



The Dempster Highway is named for William John Duncan (Jack) Dempster who served with the Royal Northwest Mounted Police (RNWMP) for 37 years. He was the "Iron Man of the Trail" and led the expedition to find the remains of the Lost Patrol in 1911. The tragedy was the only serious mishap in the annual mid-winter dog-sledged excursions of the Dawson RNNWMP to Fort McPherson. The patrols were discontinued in 1921 and the highway intersects the old route at Chapman Lake (km 116).

During construction, highway engineers faced the challenge of **permafrost**. Most building over ice-rich ground occurred during the winter to avoid melting. Along much of its length the highway sits on a gravel pad 1 to 4 metres thick. The thickness is required to insulate the frozen substrate, because the dark road surface absorbs more summer heat than tundra vegetation. Another challenge was finding nearby deposits of road-surfacing gravel that could withstand wet weather and heavy loads, while providing good grip for tires.

The Dempster Highway is an all-weather gravel road through a landscape that remains mostly wilderness. From its southern starting point (km 0) east of Dawson City, Yukon, the highway crosses the Arctic Circle (latitude 66°33' North) at km 405. It passes from the Yukon into the Northwest Territories at km 465, and terminates in Inuvik at approximately km 717.5. The road also surmounts the continental divide between the Pacific and Arctic oceans (km 82) and traverses two mountain ranges (Ogilvie and Richardson mountains) of the **Canadian Cordillera**. It is a spectacular multi-day journey, so take some time to enjoy it!

### Introduction to the Dempster Highway



### Northern Canadian Cordillera

The Dempster Highway is the most northerly road crossing the Canadian Cordillera. Current **tectonics** and **seismicity** across the northern Cordillera result from oblique collision of the Yakutat **terrane** with the North American plate margin. The Yakutat terrane is a piece of oceanic-continental crust that has moved northwest on the Pacific Plate to collide with North America in the Alaska Trench. This collision both uplifts the crust of the St. Elias Mountains, which includes Canada's highest peak, Mount Logan, and drives the upper crust of southern Yukon northeastward. The average rate of movement is 5 mm/year. Earthquakes of variable severity sometimes occur due to this movement.

### Geological regions & stratigraphy

Travelers of the Dempster Highway traverse several regions where the physical character (**physiography**) of the land is shaped by its geology and glacial history. Northwestern Canada is divided into two main areas: the **Interior Plains** which consist of generally flat-lying sedimentary rocks or **strata**, and the **Foreland Belt of the Cordillera** which includes many of the same rocks but shows the cumulative effects of mountain building (**orogeny**) during the last 150 million years (**Ma**).

The Interior Plains and Cordillera are divided into physiographic regions; shaped by different tectonic elements, each with its own structural style, history, and **stratigraphy**. The Dempster provides access to a variety of rock units (see table at right) and features across several regions. Encountered in this order (from south to north; see map on reverse), are the:

- Tintina Trench and the Selwyn Fold Belt (Southern Ogilvie Mountains);
- Taiga-Nahoni Fold Belt (Northern Ogilvie Mountains);
- Eagle Fold Belt (Eagle Plain);
- Richardson Anticlinorium (Richardson Mountains);
- Northern Interior Platform; and
- Aklavik Arch Complex.

The stratigraphic succession that makes up the Cordillera and Interior Plains extends as a wedge of **sedimentary** rocks that thickens westward from the edge of the Canadian Shield. This wedge is up to 20 km thick and exposed by uplift in the Cordillera. The succession consists of six general stratigraphic assemblages that are separated by **unconformities**. These assemblages (see figure at right) extend from the Proterozoic (as old as 1800 Ma) to Late Cretaceous (as young as 65 Ma). The wedge lies on **igneous** and **metamorphic** rocks thought to be the continuation of the Canadian Shield to the east.

### Mineral & hydrocarbon resources

Northwestern Canada has excellent potential for both minerals and hydrocarbon resources. Dempster Highway construction was initiated to access prospective hydrocarbon resources of Eagle Plain. Its completion was spurred by exploration activity targeting petroleum potential of the Mackenzie Delta and Beaufort Sea. Mining is an important component of Yukon's economy and history (the famous Klondike gold rush established Dawson City), and there is renewed interest in hydrocarbon resources. In NWT, mining (including the new diamond discoveries north of Yellowknife) and hydrocarbon production (such as Canada's fourth largest producing oil field at Norman Wells) are significant economic contributors. The oil and natural gas resources of the Beaufort-Mackenzie Region and Mackenzie Valley continue to hold great potential.

