CHAPTER 10
Part 1 of 3

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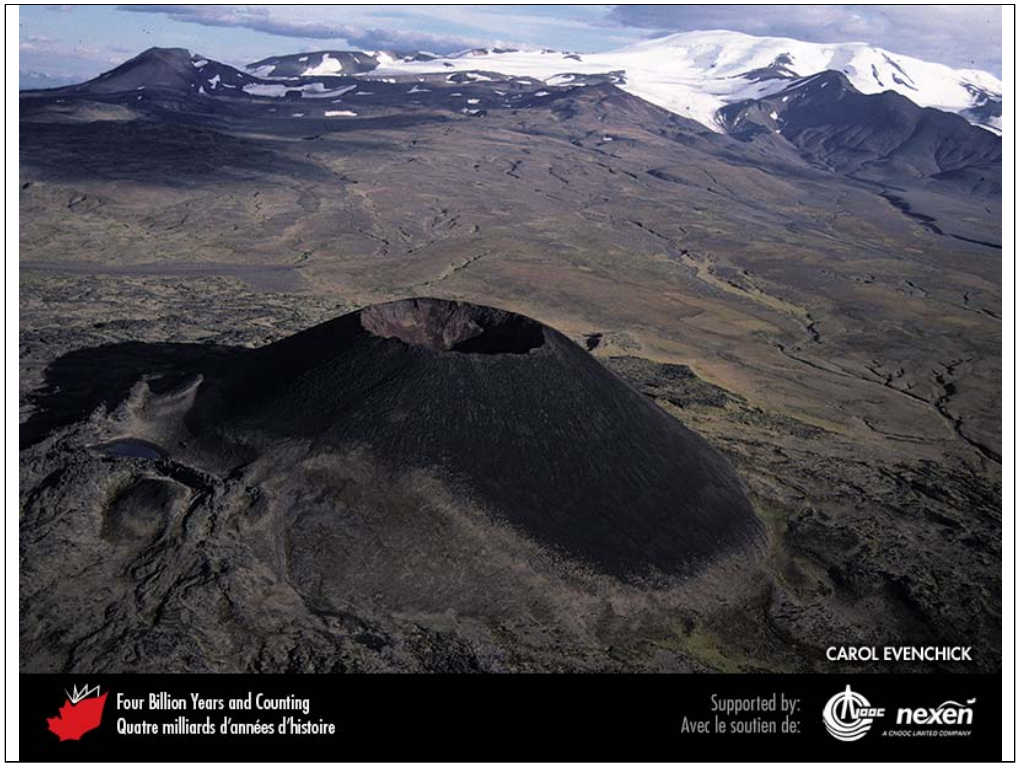

Volcanoes have been active in the western Cordillera throughout the Cenozoic. Eve Cone is a 150-metre-high cinder cone on the northern flank of Mount Edziza, one of three large shield volcanoes in the Stikine Volcanic Belt of northern British Columbia. Eve Cone was active around the year 700 CE. CAROL EVENCHICK.

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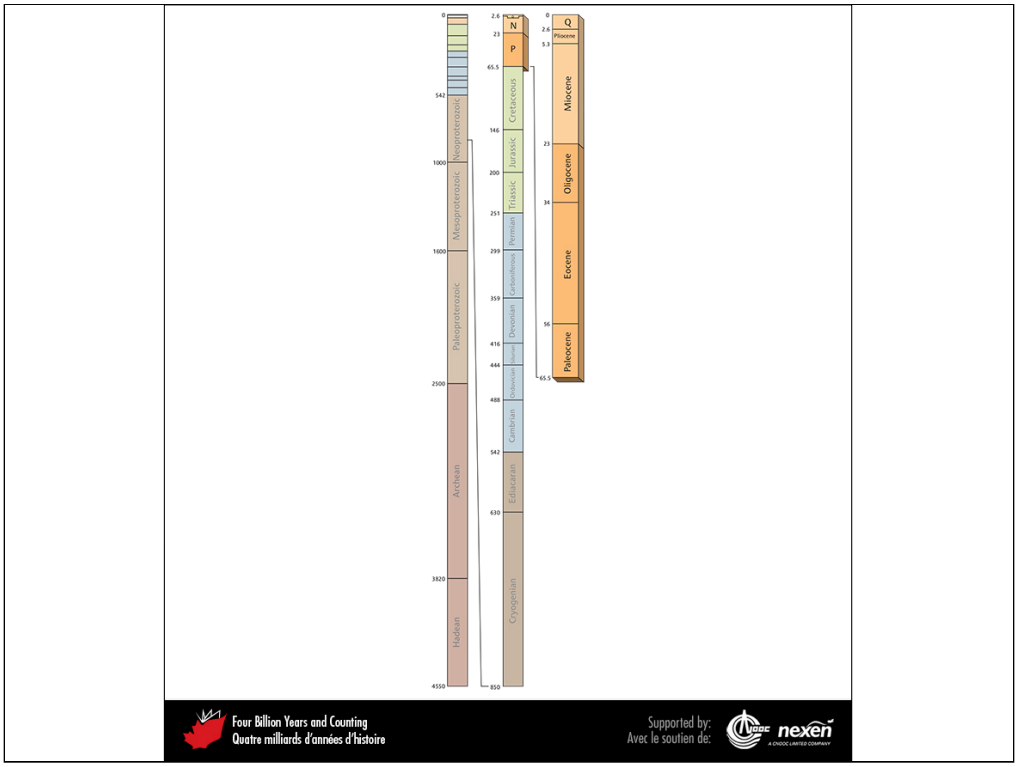

Geological time scale, showing the interval covered in this chapter. Numbers indicate millions of years ago. P = Paleogene, N = Neogene, Q = Quaternary.

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Aerial view of Eureka on Ellesmere Island, Nunavut, which was one of a network of weather and radar stations set up by Canada and the United States in 1946. KELLY BENTHAM.

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Tree stump, probably of the dawn redwood, from the Eocene fossil forest on Axel Heiberg Island, Nunavut. JIM BASINGER.

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Dawn redwood cones from the Eocene fossil forest on Axel Heiberg Island, Nunavut. HANS DOMMASCH.

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Dawn redwood foliage from the Eocene fossil forest on Axel Heiberg Island, Nunavut. JIM BASINGER.

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Walnut seeds from the Eocene fossil forest on Axel Heiberg Island, Nunavut. JIM BASINGER.

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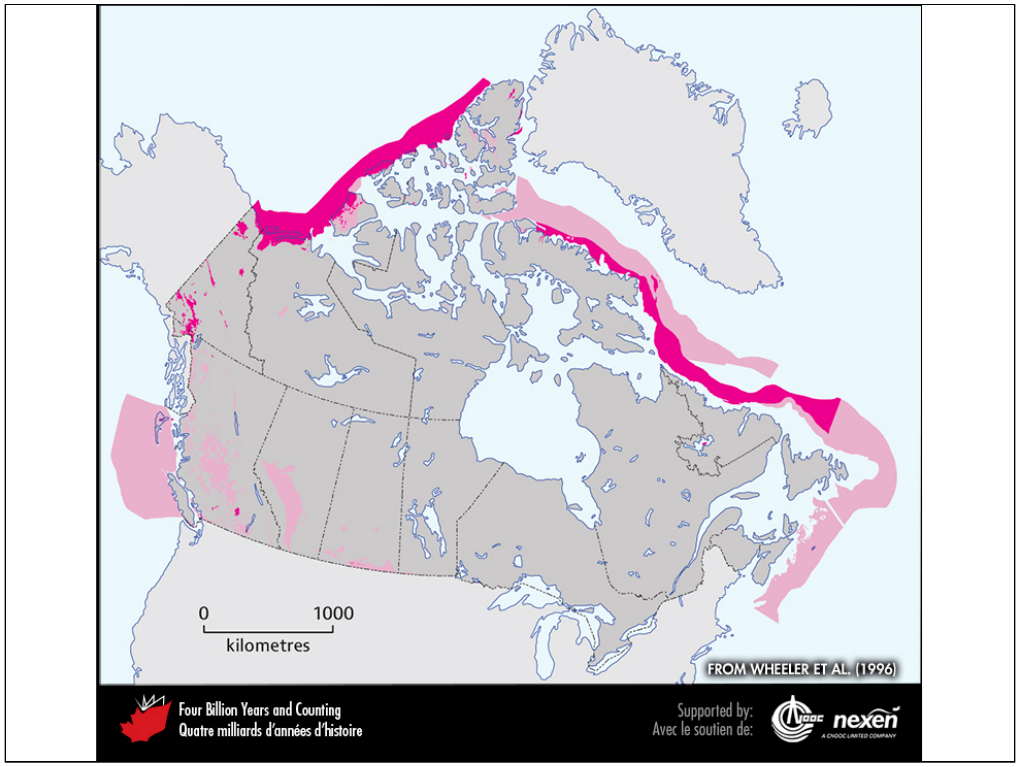

General extent of Cenozoic rocks at the surface (beneath glacial deposits), onshore and offshore. The lighter shaded areas denote either uncertainty or areas where rocks of the particular age have been confirmed but are intimately associated with rocks of other ages and the scale of the map doesn't allow us to show them separately. ADAPTED FROM WHEELER ET AL. (1996).

