Journey Through Time With B.C.'s Fabulous Fossils

Paleontology Division of Geological Association of Canada

The British Columbia Paleontological Alliance

The British Columbia Paleontological Alliance (BCPA) is a union of professional and amateur paleontologists working to advance the science of paleontology in the province through fostering public awareness, scientific collecting and education, and by promoting communication among all those interested in fossils.
The BCPA produces a newsletter and distributes it to members, libraries and museums across British Columbia. The BCPA also sponsors a spring Paleontological Symposium, held every two years. The symposium brings together amateur and professional paleontologists from across Canada and North America, to exchange the latest ideas on British Columbia paleontology.
Member societies hold monthly meetings and spring and summer field trips, all open to the public. Guest speakers at the monthly meetings explore the latest thinking on aspects of paleontology.

Collecting Fossils

Fossils are found in many places in British Columbia. The BCPA believes strongly that fossils are a critical record of ancient life forms, of importance to us all. Fossils are particularly valuable for scientific study, as part of our shared heritage, and for education. Any collecting of fossils must take these primary values into consideration.

Standards and Ethics for Scientific Collecting

Ensure that appropriate permission and/or permits have been obtained from landowners or governmental authorities before venturing to a fossil site. Leave each site as found with respect to gates, fences or constructions on the property. Practice sound environmental etiquette. Ensure that the size of field groups, as well as collecting methods employed, minimize the impact of collection on the outcrop. Take appropriate safety precautions while collecting and carry a first aid kit in each field group. Members will not collect from Paleontological Research Sites. Collectors must record and maintain documentation of all relevant geographic and stratigraphic information for each fossil in their collections. Every effort should be made to ensure that this information is accessible to interested professional researchers. Fossil collections must be properly curated. Each specimen should normally have a unique identifying number related to a documented fossil locality. Specimens should be stored in a manner consistent with their long-term preservation. Important specimens should be housed in a recognized paleontological repository. Sale of fossils for personal or corporate profit by any member of the Alliance is unacceptable. The BCPA serves as a common voice for paleontology in matters of heritage conservation, scientific investigation and public education. The BCPA also works with the Province of British Columbia to assess the scientific importance of fossil resources across the province. The BCPA has worked with the Province of British Columbia to protect important fossil sites from exploitation or development.

BC Paleo Societies

The BCPA includes six regional societies. Contact the closest one to join now!
Northern British Columbia Paleontological Society (NBCPS): 725 Selwyn Cr., Prince George V2M 5H6
Thompson-Nicola Paleontological Society: PO Box 3010, Kamloops V2C 5N3
Vancouver Island Paleontological Society: PO Box 3142, Courtenay V9N 5N4
Vancouver Paleontological Society: Centrepoint PO Box 19653, Vancouver V5T 4E7
Vancouver Island Paleontological Museum Society: 151 W. Sunningdale, Qualicum Beach V9K 1K7
Victoria Palaeontology Society: 318 Niagara St., Victoria V8V 1G6

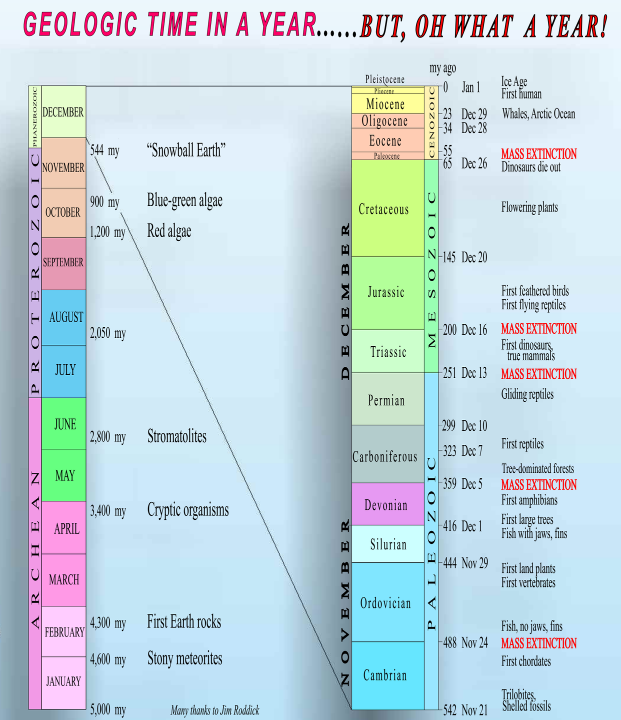
What are Fossils?