Rock Types		Hydrocarbons	
Shale (gray)	Evaporite	Gas discovery	Gas show
Shale (black)	Limestone	Oil discovery	Oil show
Shale, siltstone	Dolostone	Source rock	
Shale (foredeep)	Diamict, alluvium		
Sandstone (traton-derived)	Alkaline volcanics		
Shale (foredeep)	Gabbro, diabase, diorite		
Sandstone, siltstone (foredeep)			
Conglomerate and sandstone			
Red beds			
Contacts			
Conformable			
Unconformity			
Disconformity/Condensed Section			
Uncertain			

## Geoscience Office



**Roadside Geology of the Dempster Highway, Northwest Territories & Yukon**  
 A geological roadmap for Canada's most northwestern road  
 Yukon Geological Survey  
 Box 2703 (K102), 102-300 Main Street  
 Whitehorse, YT Y1A 2C6  
 867.669.2636 nigo@gov.yk.ca  
 867.667.5200 geosales@gov.yk.ca  
 www.nwtgeoscience.ca  
 www.geology.gov.yk.ca

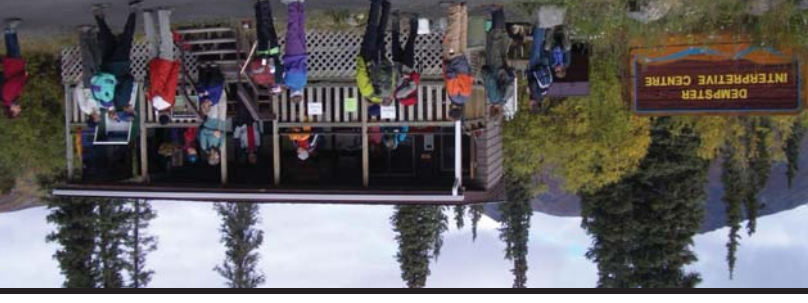
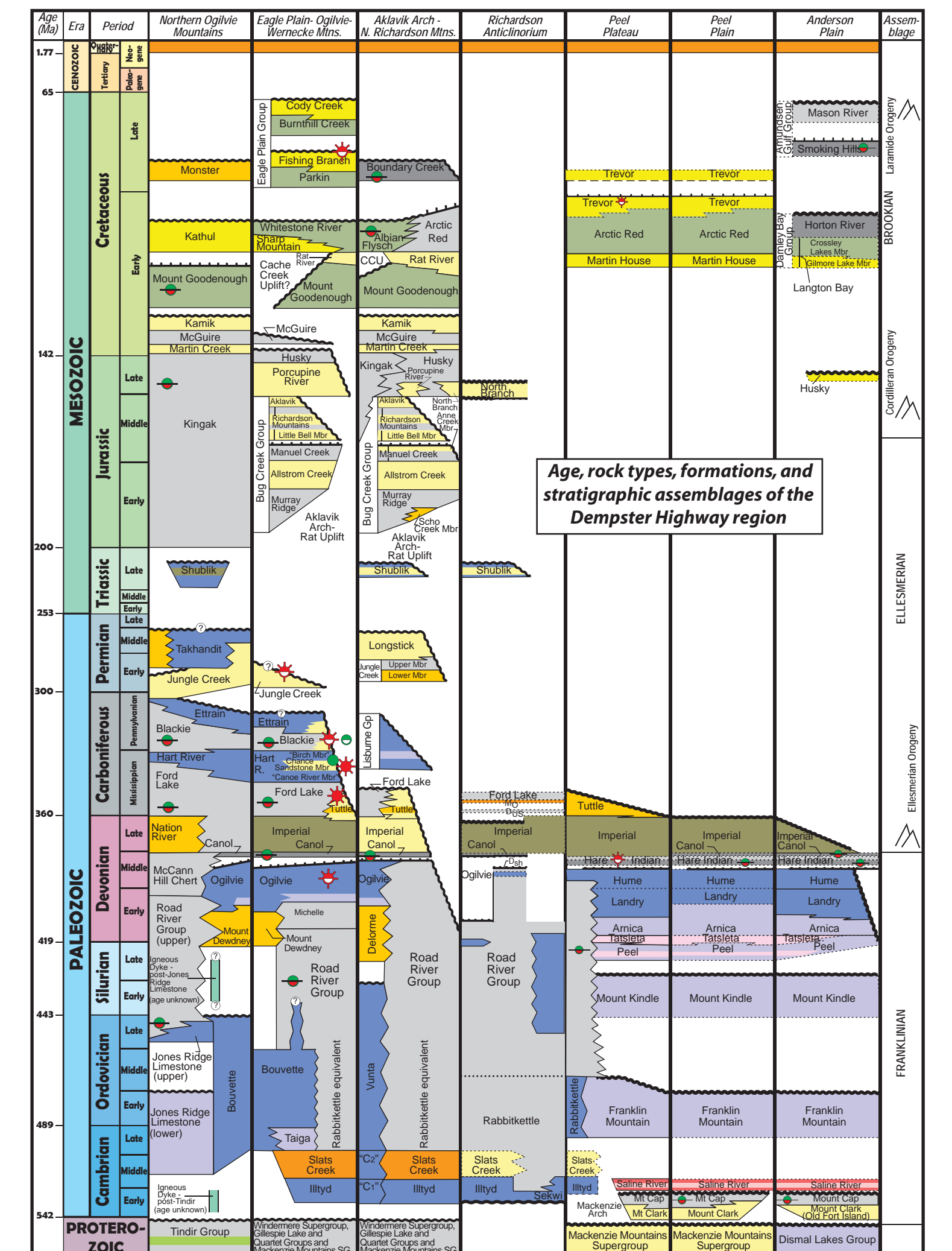
**Citation**  
 Jones, A.L. & Pyle, L.J. (compilers), 2007. Roadside Geology of the Dempster Highway, Northwest Territories & Yukon. A geological roadmap for Canada's most northwestern road. NWT Open Report 2007-009 & YGS Open File 2007-11. 1 folded map.