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Paleogeography of North America and adjacent regions in the Paleocene, 60 million years ago. Land is shown in brown, with shading showing topography. The lighter blue areas represent possible coastal or nearshore areas, darker blue represents deeper ocean waters, and black indicates trenches. Aspects of modern geography are shown for orientation.

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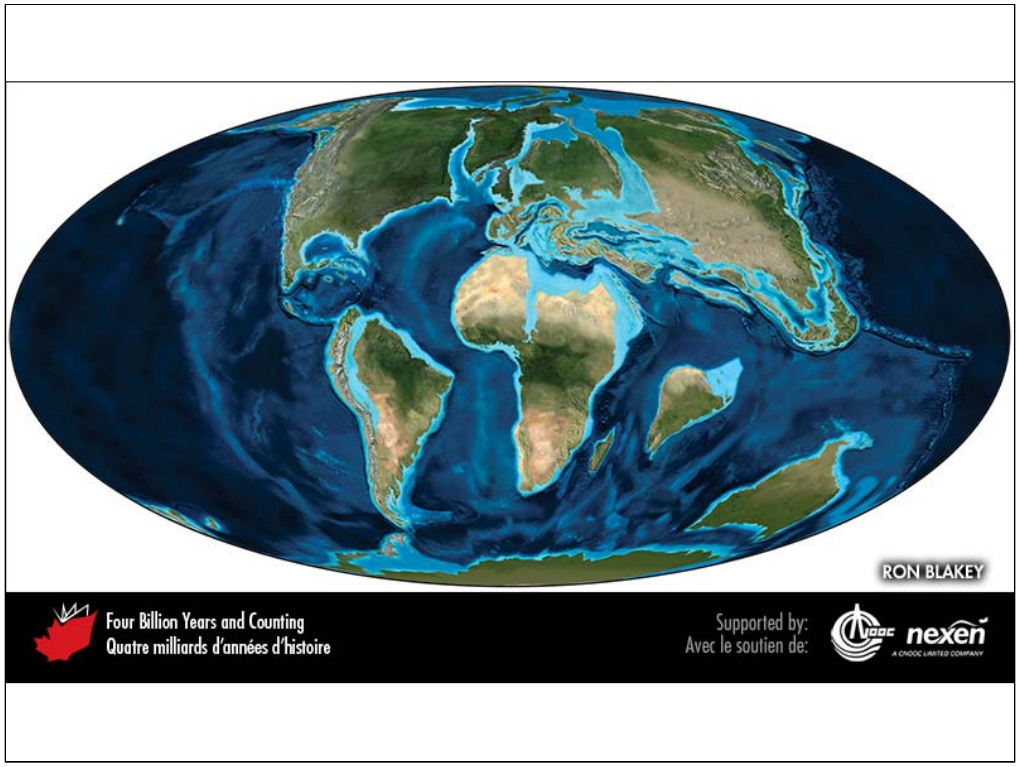

Global paleogeography 60 million years ago, during the Paleocene. Colours as for previous figure.

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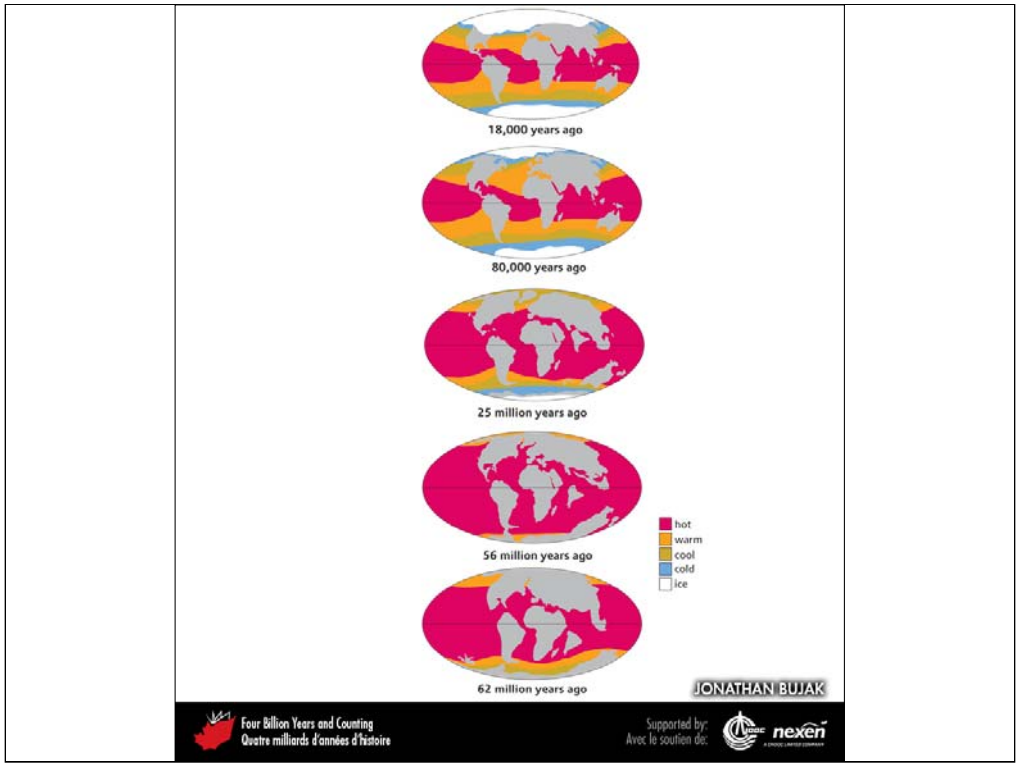

Changing general ocean temperatures through the Cenozoic, showing the trend from a "greenhouse" world 62 million years ago and the Paleocene-Eocene Thermal Maximum 56 million years ago, to the "icehouse" world of today. JONATHAN BUJAK.

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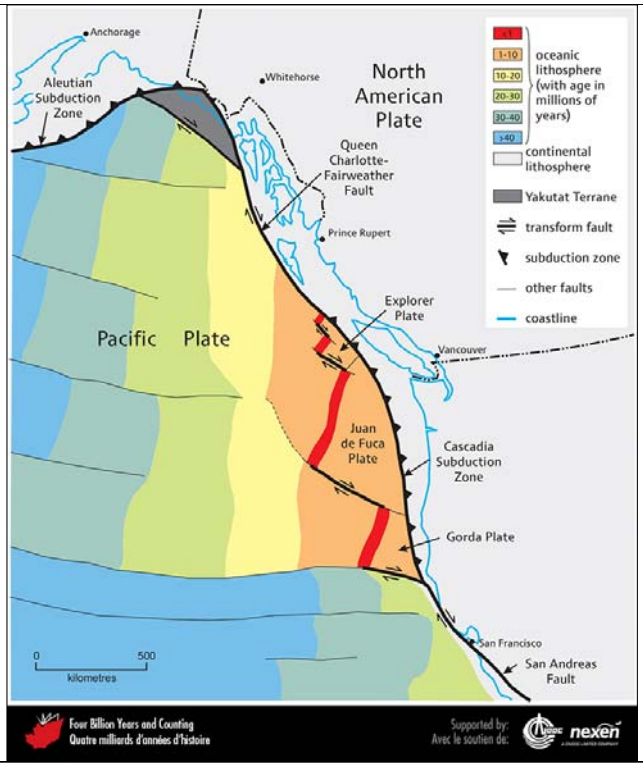

Ages of oceanic lithosphere in the northeastern Pacific Ocean and the structures bounding the western margin of the North American Plate. Young oceanic lithosphere, coloured red, reflects the position of spreading ridges. ADAPTED FROM VARIOUS SOURCES.

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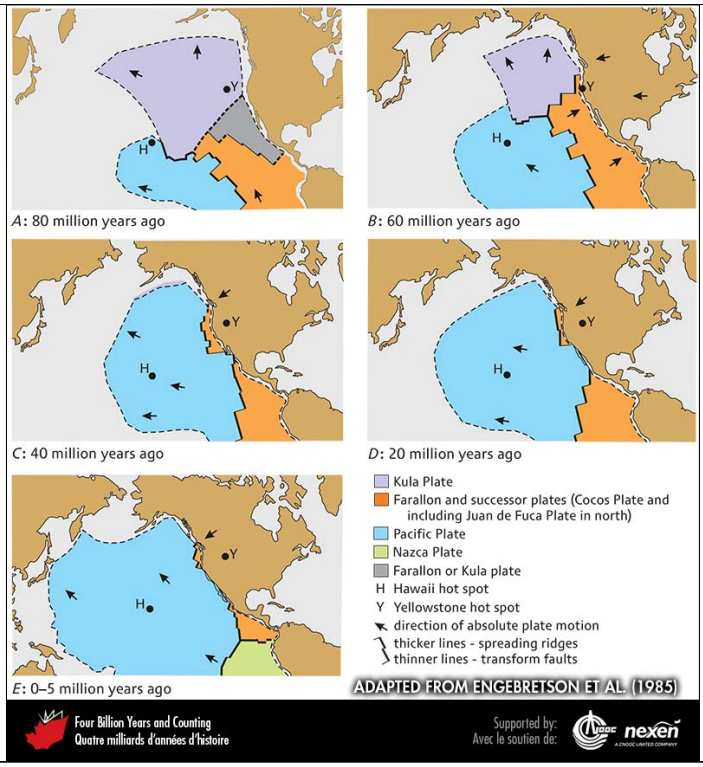

Evolution of tectonic plates in the northeastern Pacific Ocean during the past 80 million years, based on a modern map. ADAPTED FROM ENGEBRETSON ET AL. (1985).

