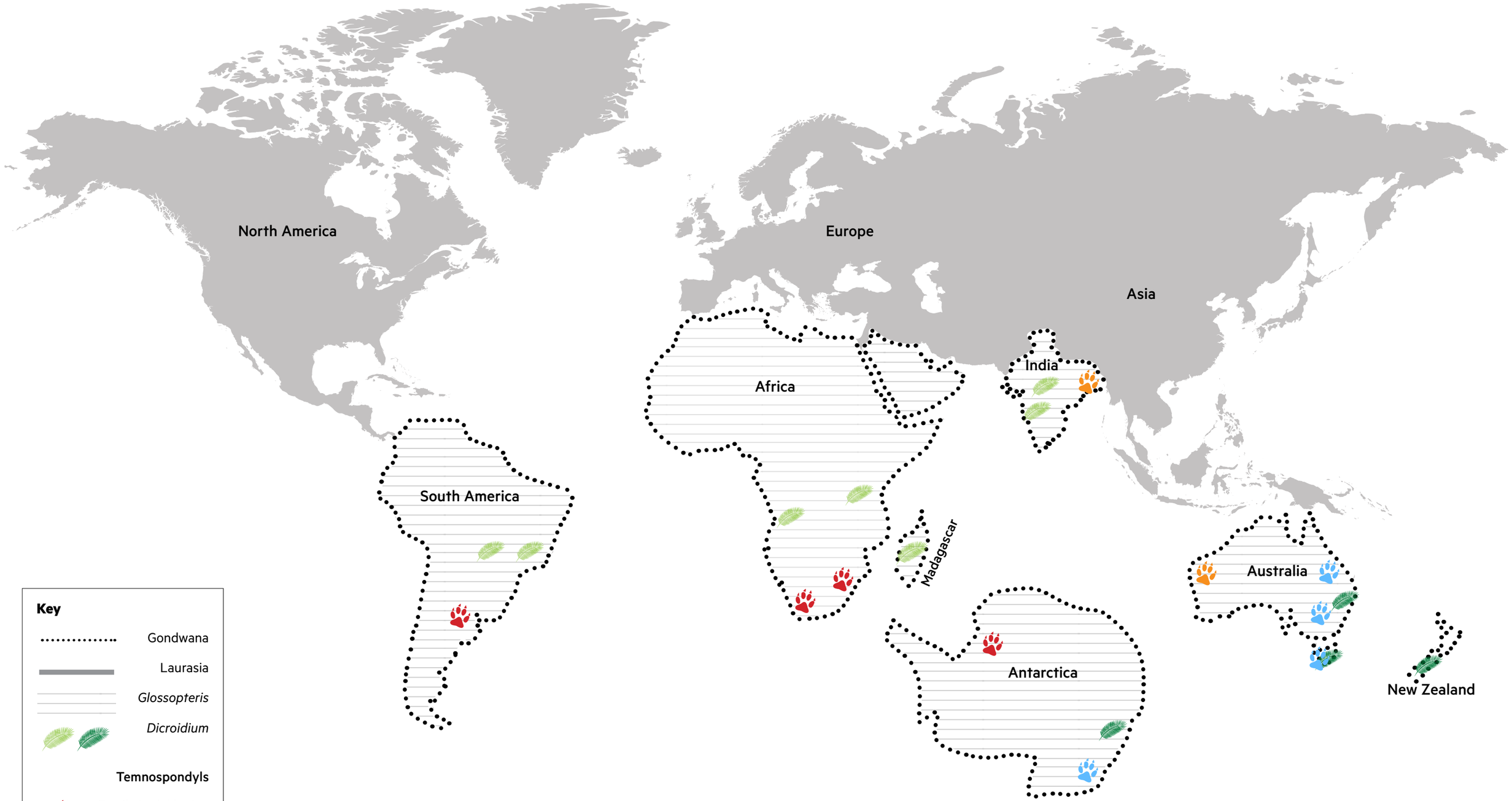
Dr Andrew Rozefelds is a palaeobotanist and the Head of Geosciences at the Queensland Museum. He has had the opportunity to work all around the world, including at the Smithsonian Museum of Natural History in Washington, USA, though his favourite objects to work on are fossilised plants from Queensland.

'Working in Australia it is evident that we know relatively little about the fossil record of this continent. There are new discoveries turning up all the time, and museums have played a key role in telling stories about our fossil heritage and the history of this continent. We are in an exciting phase of discovering new information about the geoheritage of the country, and while our continent has links to the other southern continents, the recent flora and fauna of our island continent evolved in relative isolation, so this is a uniquely Australian story.' – Dr Andrew Rozefelds

To learn more about Dr Andrew Rozefelds you can check out his profile on the Queensland Museum website.

Figure 8: Can you believe it? Dr Andrew Rozefelds has had five species named after him! A living spider *Ixamatus rozefeldsi*, a plant *Boronia rozefeldsii*, and three prehistoric species discovered from fossils!

Recreating Gondwana - World Map and Fossil Evidence for Continental Drift



Key

- Gondwana
- Laurasia
- *Glossopteris*
- *Dicroidium*

Temnospondyls

- Family Lydekkerina
- Family Rhytidosteidae
- Family Brachyopidae

Please note: This map contains select examples of thousands of fossils!