Locally if certain sites are critical to your visit. Enjoy the geology and the drive! A result some distances recorded on this map will be inexact. Please check the kilometre posts (northern section) are periodically moved or re-placed. As barriers are opened and closed by highway maintenance crews, furthermore, parts of the road are re-constructed, and various bottom (gravel) pits and The road distances and outcrop access were correct as of July 2005 (northern section) and September 2006 (southern section). Each summer, however, some note the time change as you make plans, particularly for the ferry crossings. The time changes from Pacific Standard Time to Mountain Standard Time as you cross the boundary from the Yukon to the Northwest Territories. Please Conversely, despite the lack of traffic, remember that this is a first-order highway and drivers of large trucks treat it that way. They are not expecting to encounter pedestrians, dogs or middle-of-the-road sightseers. Thus it is important to seek pullouts or completely move your vehicle from the traveled portion of the road. Never park along sharp or blind curves. Help after an accident on this remote road will be a long time coming. The highway crosses expansive wilderness. Maintain respectful and safe distances from wildlife. Depending on seasonal conditions and traffic, ensure your vehicle is suitable for the trip, spare tires, emergency kits, extra food and additional fuel are essential when travelling in this remote area. If you are stranded it may be many hours before another vehicle passes by, so plan ahead.



**Cautionary notes**  
 The Dempster Highway is a gravel road, quite narrow in places and rough. Well maintained pullouts with informative signboards are currently located at: Western Arctic Regional Visitor Centre in Inuvik. (km 71), and the Delta Visitor Information Centre in Dawson City, Yukon. The Dempster/Dempster Highway and are staffed from May to September; the Dempster/ and Inuvik Three Interpretive and Visitor Information centres focus on the six terraced campsites are located along the highway. Gas, food, and lodging are available at Dawson City, Eagle Plains Lodge, Fort McPherson, and Inuvik. Three Interpretive and Visitor Information centres focus on the Dempster Highway and are staffed from May to September; the Dempster/Delta Visitor Information Centre in Dawson City is dedicated to the "Road to the West Arctic", Tombstone Mountain Campground (km 71), and the Western Arctic Regional Visitor Centre in Inuvik.

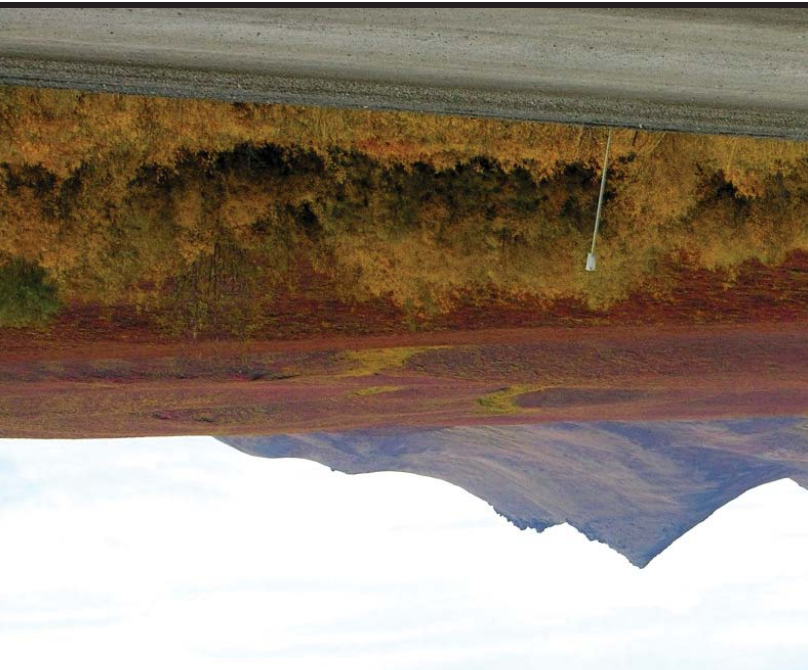
**Further reading**  
 Pyle, L.J., Roots, C., Allen, T.L., Fraser, T.A., Bond, J., Jones, A.L., & Gal, R.P. 2007. Roadside Geology of the Dempster Highway, Northwest Territories & Yukon. A traveler's guide to the Geology of Canada's most northwestern road. Northwest Territories Geoscience Office and Yukon Geological Survey, NWT Open File 2007-05 & YGS Open File 2007-10, 92 p.