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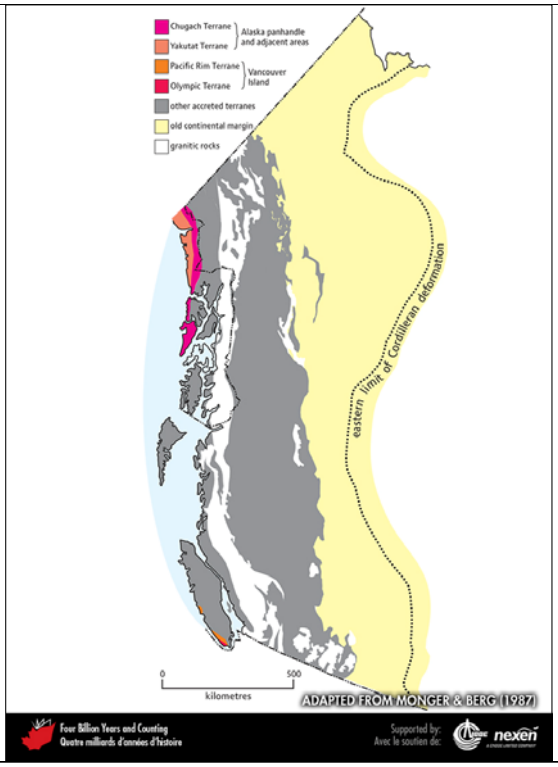

The Canadian Cordillera and adjacent parts of southeastern Alaska showing the westernmost terranes, the latest additions to the continent. ADAPTED FROM MONGER AND BERG (1987), COURTESY OF THE US GEOLOGICAL SURVEY.

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Pebbly mudstone of the Pacific Rim Terrane, at Chesterman Beach, Pacific Rim National Park Reserve of Canada, British Columbia. The Pacific Rim Terrane is composed of generally coarse clastic rocks and igneous rocks of Jurassic to Cretaceous age. JIM MONGER.

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CHAPTER 10
Part 2 of 3

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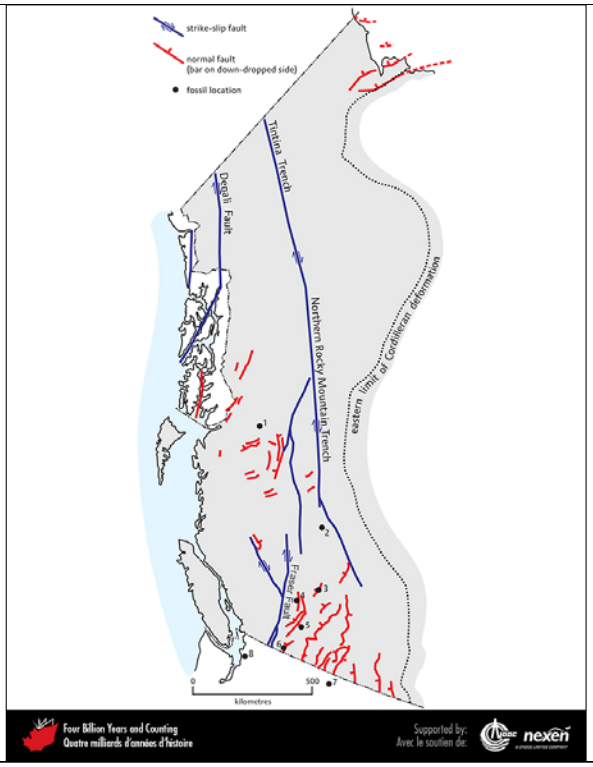

Locations of the major strike-slip faults and prominent normal faults active in the Cordillera during the Cenozoic. The numbered locations show fossil sites: Driftwood Canyon (1), Horsefly (2), Chu Chua (3), McAbee (4), Quilchena (5), Princeton (6), Republic (7), and Chuckanut (8). The last two localities are in the United States.

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The Okanagan Valley Fault southeast of Okanagan Falls, British Columbia. Bluffs above the lake at left consist of Jurassic to early Cenozoic gneiss. The surface that gently slopes away from the top of the bluffs marks the fault plane. Above this normal fault are weakly metamorphosed Paleozoic to Cenozoic rocks. JIM MONGER.

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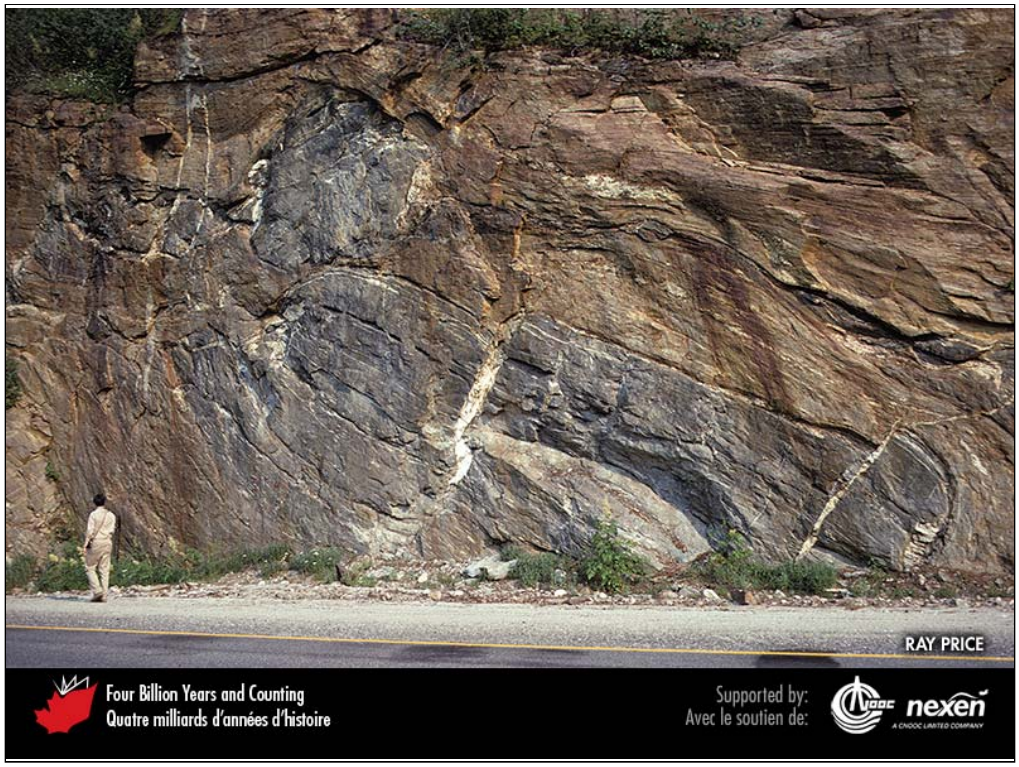

In this exposure at Three Valley Gap, southwest of Revelstoke, British Columbia, the darker, dog-bone-shaped body is a boudin, which was originally part of a mafic intrusion but has been metamorphosed to amphibolite. This boudin formed during the Eocene at the same time as brittle normal faulting in the upper crust. RAY PRICE.

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Paleogeography of North America and adjacent regions in the late Eocene, 35 million years ago. Land is shown in brown, with shading showing topography. The lighter blue areas represent possible coastal or nearshore areas, darker blue represents deeper ocean waters, and black indicates trenches. Aspects of modern geography are shown for orientation.

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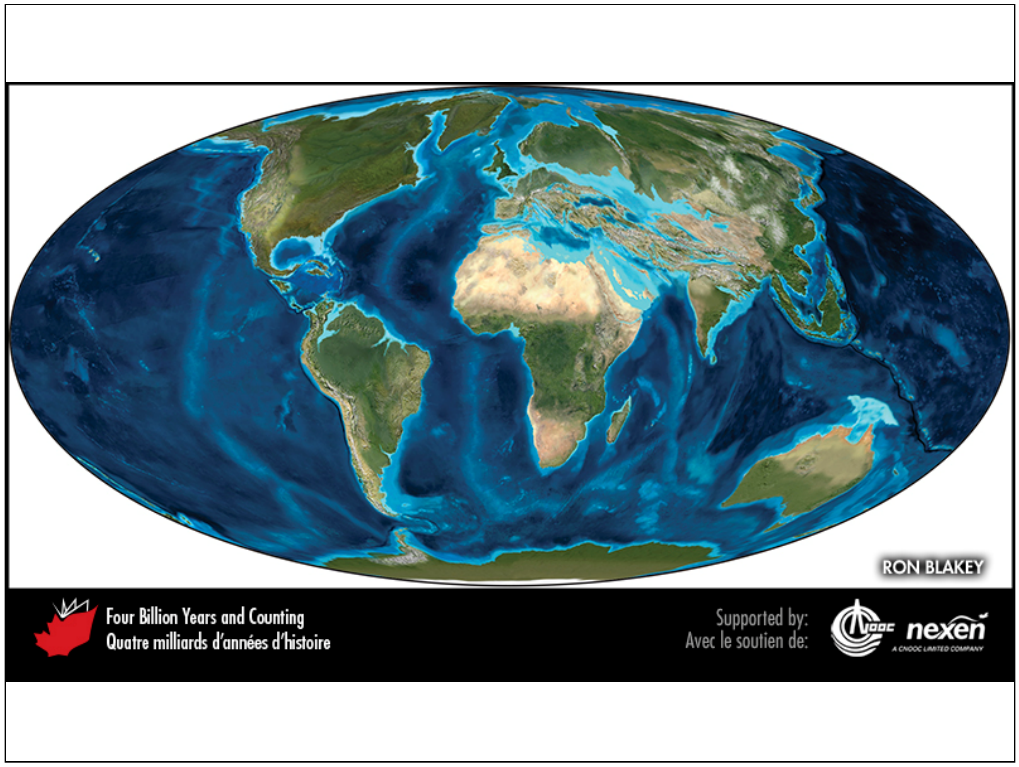

Global paleogeography 35 million years ago, during the late Eocene. Colours as for previous figure.