Fossils are the petrified remains of animals and plants that lived in the distant past of Earth's history. Fossils are found widely throughout British Columbia and include sea creatures like bivalves, ammonites and marine reptiles that swam in the ancient oceans, or lived on or in the ocean floor. Fossils of land-dwelling organisms are also abundant, such as flowers and leaves, insects, freshwater fish, and mammoths. So many fossils! Some of the oldest complex life forms on the planet are found in British Columbia, as well as relicts from the much more recent Ice Ages. Perhaps no other province in Canada exhibits the wealth of fossil forms found in British Columbia!

The Immensity of Geologic Time

The Earth is a very old planet indeed, more than 4.5 billion years old! Life evolved sometime in the first billion years of that history. The first organisms were primitive algae and bacteria. More complex forms, such as jellyfyish and worms, began to evolve around 1 billion years ago and the first animals with shells appeared about 545 million years ago (Ma). The time of the Earth's history beginning and after the appearance of the first animals with hard skeletons is referred to as the Phanerozoic Era, or time of common and abundant life forms.

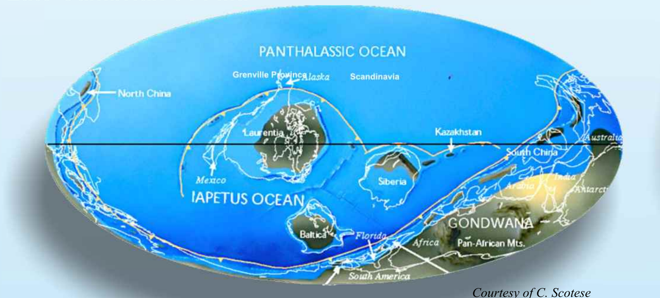
To get a sense of the enormous expanse of time represented in Earth's history, consider this example. If we compress our planet's total history into one year, then the amount of time that complex life forms such as shelled creatures have existed represents only about the last 5 weeks of that year. The mass extinction that wiped out the dinosaurs at the end of the Cretaceous Period 65 million years ago, would have occurred on December 26th, and our species, *Homo sapiens*, would not have evolved until just a few minutes before midnight on the very last day of the year!



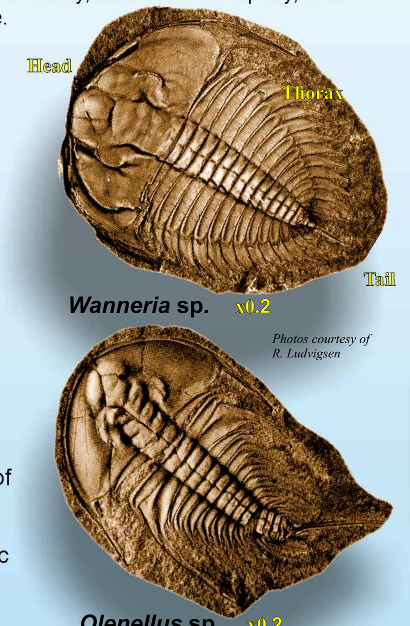
Cranbrook's Early Cambrian Trilobites

The supercontinent "Rodinia" formed 1100 million years ago (Ma) in the Proterozoic Eon and began to rift, or break apart, about 750 Ma. The margin of the newly-created continent "Laurentia" (ancestor of North America) became a site of deposition for shallow marine sediments and their fauna throughout the Cambrian Period (ca. 544 to 490 Ma). With this continental breakup, called "rifting" by geologists, came the "Cambrian Explosion of Life" - one of the most spectacular biological diversification events in the history of the Earth. Most of the living animal groups known today appeared in the fossil record during this Cambrian burst of evolution. The **trilobites** are one group that arose during this Cambrian explosion. Today, trilobites are important fossils for dividing the Cambrian Period into fossil zones, zones that help determine relative geologic time, that is, which layers of rock came first, and which came later. Trilobites are easily recognized, abundant, distributed widely, and evolved rapidly, thus providing a high degree of resolution in the geological time scale.

Late Cambrian 514 Ma



Courtesy of C. Scotese



***Wanneria* sp.** x0.2

Photos courtesy of R. Ludvigsen

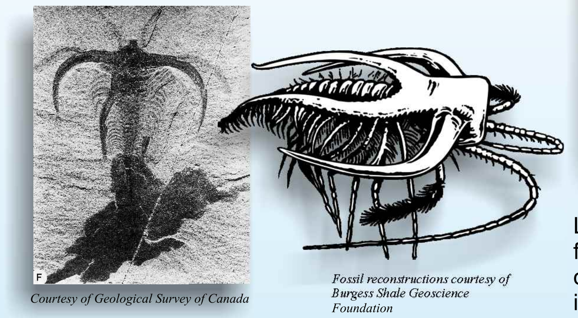
***Olenellus* sp.** x0.2

Rocks of southeastern British Columbia contain a variety of Cambrian trilobite fossils. Trilobites are arthropods composed of three body sections, a head, a thorax and a tail. Their exoskeleton consists of calcium carbonate and is easily preserved. The trilobites, so abundant throughout the Paleozoic Era, went extinct at the end of the Permian Period, 250 million years ago.