**How to get there**  
 You can drive (or bike) the Dempster Highway from either Dawson City, Yukon or Inuvik, NWT. Dawson City is 536 km by road from Whitehorse. Inuvik is served by daily flights from Yellowknife and Whitehorse. Kilometre signposts along the east side of the highway, beginning at km 0 at South Klondike River 45 km east of Dawson City, through the Eagle Plains Lodge (roughly halfway) at km 369, to Inuvik at km 717. For more information about planning your trip, please consult the following websites and links therein: www.exploreinuvik.com  
 www.travelyukon.com

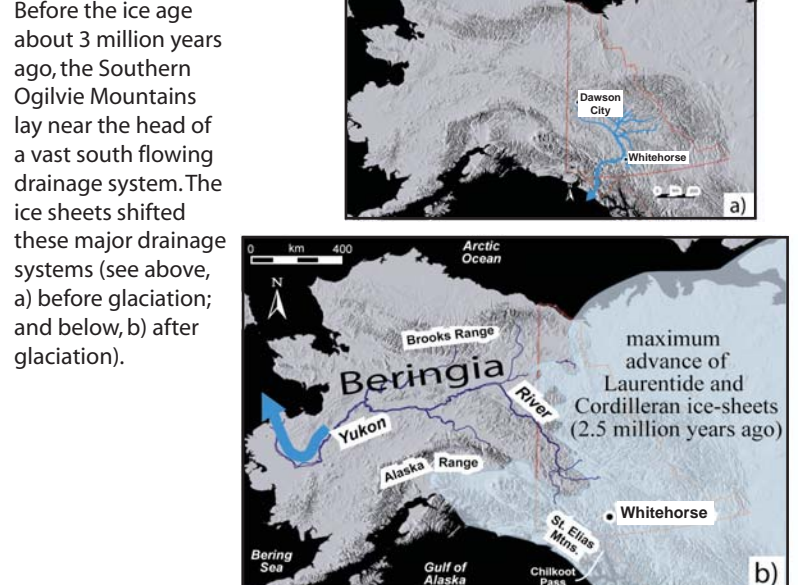
- Km 528.5: Tettit Gwinnjik Wayside Park: viewing platform, interpretive signs.
- Km 465: Northwest Territories / Yukon border; and
- Km 405: Arctic Circle and Richardson Mountains;
- Km 378: Eagle River: RNWMP manhunt for the "Mad Trapper of Rat River";
- Km 259.2: Gwazhal Kak Rest Area: geology, petroleum exploration;
- Km 102: Two Moose Lake; "thaw lakes" and waterfall;
- Km 74: Northwest Fork Pass Viewpoint: Tombstone Mountain, valley history;
- Km 71: Interpretive Centre: natural history displays;
- Km 0: Landscapes, wildlife resources, services for the motorized traveler.

The Dempster Highway is open all year, but the Peel and Mackenzie rivers (km 537 and 605 respectively) are uncrossable during spring ice breakup and fall freezing. From June to October, government ferries cross the Peel and Mackenzie/Arctic Red rivers on a regular schedule. From late November to April, an ice road is maintained across the status of ferries and ice roads is available at www.dot.gov.yk.ca or toll-free 1.800.661.0750.



### Glacial history

The Dempster Highway traverses glaciated and unglaciated landscapes. Areas that were not covered by ice formed the eastern edge of Beringia - a cold dry sub-continent that joined Alaska with far-east Russia across a lowland where Bering Strait is today. During the last ice age, Beringia was cut off from southern North America by two ice sheets: Cordilleran (from the south) and Laurentide (from the east). Glacial landscapes and deposits are associated with movements of these ice sheets. The Cordilleran Ice Sheet covered most of central and southern Yukon. It advanced westward and northward at least four times from 2.5 Ma to about 11 ka ago. **Glacial drift** of the last two glaciations, the Reid (300-125 ka), and the McConnell (25-11 ka) are well defined. The Laurentide Ice Sheet covered the Interior Plains, east of the Richardson Mountains divide, and reached its maximum extent around 30 ka. At least two more advances occurred later in the glaciation prior to 10.6 ka years ago. The Inuvik area was glaciated around 30 ka.



### Glossary of geological terms

- Canadian Cordillera**: area of deformed (folded or faulted) mountain belts and plateaus that extend 2000 km from the U.S. border north to the Beaufort Sea and Alaska in the north. The Cordillera includes a diverse assemblage of mountain belts, some of which consist of terranes or crustal fragments. Different tectonic regimes exist along the length of the Cordillera due to variations in plate tectonic interactions.
- Foreland Belt of the Cordillera**: along with the Interior Plains, area of Northwest Canada consisting of sedimentary rocks or strata that show the cumulative effects of mountain building during the last 150 million years.
- glacial drift**: rock material transported and deposited by glacial ice or meltwater.
- igneous**: rock solidified or crystallized from molten material (magma). *Intrusive* refers to magma emplaced in the Earth's crust; *extrusive* refers to igneous rock erupted onto the Earth's surface.
- Interior Plains**: large area of nearly horizontal bedrock comprising plains and plateaux covered by thick glacial drift.
- ka**: stands for thousand years old or ago.
- Ma**: stands for million years old or ago.
- metamorphic**: rock formed through recrystallization, mineral or chemical change to pre-existing rock, due to high temperature or pressure.
- orogeny**: rocks subjected to deformation (folding and/or faulting) during mountain building.
- permafrost**: ground (rock or soil) that remains at or below 0°C for at least two years. It may be continuous in a zone uninterrupted by unfrozen pockets of ground, or discontinuous in a zone with patches of unfrozen ground.
- physiography**: the physical expression of the land, also referred to as *geomorphology*, the description and origin of landforms.
- sedimentary**: rocks formed by deposition of sediment, solid material that is either transported by water, wind or ice, or chemically precipitated from solution.
- seismicity**: or seismic activity, refers to the phenomenon of Earth's movements, usually earthquakes.
- strata**: or stratum, a layer or bed of sedimentary rock.
- stratigraphy**: study of rock layers, including their attributes, origin, arrangements, and relationships.
- tectonics**: study of relationships, origins, and evolution of Earth's crust.
- terrane**: a crustal block or fragment that has a distinct geological history from adjacent blocks, and is commonly fault-bound.
- unconformity**: a surface that represents a gap in the geological record, such as a period of erosion of strata.