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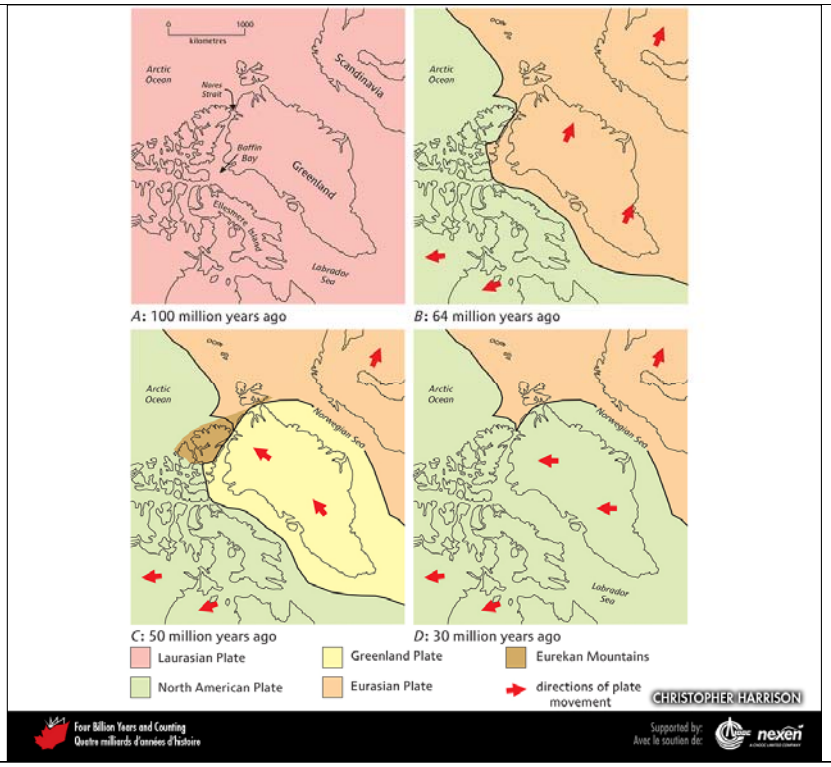

The changing plate-tectonic relationships of Laurasia, Greenland, North America, and Eurasia for middle Cretaceous (*A*), early Paleocene (*B*), early Eocene (*C*), and Oligocene and later times (*D*). The modern shoreline is shown for orientation, and Eocene plate positions are shown on all figures for simplicity. ADAPTED FROM VARIOUS SOURCES.

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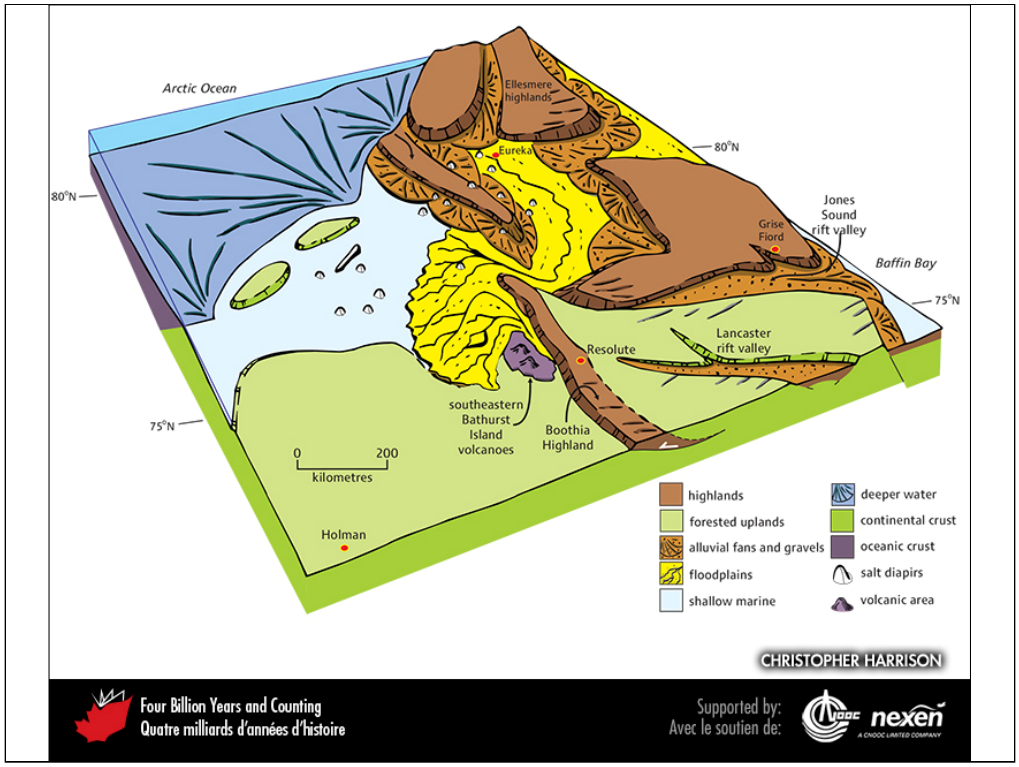

Paleogeography of what was to become the Canadian Arctic in the late Paleocene to Eocene, 62 to 35 million years ago. The approximate location of Holman, Resolute, Grise Fiord, and Eureka are included to provide a guide for orientation, as well as paleolatitudes.

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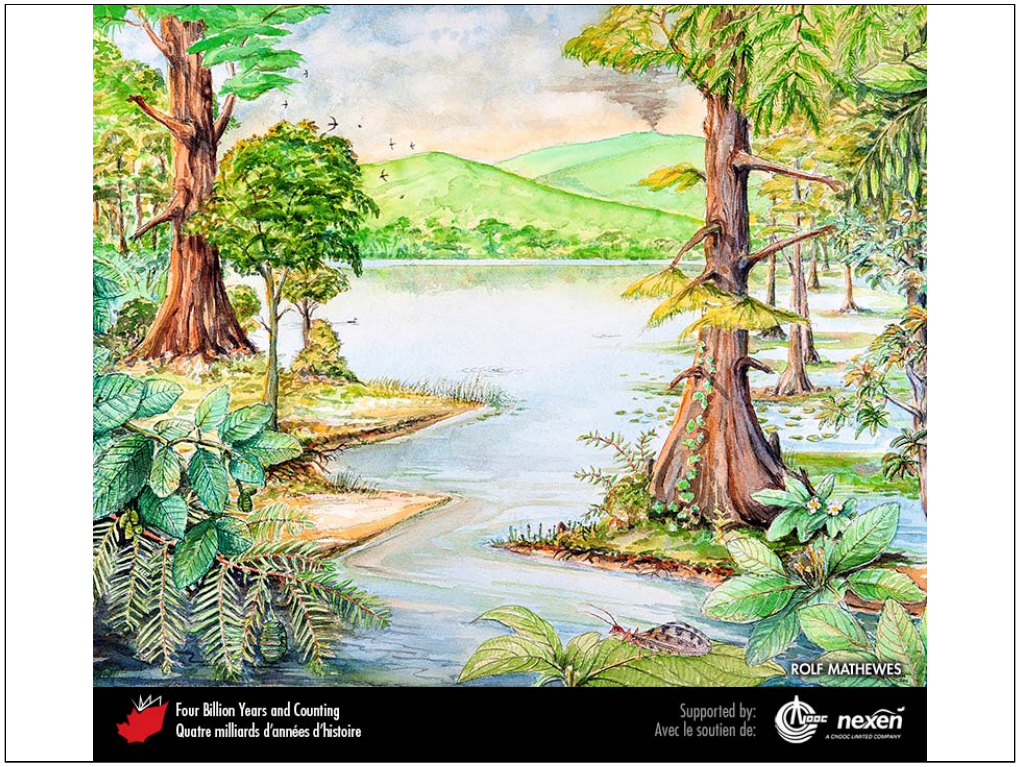

An early Eocene summer lakeside scene based on fossils, about 50 million years old, found near Quilchena, British Columbia. On the right is a large swamp cypress tree with flowering "water willow" (*Decodon*) shoots at its left base. Leaves of tea-family plants can be seen at far and lower right, with a fruiting branch of ash at upper right. The shallow waters around the cypress support floating mats of algae, the fern *Azolla*, and leaves of water lily. At left, an alder branch with cones hangs over a fertile shoot of dawn redwood. The small blade-leafed plants at the middle water's edge, although not true grasses, may be early relatives of that group or other grass-like plants. Animal fossils at Quilchena include insects, which likely provided food for the swallow-like swifts (upper left), fossils of which have been found recently. ARTWORK COPYRIGHT ROLF MATHEWES.