The Middle Cambrian Burgess Shale

The Burgess Shale is found in Yoho National Park, near the town of Field. Prior to the discovery of the Burgess Shale by Charles Walcott in 1909, most known Cambrian fossils were from creatures with hard exoskeletons, such as the trilobites. What makes the Burgess Shale exceptional is that it preserves soft-bodied organisms, such as worms, sponges and algae. Features rarely found preserved as fossils, such as gut contents, antennae and delicate appendages, are clearly visible on these fossils. The Burgess Shale was declared a UNESCO world heritage site in 1981, joining the Grand Canyon and the Pyramids of Giza.

The dominant group (technically a *phylum*) represented in the Burgess Shale is the Arthropoda. *Marrella*, commonly called the "lace crab," is the most abundant fossil, and was the first fossil found by Walcott. Many Burgess Shale fossils, such as the large predator *Anomalocaris*, do not fit within modern groups of arthropods and have had to be classified into separate, now extinct, categories. Some fossils, such as *Opabinia* and *Hallucigenia*, can not even be fit into any known major animal group because they are so different. These fossils are sometimes referred to as "weird wonders." Among the spectacular Burgess Shale fossils are early vertebrates, creatures with backbones, such as *Pikaia*.

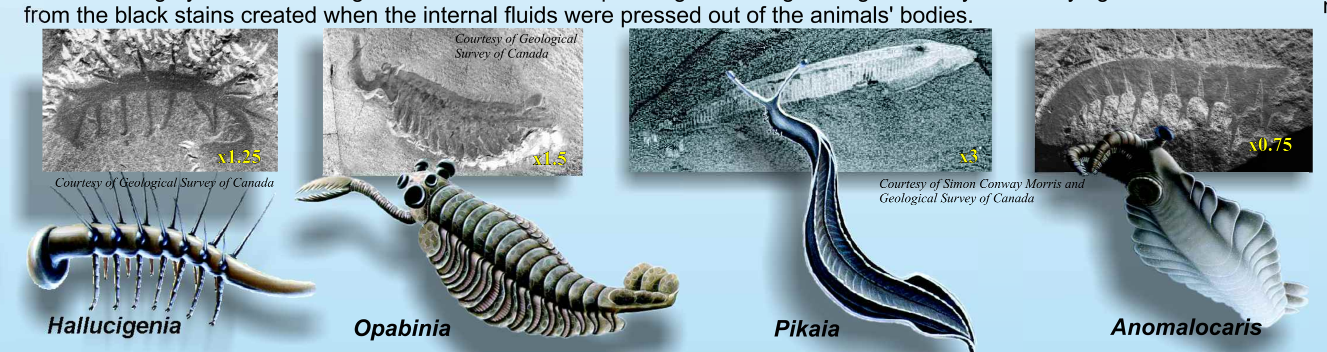


Courtesy of Geological Survey of Canada

Fossil reconstructions courtesy of Burgess Shale Geoscience Foundation

Marrella

The exceptional preservation of soft-bodied organisms makes the Burgess Shale a unique and wonderful fossil locality. To end up with such spectacular fossils, the animal remains must have been buried rapidly in sediments with little or no oxygen and no mixing by bottom-dwelling creatures. Even the squeezing of the original organisms by the overlying muds is evident from the black stains created when the internal fluids were pressed out of the animals' bodies.



Courtesy of Geological Survey of Canada

Courtesy of Geological Survey of Canada

Courtesy of Simon Conway Morris and Geological Survey of Canada

Hallucigenia ***Opabinia*** ***Pikaia*** ***Anomalocaris***

"Micro"-fossils, So Small But Oh So Important!

Courtesy of C. Barnes

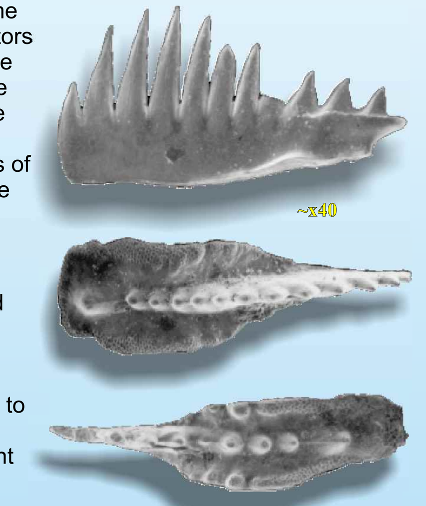
Conodont-bearing rocks near Muskwa River

Most microfossils are tiny and you need a microscope to see them. The **conodonts** ("cone-tooth") are common and abundant microfossils found in marine sedimentary rocks from the Late Cambrian (500 Ma) to the Late Triassic (200 Ma) periods. They are phosphorous-rich, tooth-like structures (0.1 to 2 mm long) that formed the feeding apparatus of an extinct group of vertebrates. In 1983, the conodont-bearing animal was described, based on soft-bodied impressions of an elongate, eel-like creature. Its feeding apparatus is located at the front of the animal. The conodont animal shown here is swimming toward you with its mouth open, showing clearly the position of the feeding structure.