**8 Km 210.0 [507.5 km] Fossils**  
West of the highway are black shale and yellowish grey limestone of the Michelle Formation. These shale beds contain **concretions**. Near Km 211, a road cut with a wide shoulder on the east side along the Ogilvie River exposes the contact with light grey limestone of the Ogilvie Formation. The cliff consists of fossil-rich limestone with **crinoids**, **bryozoans**, and **trilobites**. Large blocks form a riprap, a natural barrier to erosion, along the river.

**7 Km 194.0 [523.5 km] Divii Ddhaa: Sappers Hill**  
This castle-like ridge consists of a north-dipping limb of Devonian age Ogilvie Formation limestone in the **hanging wall** of a south-directed thrust fault. Erosion at the base of the cliff produces conical outcrops rising from grey limestone rubble (picture taken at Km 190, looking north).

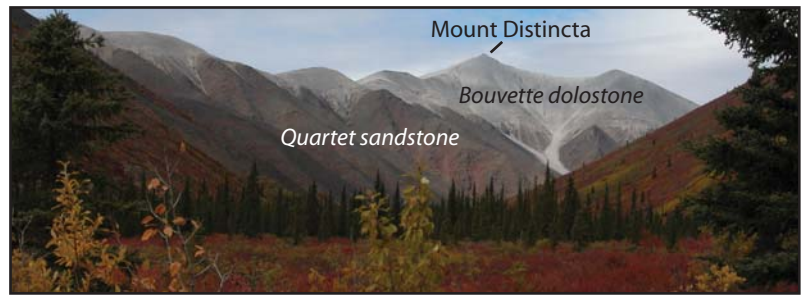


**6 Km 153.0 [564.5 km] Windy Pass**  
The large pullout south of the highway (at elevation 1060 m) is a three minute stroll from outcrops and the base of a broad shoulder south of the pass. This lightly vegetated landscape is a plausible stand-in for a Beringian (see reverse) landscape. The fossiliferous Paleozoic Bouvette Formation dolostone, found here in large blocks, has a mottled appearance from burrowing of ancient animals (**trace fossils**). Fragments of silicified coral are also abundant.



**5 Km 143.0 [574.5 km] Wernecke breccia**  
A small pull-out on the west side is surrounded by rubble of dark brown rock that forms an exposure of the oldest (Proterozoic) rock on the Dempster: a dark siltstone. Large boulders, located a dozen metres south, are a distinctive **breccia** studied with sparkly hematite, an iron oxide mineral. The breccia was emplaced 1600 million years ago, as fluid moved upward through the sedimentary rocks. It can contain copper, uranium, and gold.

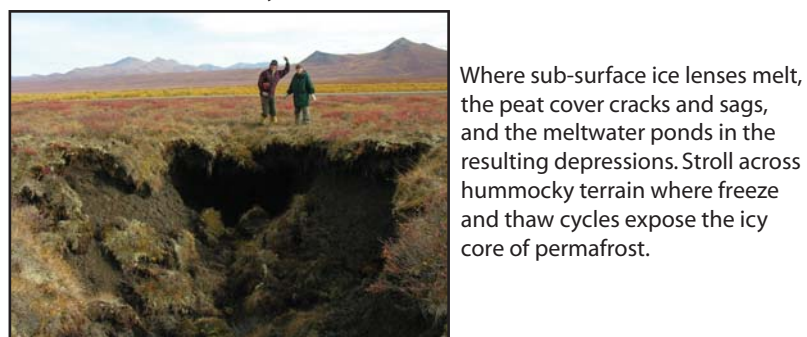
**4 Km 137.0 [580.5 km] Mount Distincta viewpoint**  
The mountainside at the head of the tributary west of the highway shows the sub-Cambrian **unconformity**, representing about 1 billion years of time and 10 km of strata eroded. Dark Proterozoic age Quartet sandstone lies beneath the light grey Paleozoic Bouvette dolostone. Mount Distincta (1760 m) is the highest of the rounded peaks in the area.