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Wing of a lacewing insect found in the Eocene lake deposits at Quilchena, British Columbia. ROLF MATHEWES

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Dawn redwood foliage at left and a cypress branch crossing the bottom-right of the image. These fossils were found in the Eocene lake deposits at Quilchena, British Columbia. RON LONG.

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Flower calyx *Florissantia quichenensis* found in the Eocene lake deposits at Quilchena, British Columbia. ROLF MATHEWES.

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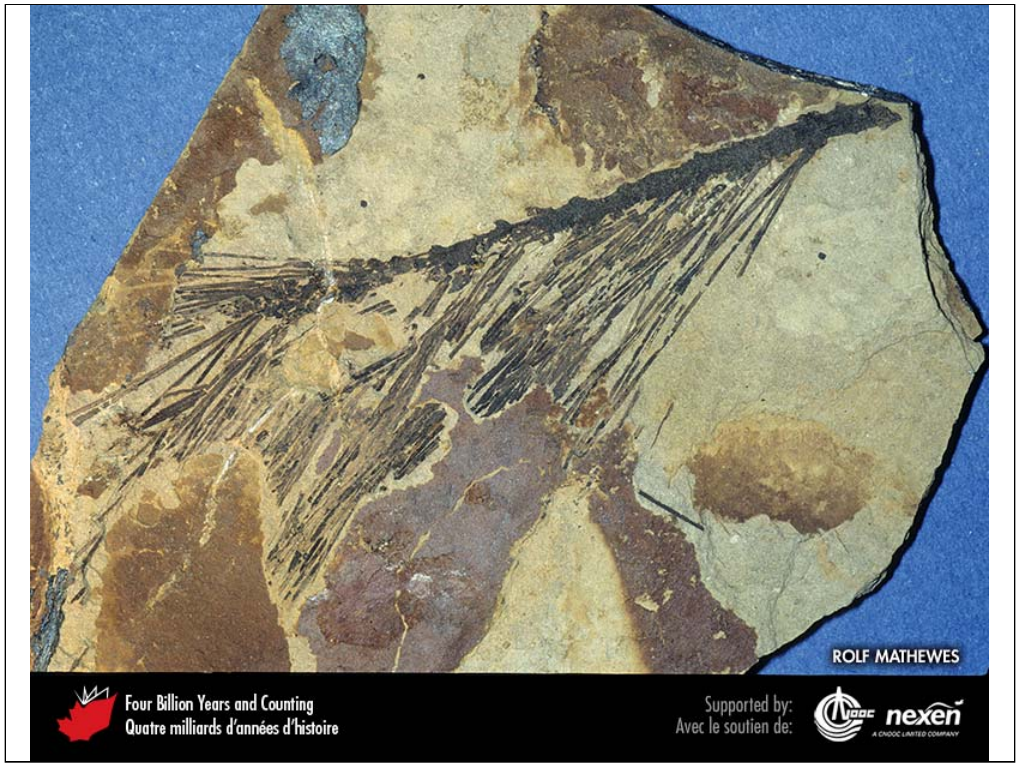

Pine branch with needles found in the Eocene lake deposits at Quilchena, British Columbia. ROLF MATHEWES.

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Flight feather found in the Eocene lake deposits at Quilchena, British Columbia. ROLF MATHEWES.

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A waterstrider found in the Eocene lake deposits at Quilchena. ROLF MATHEWES.

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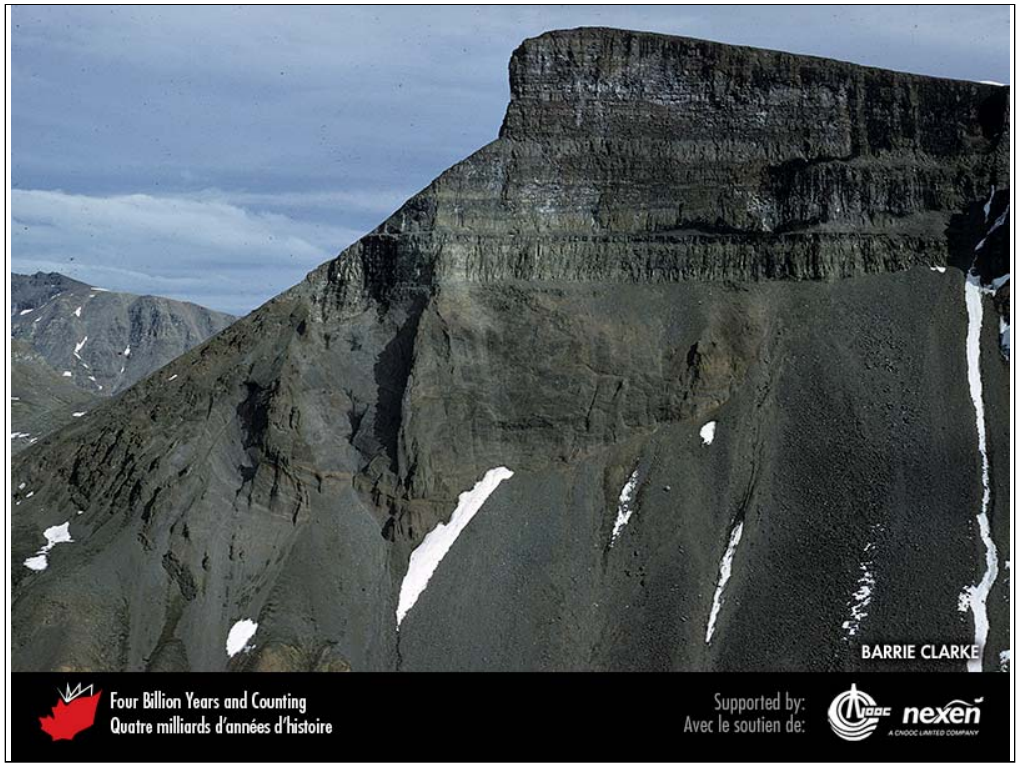

Flat-lying Paleocene basalt flows resting on brown volcanic breccia, on the coast of Baffin Island, northwest of Cape Dyer. BARRIE CLARKE.

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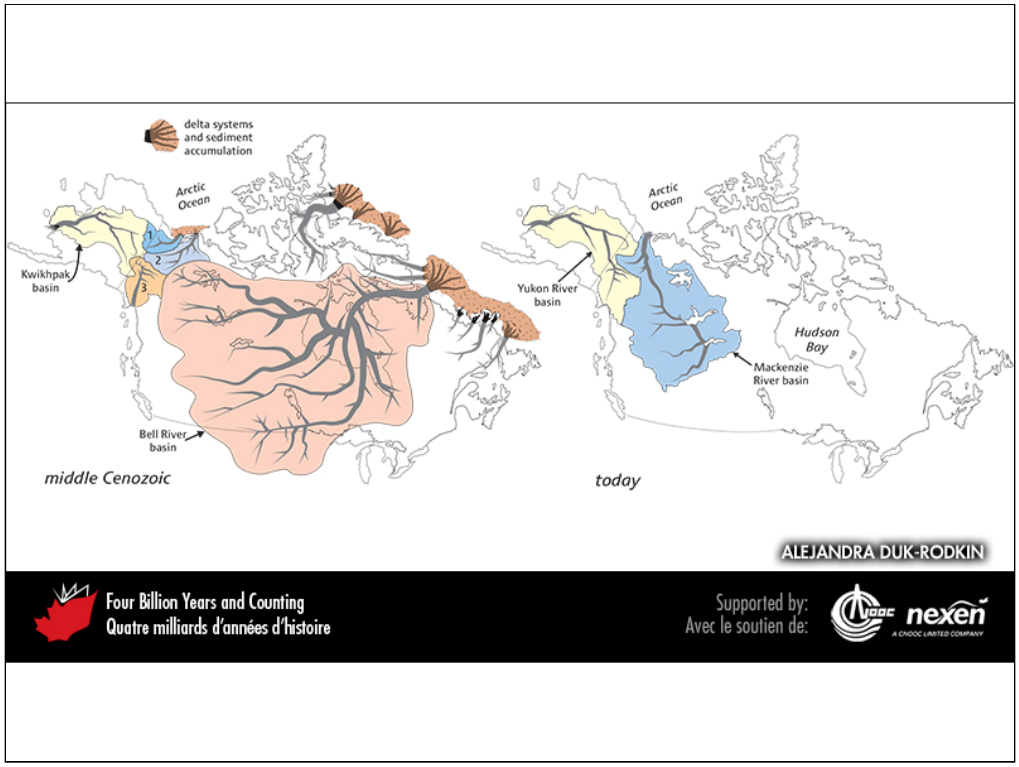

A comparison of middle Cenozoic (left) and modern (right) river drainage basins of northern parts of North America. For much of the Cenozoic two small river systems drained into the Arctic Ocean, and most of the interior was drained by the vast Bell River System. Today, the Mackenzie River basin covers a large area of northwestern Canada. Note too how the river basins of Alaska and Yukon have changed (see pages 210–211). In the map at left, 1 = ancestral Porcupine River Basin, 2 = ancestral Peel River basin, 3 = ancestral Yukon River basin.