Courtesy of M. Purnell

Long before we knew what kind of animal conodonts came from, they were used as geological zone markers, indicators of the passage of time. Over 100 conodont zones, or time intervals, are used to subdivide the Paleozoic Era and the Triassic Period. Conodonts are particularly helpful for the global correlation of rock layers. In British Columbia, studies of conodonts reveal the history of remote reaches of the Rocky Mountains, in rocks that accumulated along the margin of the ancient continent Laurentia.

Triassic conodonts



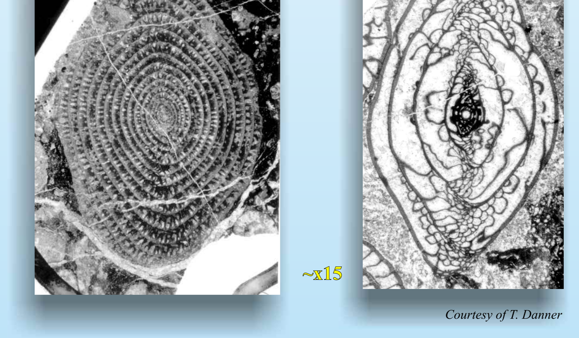
Courtesy of Geological Survey of Canada

Another important group of microfossils, the **fusulinids**, first appeared in the Carboniferous Period and flourished for the next 100 Ma, until the Permian. Fusulinids were small, spindle-shaped and rounded creatures. They secreted a complex, calcium carbonate shell. Most of these one-celled organisms were tiny, but some grew up to 10 cm long! They flourished in tropical shallow-water environments and evolved rapidly, making them important time indicators. Fusulinids also provide information on water depth, ocean salinity, and temperature.

Fossils and Terranes

The Canadian Cordillera is a complex assemblage of mountain ranges, basins and plateaux, constructed from the ancient western margin of North America (the North American craton) and numerous "exotic terranes." The terranes are large blocks of the Earth's crust whose places of origin are often far removed from their present locations. After they formed, the blocks were carried on pieces of migrating oceanic crust across the surface of the Earth to their present location. Time-indicative and environment-indicative fossils found in these terranes have helped to reconstruct the complex paleogeography (ancient geography) of the Canadian Cordillera and the ancient Pacific region.

Fossils such as **conodonts**, **radiolarians**, **ammonoids**, and **fusulinids** show that some of the terranes of the Canadian Cordillera formed at equatorial latitudes, in the Panthalassic Ocean that surrounded the continent of Pangaea during the Carboniferous to Triassic periods. Some equatorial fusulinid types found in central and east Asia are known in North America only from localities in British Columbia, suggesting these rocks may have formed far to the west of their present location. Their presence in the central Canadian Cordillera poses a significant challenge for paleogeographic interpretation!



Courtesy of T. Danner

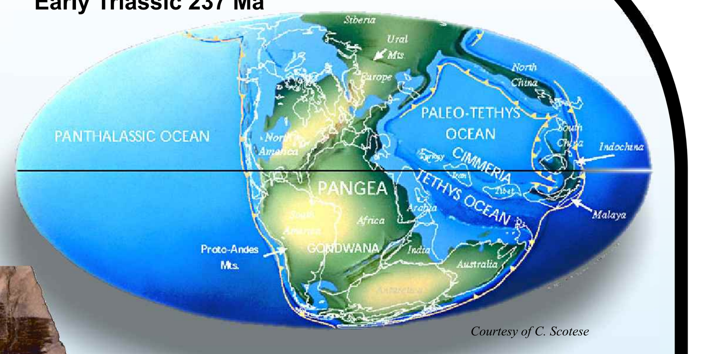
Permian fusulinids from Marble Canyon

Perhaps the most famous terrane of the Canadian Cordillera is the island belt forming Queen Charlotte Islands and Vancouver Island, the most "outboard" part of British Columbia. Fossils from the islands show that the rocks that comprise them originally formed near the equator during Triassic time. Scientists have thus named these far-traveled lands "Baja British Columbia!"