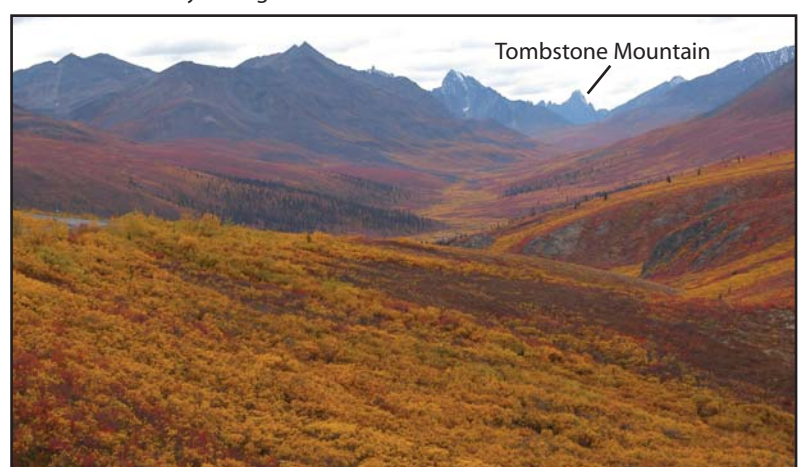
**3 Km 116.0 [601.5 km] Pilot Mountain viewpoint**  
The first phase of Dempster Highway construction, completed in 1961, ended at the rest area at Chapman Lake. Across the valley to the east is Pilot Mountain (a.k.a. Mount Vines). Note the smooth lower slopes (black shale) and the summit erosional remnants (called tors; composed of limestone and conglomerate) indicative of unglaciated terrain.



**2 Km 96.5 [621.0 km] Melting permafrost, Palsa bog**  
Look for ponds and lumpy ground below the relatively level tundra. There is no pullout; park as far off the highway as possible. Dome-shaped **palsas** are **periglacial** landforms that have an ice-rich core and are heaved upward during seasonal thaw and re-freeze cycles.



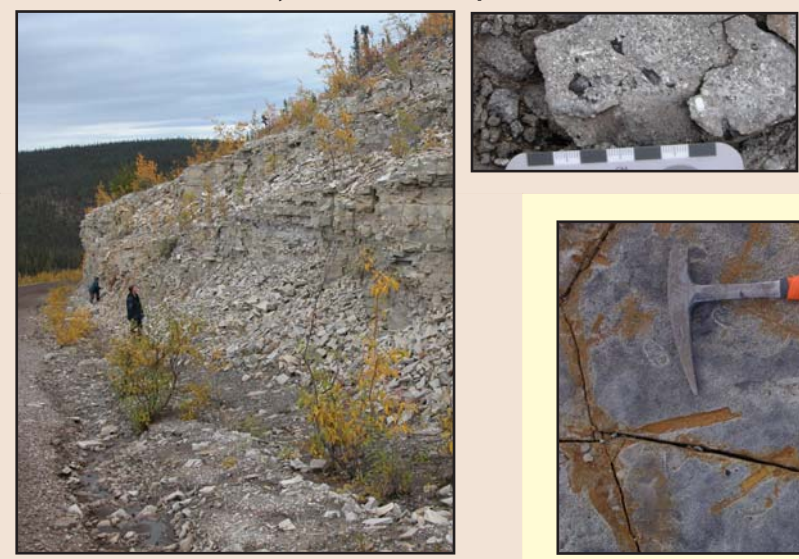
**1 Km 74.0 [643.5 km] Tombstone Mountain lookout**  
The highest point in this area is Tombstone Mountain (2500 m), which is about 20 km away at the head of the North Klondike River. The jagged skyline results from long, steep fractures in the resistant **syenite** and **granodiorite** rock that cooled 92 million years ago.



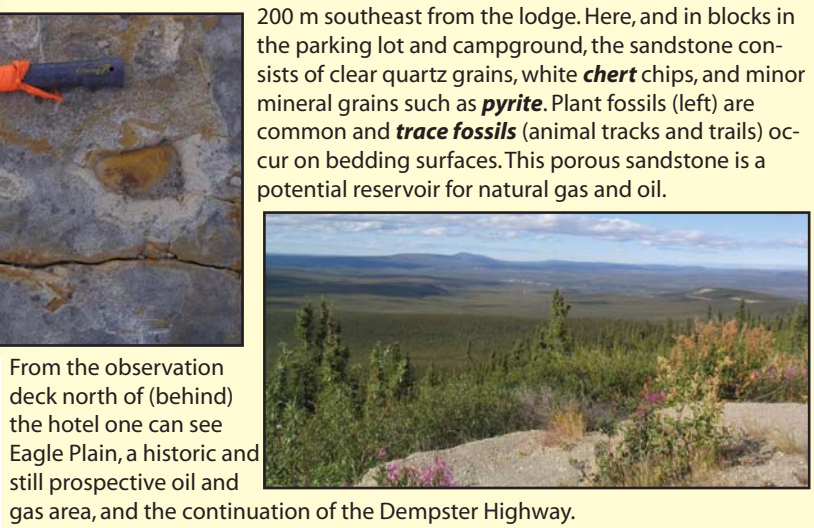
**9 Km 221.4 [496.1 km]: Elephant Rock rest area**  
The elephant does not roam in this taiga valley! Look high on the skyline five km to the south on a distant ridge, where pillars of weathered carbonate rocks form a familiar silhouette. A prominent fold in a resistant cap of limestone is also visible to the southwest.