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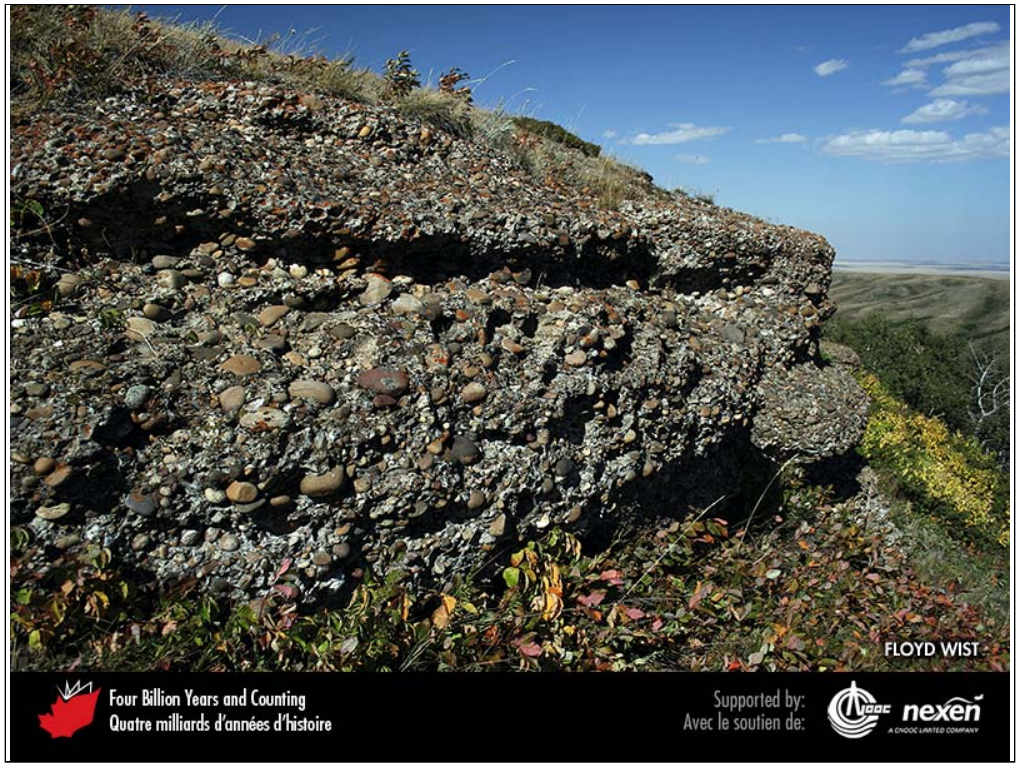

Tertiary conglomerate, originally fluvial gravels, Cypress Hills, southwestern Saskatchewan. FLOYD WIST.

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An angry-looking pair of entelodonts, pig-like animals whose remains have been found in Eocene to Miocene deposits of the Prairies. ART BY AND COPYRIGHT OF MARIANNE COLLINS, USED WITH THE ARTIST'S PERMISSION.

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Paleogeography of North America and adjacent regions in the Miocene, 15 million years ago. Land is shown in brown, with shading showing topography. The lighter blue areas represent possible coastal or nearshore areas, darker blue represents deeper ocean waters, and black indicates trenches. Aspects of modern geography are shown for orientation.

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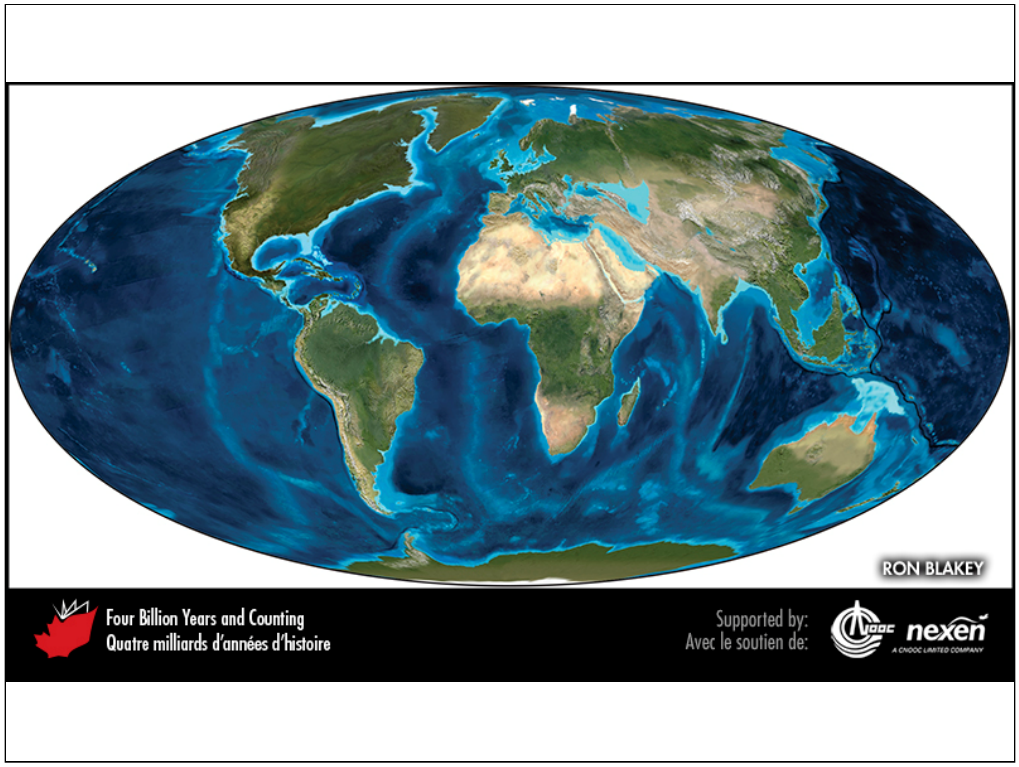

Global paleogeography 15 million years ago, during the Miocene. Colours as for previous figure.

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Mount Garibaldi, a stratovolcano of the Cascade Magmatic Arc northeast of Squamish, British Columbia, was last active about 13,000 years ago. This view is from the northwest. PAUL ADAM.

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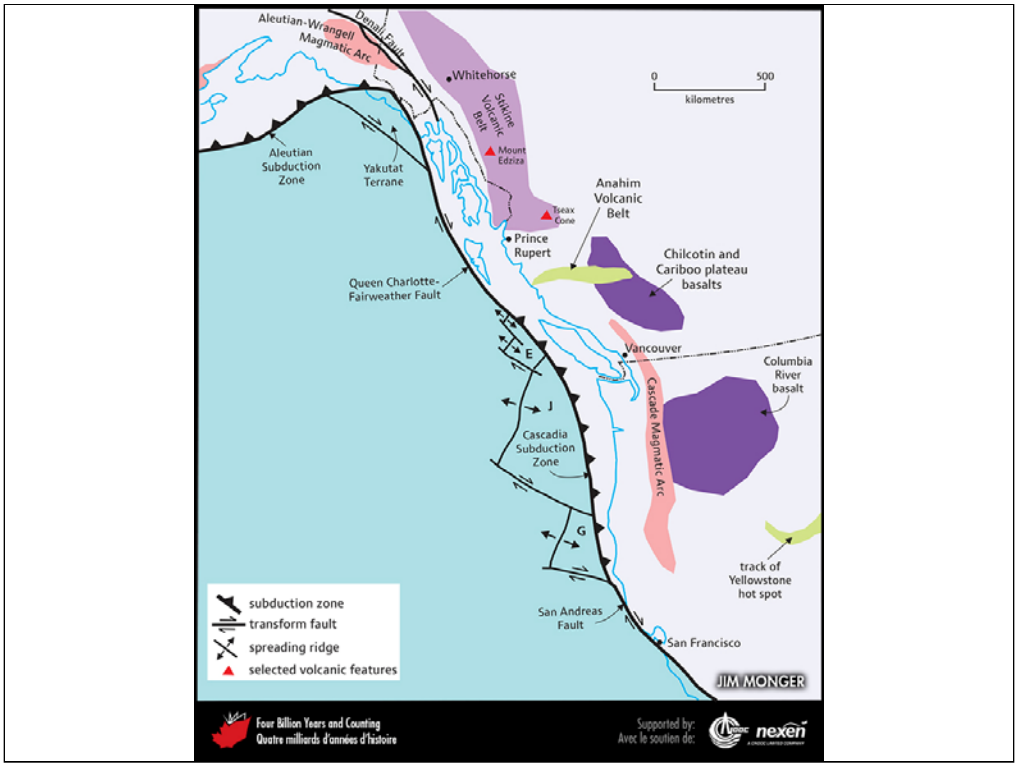

The location of active volcanic areas in western North America and the distribution of plates and plate boundaries associated with the continent's western margin and the northeastern Pacific Ocean. The Columbia River basalts form a huge area of volcanics in the northwestern United States akin to the Chilcotin and Cariboo basalts of British Columbia. E = Explorer Plate, J = Juan de Fuca Plate, G = Gorda Plate.