Wapiti Lake's Triassic Fish

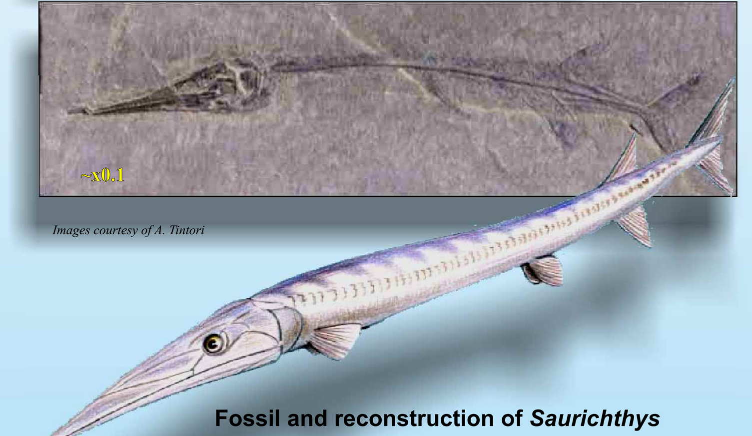
Wapiti Lake, located in east-central British Columbia near the Alberta border, is one of the world's best fish fossil localities of the Early to Middle Triassic Period, representing marine life just before the dinosaurs ruled the land. Wapiti Lake fossils were deposited when eastern British Columbia was under ocean waters at the western edge of the ancient continent Pangea.

Early Triassic 237 Ma



Courtesy of C. Scotese

Whiteia Courtesy of Royal Tyrrell Museum of Palaeontology



Images courtesy of A. Tintori

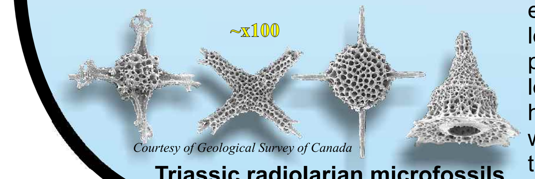
Fossil and reconstruction of *Saurichthys*

The rocks at Wapiti Lake contain a great diversity and abundance of exquisitely-preserved fish, ranging from small plankton grazers to large predators such as *Whiteia*, a primitive coelacanth, or lobe-finned fish. The modern ray-finned fish are also well-represented at Wapiti Lake. Looking like a giant sunfish, *Bobasatrania* had a magnificent set of crushing teeth. In contrast, *Saurichthys* was a long, narrow-bodied predator with elongate jaws - one specimen was even found with a small fish in its mouth! Reptiles, especially **ichthyosaurs**, and invertebrates are also found at the Wapiti Lake site. With all these different kinds of fossils, the Wapiti Lake locality reveals much about Triassic marine ecosystems.

Precambrian	Cambrian	Ordovician	Silurian	Devonian	Carboniferous	Permian	Triassic
4,500 Million years ago (Ma)	542 Ma	488 Ma	444 Ma	416 Ma	359 Ma	299 Ma	251 Ma
	Paleozoic Era						Mesozoic Era

Mass Extinction!

Fossils found on Queen Charlotte Islands record one of the most catastrophic biological events in Earth's history - the end-Triassic mass extinction! It has been estimated that 95% of the plants and animals living on the Earth went extinct at this time, about 200 million years ago. On the islands, the extinction event is revealed to us through the study of **radiolarian** microfossils, tiny one-celled animals that live in the oceans and produce beautiful shells made of silica. Virtually all of the Triassic radiolarian microfossils found on Queen Charlotte Islands went extinct at the same time, never to appear again in the fossil record. Then, in the early part of the Jurassic Period, totally new forms evolved to take the place of those which had disappeared. The cause of this extinction is unknown but, like the extinction which occurred at the end of the Cretaceous and resulted in the demise of the dinosaurs, the impact of a meteor has been suggested. Or perhaps, worldwide volcanic activity may have dramatically altered the Earth's climate, making it impossible for most life forms to survive.



Courtesy of Geological Survey of Canada

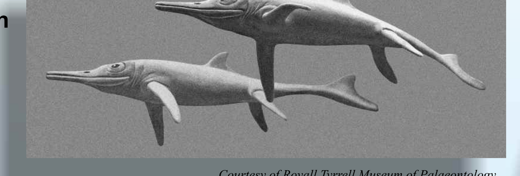
Triassic radiolarian microfossils

Mesozoic Marine Reptiles

Ichthyosaurs resemble a cross between a modern shark and a dolphin, with a stream-lined body, a slender skull with sharp dolphin-like teeth, and a shark-like tail that moved from side-to-side. The forked tail, large eyes, and hydrodynamic body suggest they were fast-moving predators.