**10 Km 348.0 - 349.0 [369.5 - 368.5 km]: Hart River Formation**  
An exposure of Hart River Formation extends for about 1.5 km along the east side of the highway (below, left). This is one of the few resistant roadside outcrops on the Eagle Plain. The outcrop is a pale orangish grey, siliceous, laminated limestone that contains plant fossils (impressions), coal fragments (below, right), minor sandstone, and shelly fossils like **brachiopods**.



**11 Km 369.0 [348.5 km]: Eagle Plains Lodge**  
This year-round centre was built in 1978 and provides gas, food, and lodging. The site was selected because bedrock (Tuttle Formation sandstone) is close to surface, otherwise costly pilings would be required to keep the permafrost under the buildings from melting. Pale orange Tuttle sandstone is exposed across the road 200 m southeast from the lodge. Here, and in blocks in the parking lot and campground, the sandstone consists of clear quartz grains, white **chert** chips, and minor mineral grains such as **pyrite**. Plant fossils (left) are common and **trace fossils** (animal tracks and trails) occur on bedding surfaces. This porous sandstone is a potential reservoir for natural gas and oil.



**12 Km 405.6 [311.9 km]: Arctic Circle rest area**  
A panorama eastward from the interpretive display shows the western flank of the Richardson Mountains. These mountains are underlain by the Richardson Anticlinorium which exposes the basinal (deeper water) shales of the Canol and Imperial formations in the foreground, with older strata of the Road River Group forming the higher peaks in the mountains.



**13 Km 445.8 [271.7 km]: Rock River campground**  
The river at the campground cuts through Imperial Formation to create a two km wide valley. In the vicinity of the river, the Imperial Formation is exposed along both sides of the highway. The older Canol Formation can be observed by hiking east (upstream) along the creek. The bright red color of Canol shales can be viewed from the bridge over Rock River, and again at Km 450. These 'burnt shales' are likely the result of the burning of carbon-rich material in the rock during a past forest fire.

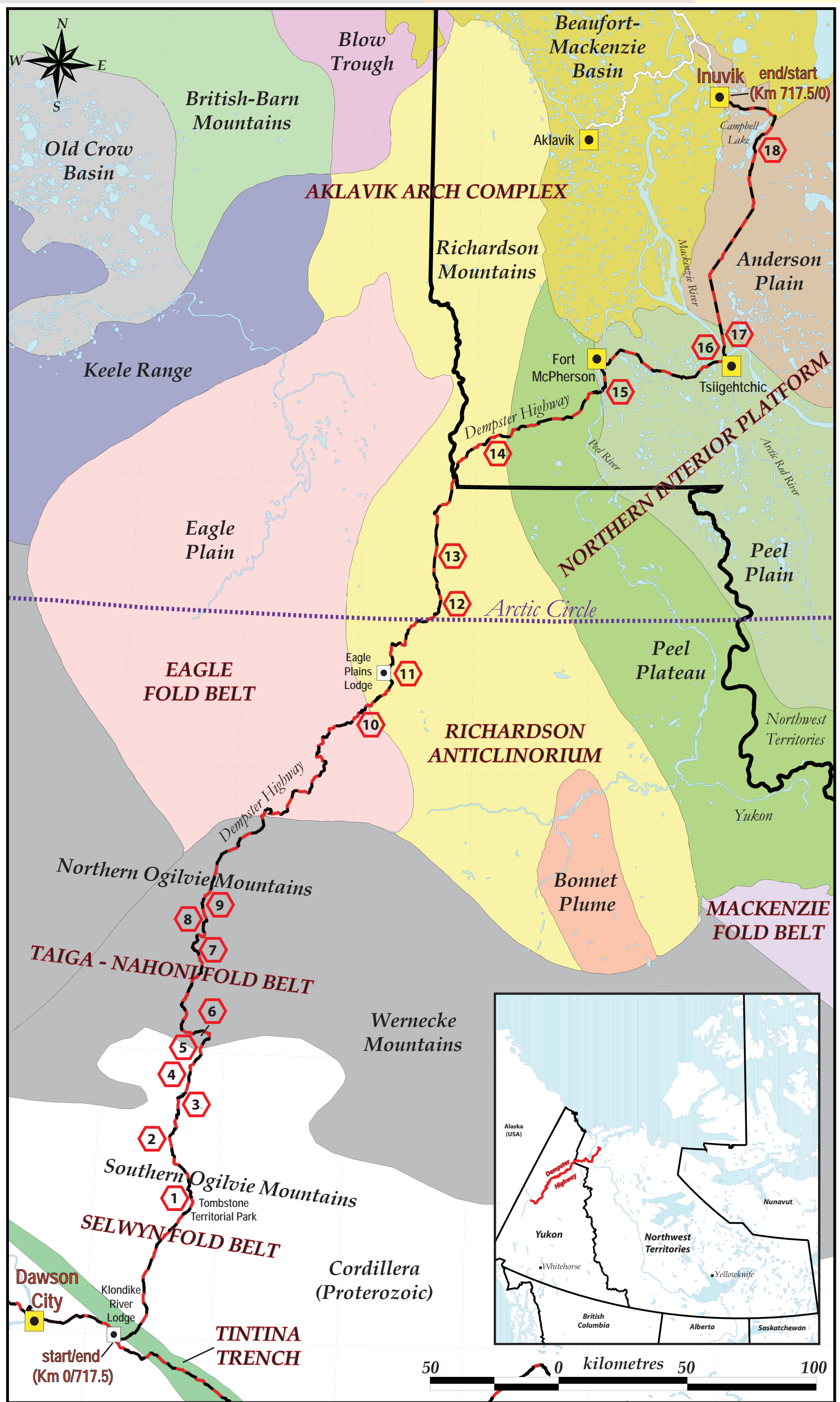
**14 Km 485.0-487.0 [230.5-232.5 km]: Vittrekwa Pass**  
Vittrekwa Pass is a high-walled ancient glacial meltwater channel containing terraces of sediments that flank the highway. Gravel from these terraces is a source of road building materials. Exposures in creeks alongside the road expose folded and deformed Imperial Formation sandstone and shale. The pass is the transition of the Richardson Mountains to Peel Plateau to the northeast.