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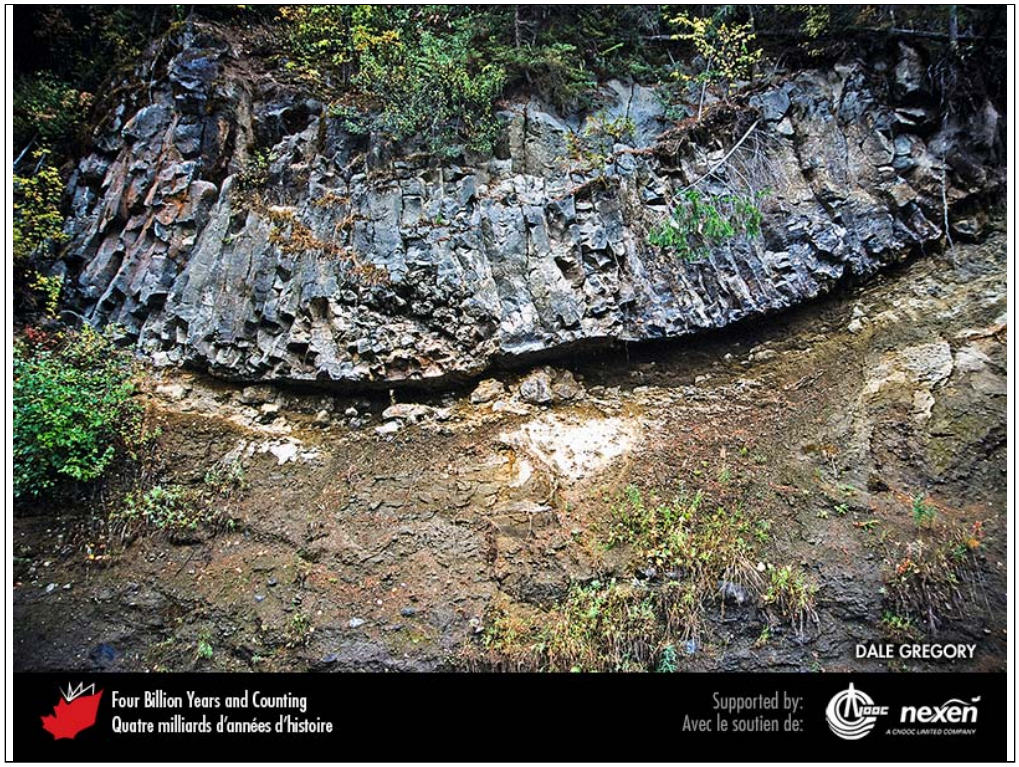

Close-up of the base of a lava flow over till at Mushbowl Hill, Wells Gray Provincial Park, British Columbia. The volcanic rocks at Wells Gray are possibly related to the Anahim Volcanic Belt. DALE GREGORY.

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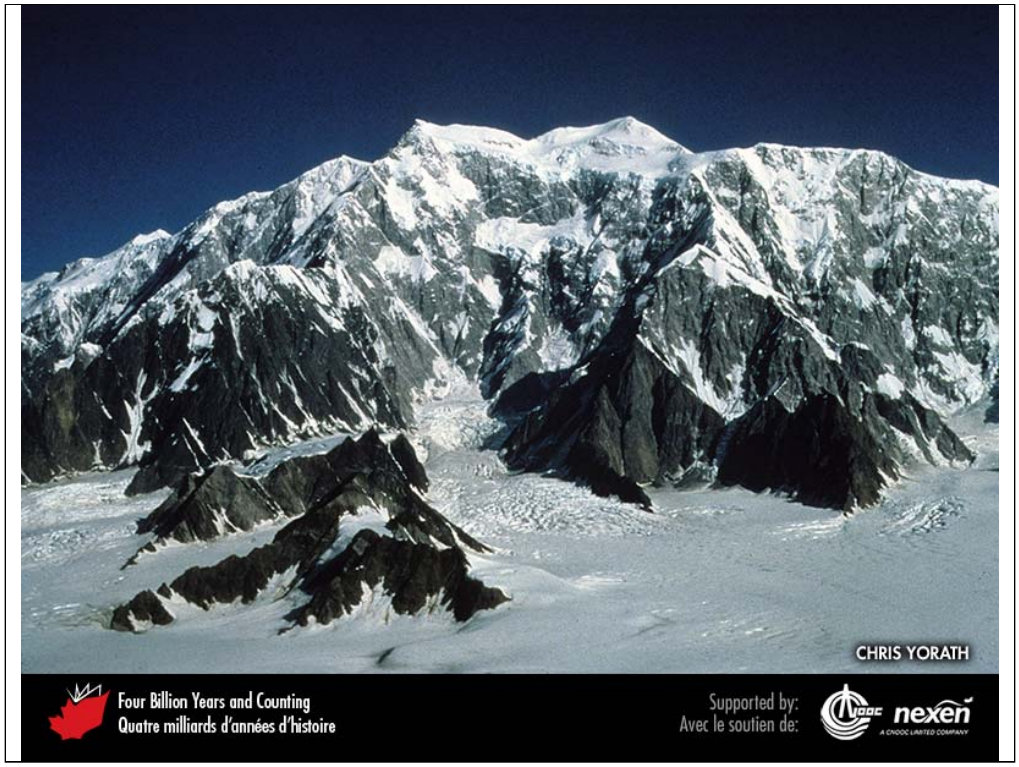

At 5,951 metres, Mount Logan in the St. Elias Mountains of Yukon is the highest peak in Canada. Mount Logan consists mainly of Jurassic and Cretaceous granitic rocks. The lower southwestern slopes are underlain by early to late Cretaceous sedimentary strata of the Chugach Terrane. A fault, clearly visible here as the abrupt change from grey to dark brown, separates the granitic rocks from the sedimentary strata. CHRIS YORATH.

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Mount Waddington, formed of late Cretaceous gneiss, is the highest peak in the predominantly granitic Coast Mountains. JOHN SCURLOCK.

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Physiography of the central Canadian Cordillera showing how valleys (arrows) lead into the Nechako Basin at angles that suggest the original flow of the headwaters of the Fraser River was to the east. The geologically recent rise of the Rocky Mountains blocked the route and flow was diverted southwestward down the modern Fraser River. BASE MAP FROM AMANTE AND EAKINS (2009).

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The modern Fraser River near Big Bar Creek, British Columbia, flows in a deep inner Holocene valley incised into a broader pre-glacial valley. Terraces mark former levels of the valley floor. The Fraser River now flows south and southwest to the Pacific, but during the Miocene and Pliocene it flowed northward, then eastward. JOHN CLAGUE.

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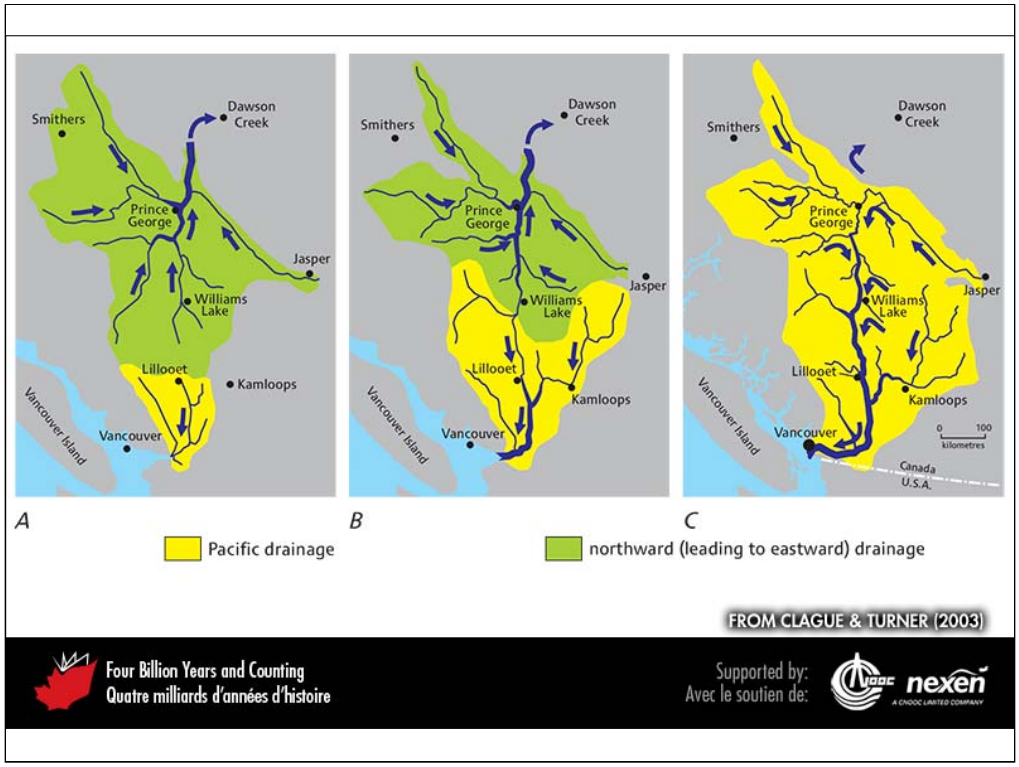

The evolution of the Fraser watershed in British Columbia. *A* shows the situation prior to the Ice Age, when the Fraser was a small coastal river. *B* shows an expanded Fraser system as the river worked its headwaters inland and the watershed captured the upper reaches of other streams. *C* shows the modern drainage. ADAPTED FROM A GRAPHIC BY RICHARD FRANKLIN FOR CLAGUE AND TURNER (2003), USED WITH PERMISSION FROM TRICOUNI PRESS.