The Mesozoic Era is known as the "Age of Reptiles" and important fossil marine reptiles have been discovered in British Columbia. The Triassic rocks of northeastern British Columbia have yielded remains of the largest ichthyosaur ever reported, perhaps reaching 30 m in length! This beast is under study at the Royal Tyrrell Museum of Palaeontology in Drumheller, Alberta.

Reconstruction of the giant Sikanni River ichthyosaur



Courtesy of Royall Tyrrell Museum of Palaeontology

Elasmosaur Courtesy of Courtenay and District Museum

Plesiosaurs and **mosasaurs** also swam in BC's Mesozoic oceans. In 1988, the remains of an 80 million year old **elasmosaur** (a type of plesiosaur) were discovered along the edge of the Puntledge River on Vancouver Island.

In life, the Puntledge elasmosaur had a 12 meter-long streamlined body, two pairs of paddle-like limbs, a long flexible neck and a small head. The mouth was armed with long interlocking teeth to trap fish.

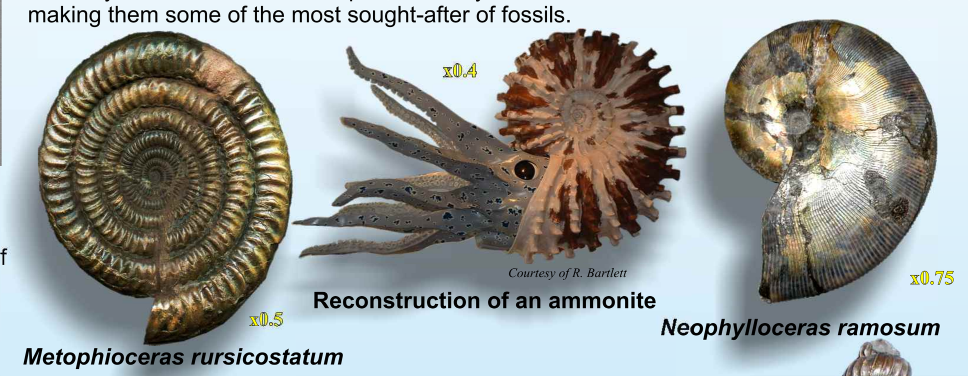
This mosasaur was found in the shale cliffs of the Puntledge River.

Mosasaur

Courtesy of R. Lundquist and Courtenay and District Museum

The Ammonites, Ancient Submarines

The **ammonites** were one of the most dominant fossil groups in the seas of the Mesozoic Era, and their remains are found throughout British Columbia. These fascinating invertebrates had a chambered shell that functioned like a submarine's ballast chambers to keep the animal level in the ocean's waters. The outermost chamber of the shell contained the soft parts of the ammonite animal, a head with eyes, tentacles for grabbing, and a powerful beak, or jaw-like feature, for crushing prey. BC's biggest ammonite was 2 meters in diameter - imagine meeting such a denizen while scuba diving! The shells of ammonites took on many varied and bizarre shapes, and they often exhibit a wonderful iridescent luster, making them some of the most sought-after of fossils.

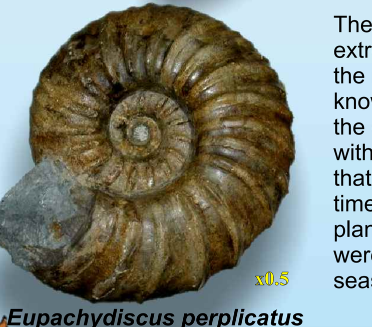


Metophioceras rursicostatum

Courtesy of R. Bartlett

Reconstruction of an ammonite

Neophylloceras ramosum



Eupachydiscus perplicatus

The ammonites evolved rapidly, so they are extremely useful for determining the age of the rocks in which they are found. No one knows why the ammonites went extinct at the end of the Cretaceous Period, along with the dinosaurs, but one hypothesis is that a giant meteor hit the Earth at that time, causing extinction of most animal and plant species. Alas, the mighty ammonites were never again to swim in the Earth's seas.

Ammonite images courtesy of D. Bowen

Eubostrychoceras elongatum

Giant Fossil Footprints

Dinosaurs and other terrestrial vertebrates lived in British Columbia during the Mesozoic Era, but discoveries of their bones are rare. Fortunately, although the dinosaurs left behind few bones, they did leave a remarkable record of fossil footprints. Fossil footprints and trackways provide a window or freeze-frame 'motion picture' of the activities of extinct animals, revealing much about walking speeds, herding behavior and predator-prey interactions. Such glimpses into ancient life activities are almost impossible to understand from skeletons.