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Reconstruction of *Puijila darwini* swimming. This creature was a "walking seal", intermediate between terrestrial mammals and pinnipeds. PAINTING BY ALEX TIRABASSO, COPYRIGHT CANADIAN MUSEUM OF NATURE.

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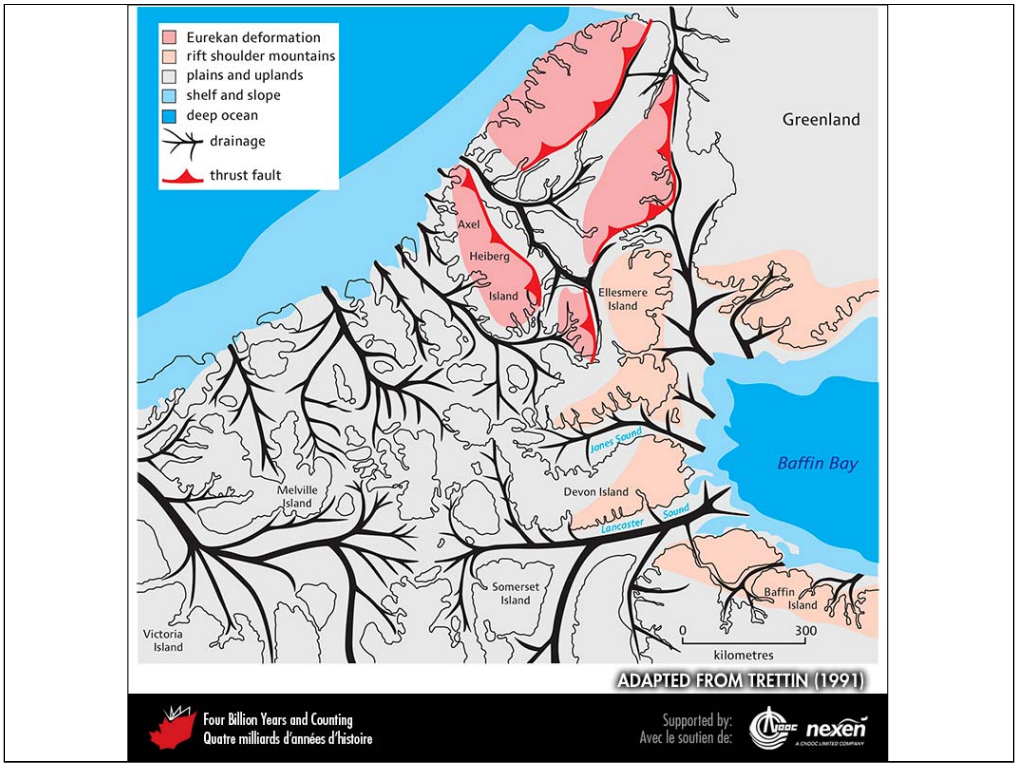

Late Cenozoic paleogeography of the region that was to become the Arctic Islands, showing the courses of major rivers. The valleys of these rivers were broadened and deepened by glaciers over the past 3 million years, so that when the ice receded after the latest glacial advance, the valleys became sea channels and the higher areas between them became the modern islands. Also shown is the distribution of rift-shoulder mountains flanking Baffin Bay and the mountains produced by the Eurekan Orogeny. ADAPTED FROM TRETTIN (1991), REPRODUCED WITH THE PERMISSION OF NATURAL RESOURCES CANADA, COURTESY OF THE GEOLOGICAL SURVEY OF CANADA.

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Paleogeography of North America and adjacent regions in the Pliocene, 3 million years ago. Land is shown in brown, with shading showing topography. The lighter blue areas represent possible coastal or nearshore areas, darker blue represents deeper ocean waters, and black indicates trenches. Aspects of modern geography are shown for orientation.

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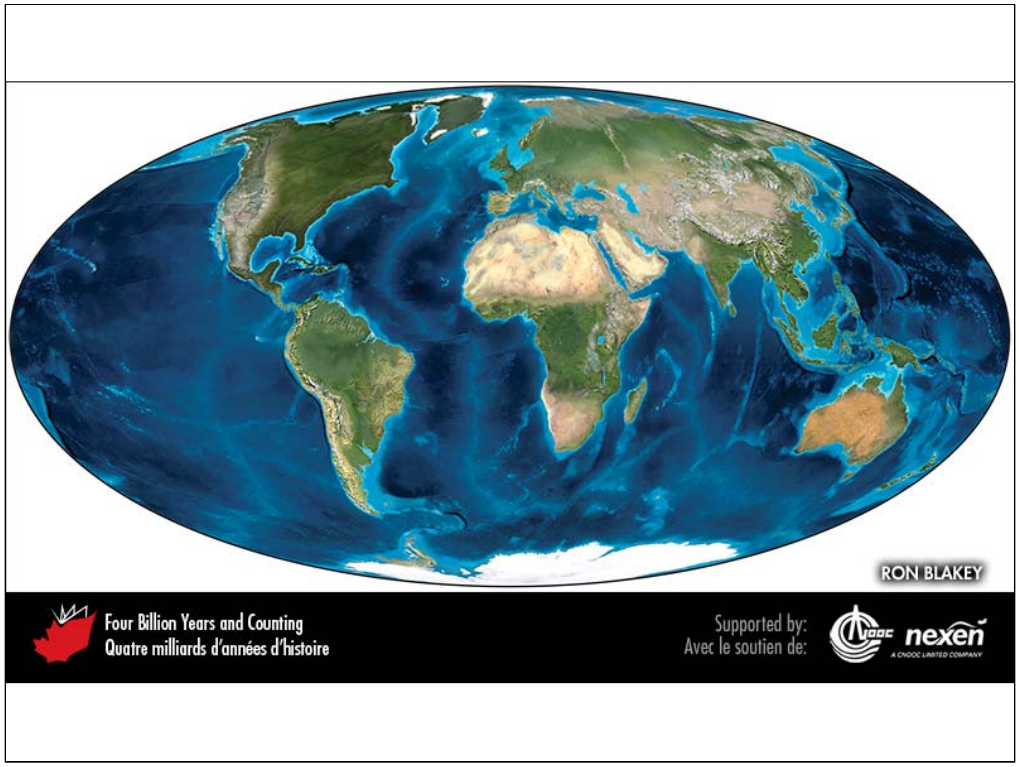

Global paleogeography of the Pliocene, 3 million years ago. Colours as for previous figure.

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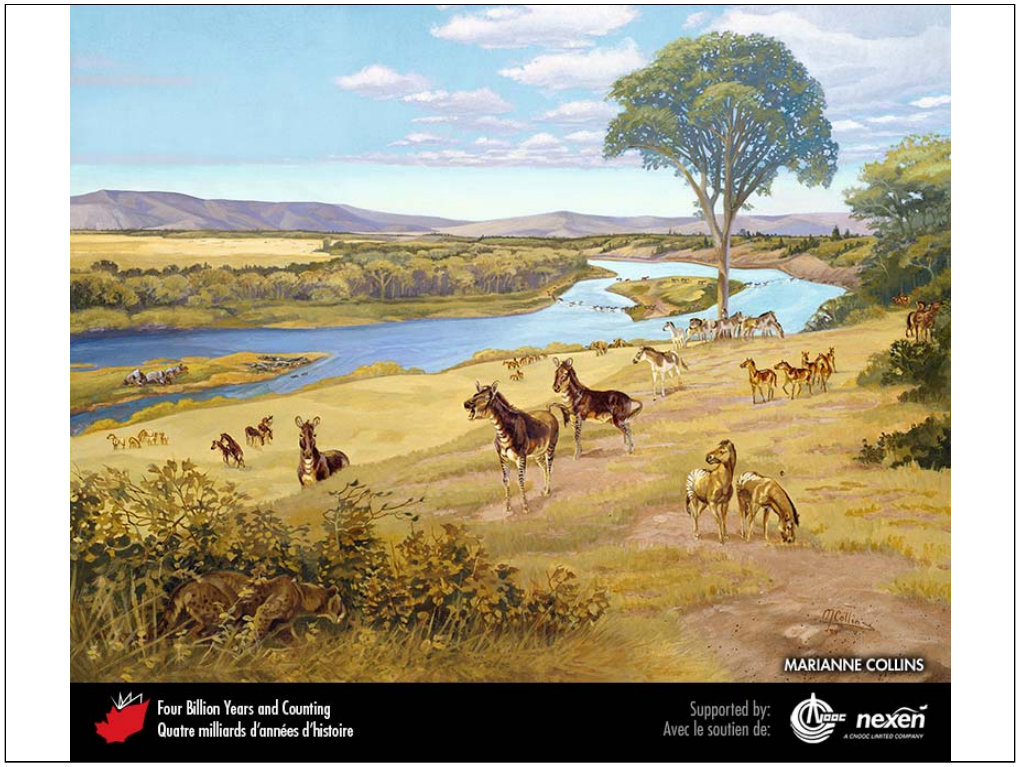

A view reminiscent of the Wood Mountain area of Saskatchewan during the Miocene. The foreground is dominated by *Merychippus*, a three-toed horse, while a group of *Merycodus*, an extinct pronghorn, look on in the middle distance at right. Painting copyright Marianne Collins, artist. ART BY AND COPYRIGHT OF MARIANNE COLLINS, USED WITH THE ARTIST'S PERMISSION.

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