Though we cannot precisely identify the trackmakers as well as we could if we had their bones, we can still tell what kind of animals walked across ancient British Columbia. Wandering the province's landscape were two and four-legged herbivorous ornithopods, hadrosaurs, armored ankylosaurs and the giant sauropods. Meat-eating dinosaurs roamed about as well. Some of these predators made footprints scarcely a few centimeters long and were about as big as chickens. Others made footprints almost a meter long and were the size of, and perhaps closely related to, familiar flesh-rippers such as *Allosaurus* and *Tyrannosaurus*. BC rocks also preserve footprints of walking and swimming reptiles, possibly crocodiles, and of turtles, birds and amphibians.

British Columbia's "track record" extends in time from the Jurassic/Cretaceous boundary up to the early part of the Late Cretaceous. Three main track-bearing formations are known: the Mist Mountain Formation (Jurassic/Cretaceous, ~140 Ma), in the southeastern corner of the province and containing the oldest evidence of land vertebrates known from western Canada; the Gething Formation (Cretaceous: ~114 Ma) in the Peace River Canyon area; and the Dunvegan Formation (Cretaceous: ~ 94 Ma), exposed extensively in the northeastern part of the province.

Courtesy of C. Helm

Cretaceous Forests of Vancouver Island

Angiosperms, commonly known as flowering plants, first evolved in the Early Cretaceous. The development of the angiosperm fruit and flower endowed this group of plants with reproductive advantages, and led to a spectacular evolutionary radiation during the Late Cretaceous. As flowering plants diversified, the cycads and conifers that had dominated the Mesozoic Era declined, and British Columbia's flora and vegetation were transformed into a more modern look.

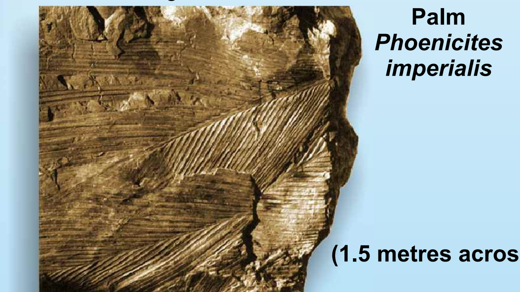
Courtesy of R. Ludvigsen

Angiosperm fruit, possibly Magnoliaceae

Courtesy of R. Hebda

Leaf of Spurge family (Euphorbiaceae)

On Vancouver Island, the fossil flora represented in the Upper Cretaceous Nanaimo Group contains angiosperm leaves, remarkably-preserved rare flowers, conifer foliage, and delicate fern fronds. A frond from an extinct genus of palm is nearly 2 meters long! Palm fronds, sycamore tree leaves and sumac-like tropical hardwood flowers reveal a warm Cretaceous climate, a true Greenhouse Earth. The abundance of fossilized leaves of tropical members of the Spurge Family (Euphorbiaceae) suggest a Cretaceous forest canopy dominated by warmth-loving trees.



Courtesy of R. Ludvigsen

Palm *Phoenicites imperialis*

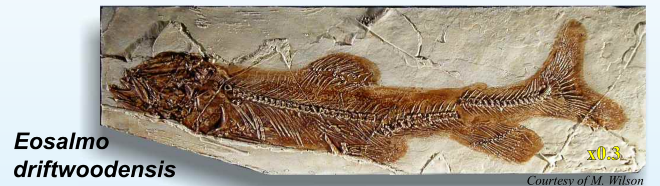
(1.5 metres across!)

Courtesy of R. Ludvigsen

Cretaceous fern bouquet of *Asplenium* (left) and *Coniopteris* (right)

Eocene Environments

Fossil sites in the Interior of British Columbia at Princeton, McAbee, Horsefly and Hat Creek contain abundant and diverse fossils from lake environments of the Eocene Epoch (55 to 34 Ma). The layers of fine volcanic sediment deposited on these lake bottoms preserve the finest details of freshwater fish, insects and plants.



Eosalmo driftwoodensis

Courtesy of M. Wilson

Most plants are preserved as compressional fossils, squashed between layers of mud. British Columbia has some of the oldest fossilized plants from the Eocene time. After millions of years hidden in the depths of the earth, conifer needles, fern fronds, and the leaves, seeds, and fruit of flowering plants are all brought back to life when finely-layered slabs of Eocene shale are split by an excited fossil collector!

Eosalmo rosei (the dawn salmon) is the most commonly found fossil fish, but *Eosalmo driftwoodensis* from the Smithers area is perhaps the most important Eocene fish discovered in BC. It links the Salmonidae (salmon and trout) and Thymallinae (grayling) subfamilies and shows that the first salmon-like features developed as modifications of the body, tail and scales. The full age-range of the life cycle of *E. driftwoodensis* has been recovered from fossil sites in BC's Interior, supporting the theory that sea migration of modern salmon fish developed only recently.

The Princeton Chert represents shallow lake deposits with alternating layers of chert, a silica mineral, and coal. Flowering plant remains, sometimes of whole plants, were preserved in the chert by permineralization, a process by which silicic acid infiltrates the spaces between cells and preserves internal structures perfectly.

Microfossils Help Find Oil and Gas

The first **foraminifera** evolved in the Early Cambrian Period, and representatives of the group live in all of today's oceans. They are small (~1 mm) one-celled organisms, many of which secrete calcium carbonate coverings, or shells (technically called tests), that accumulate on the sea floor after the animals die.

Ichthyoliths (fish-stones) are the microscopic remains of fish, mainly scales and teeth, recovered from ocean sediments and sedimentary rocks. Given their tiny size, ichthyolityhs and foraminifers are often found in the sediment cores (2" diameter) retrieved from oil wells. These cores are so narrow that larger fragments of fish skeletons and other animals are rarely found in them.

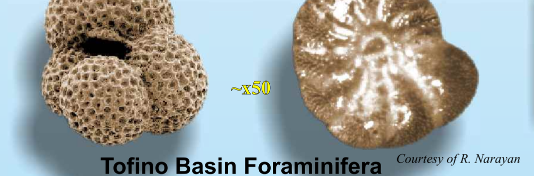
Ichthyoliths and foraminifers are important in studies of the oil and gas deposits in the west coast offshore sedimentary basins, including the Queen Charlotte and Tofino basins. Studies of these microfossil groups help establish the relative ages of the rocks found on Vancouver Island and in the offshore basins. These microfossils also assist in the reconstruction of ancient environments. Foraminifer tests also record the chemistry of ancient seawater and provide direct information about the geochemistry of ancient marine environments. They are particularly useful in the study of sea-level history, a history that helps us to better understand the plate tectonic processes of the region.

Courtesy of R. Narayan

Map of the offshore Tofino Basin, showing the approximate location of the 6 Shell oil wells drilled in the late 1960s

Tofino Basin ichthyoliths

Courtesy of M. Johns



Tofino Basin Foraminifera *Globigerina* and *Elphidium*

Courtesy of R. Narayan

Fossil Pollen and Climate Change

Palynology, or pollen analysis, is the study of microscopic spores and pollen grains preserved in sediments and sedimentary rocks. **Pollen** and **spores** consist of sporopollenin, a tough waxy substance that resists destruction and preserves extremely well. The fossil record of these important microfossils extends back into the Paleozoic Era. Fossil pollen and spores reveal ancient plant life and terrestrial vegetation. Their distribution in time and space in ancient strata helps to reconstruct past climates and environments.

Courtesy of R. Hebda

Pollen & Spores

Palynological studies reveal major climatic changes in British Columbia's recent past. Changes in the pollen assemblages of lake and bog sediments, and from Saanich Inlet on Vancouver Island, clearly show that 10 000 to 7 000 years ago Vancouver Island was warmer and drier than today. About 7 000 years ago, the climate moistened and forest expanded. It was not until 4 000 years ago, however, that modern forests developed. Understanding these trends is important to evaluating the potential changes that will occur in ecosystems of British Columbia in the future.

Courtesy of R. Hebda

White pine pollen **Grass pollen** **Aster pollen**

Jurassic	Cretaceous	Paleogene	Neogene	Quaternary
200 Ma	145 Ma	65 Ma	23 Ma	2 Ma
	Mesozoic Era		Cenozoic Era	

This poster was conceived and produced by James Haggart, under the auspices of the BCPA. Many individuals contributed to the poster. The basic ideas originated with students in the Introductory Paleontology class at University of Victoria, led by Leanne Pyle and Roshni Narayan, and including Ian MacLeod, Ikuko Wada, Dave Lane, Mia Pelletier, Jeremy Vincent, David Turner, Tyler Kuhn, Amber Church, Catherine Craig, Robin Black, Stephanie Dick and Jacqueline Blackwell; Chris Wilmot helped compile these contributions. Doug Embree, Betty Franklin, Skippy Miller and Jack Wittles contributed fossils illustrated in the poster. James Haggart, Bob Campbell, Elizabeth Gibbs and Richard Hebda undertook editing and design, and Melissa Grey tracked down copyright information. Robert Lundquist undertook final design and layout, with input from Dan Bowen. The Canadian Geological Foundation, the Paleontology Division of Geological Association of Canada, the Geological Survey of Canada and the BCPA provided funding. For information about this poster contact Jim Haggart, Geological Survey of Canada, 101-605 Robson St., Vancouver, BC V6B 5J3. This poster is BC Paleontological Alliance Miscellaneous Publication No. 1.