**15 Km 537.3 [180.2 km]: Peel River ferry crossing**  
A stroll along the eastern bank of the Peel River south of the ferry crossing passes through sandstone, shale, and conglomerate of the Mount Good-enough Formation. Abundant fossil shells, ironstone concretions, and horizontal burrows are present. On either side of the Peel River, the highway crosses floodplain deposits that are the southernmost extension of the Mackenzie Delta.

**16 Km 605.2 [112.3 km]: Mackenzie, Arctic Red rivers**  
Tsiigehtchic is located at the confluence of the Mackenzie and Arctic Red rivers. The Mackenzie River, the largest north-flowing river in North America, flows 1600 km from Great Slave Lake to the Beaufort Sea. From the ferry, view the dark grey shale and sandstone of the Imperial Formation on the east bank of the river.

**17 Km 608.8 [108.7 km]: Tsiigehtchic quarry**  
There is a pull-out on the east side of the highway, in the vicinity of the sign for the community of Tsiigehtchic. Although only about five metres of strata is exposed, spectacular sedimentary structures such as **load casts**, **tool marks**, **rip-up clasts**, and **cross-stratification** occur in Imperial Formation sandstone. Wood fragments and black organics are also found here.

**18 Km 692.6 [24.9 km]: Tithegeh Chi'vital Park**  
Park in a pull-out on the northwest side of the highway. The hiking trail winds through knolls of Devonian age fossiliferous limestone to a lookout over Campbell Lake. Take a look at boulders and outcrop along the trail - look for **stromatoporooids** and **trace fossils**.



**Glossary of geological terms**  
**brachiopod**: "lamp shells"; a group of marine organisms that have a fossil record dating back to the Cambrian; their external shape resembles modern clam shells.  
**breccia**: a rock consisting of angular jagged rock fragments in a finer host rock.  
**bryozoan**: "moss animals" are common fossils in Paleozoic rocks, that are an extant group of colonial marine organisms with a calcareous skeleton; fossils are full of tiny holes (like lace) and branched.  
**chert**: a very hard sedimentary rock consisting of microscopic quartz crystals.  
**concretion**: a compact, spherical, ovoid, or irregular mass of rock formed by precipitation of cementing minerals around a nucleus of fossil or rock material; more resistant than the surrounding rock.  
**conglomerate**: a coarse-grained sedimentary rock composed of rounded fragments of rock greater than 2 mm in diameter in a matrix of lithified sand or silt.  
**crinoid**: "sea lilies"; an extant group of fossils that date back to the Ordovician. They have a root and long, flexible stem made up of calcareous donut-shaped segments that support a flower-like head or calyx. Often only parts of crinoids are found.  
**cross-stratification**: sedimentary rock beds at an angle to main layering or stratification.  
**granodiorite**: a coarse-grained igneous intrusive rock consisting of mainly quartz, feldspar and dark accessory minerals like biotite and hornblende.

**hanging wall**: in rocks that are faulted, the rocks that lie above the fault plane.  
**load cast**: a type of sedimentary structure on the underside of a bed formed as a bulge of sand protruding into a finer-grained mud or clay.  
**periglacial**: near-glacial in location or conditions, such as areas of permafrost.  
**permafrost**: see reverse.  
**pyrite**: "fools gold"; a yellow, metallic, iron sulphide mineral (ore of sulphur), often crystallizes in cubes.  
**rip-up clast**: a rock fragment that may or may not be the same as its host rock type.  
**stromatoporooid**: extinct (Cambrian to Cretaceous) sponge-like, colonial marine organisms that had a porous, calcareous skeleton.  
**syenite**: an igneous intrusive rock rich in feldspar, with very little quartz and one or more dark accessory minerals including hornblende.  
**tool mark**: a mark preserved on the underside of a sedimentary bed and produced by an object (bone, wood, shell, pebbles) in the water impacting the soft sediment bottom.  
**trace fossils**: any traces of activity in the sediment, such as tracks, trails, and burrows.  
**trilobite**: a Paleozoic fossil with a three-fold segmented body (head, thorax, and tail), and lateral division of the body into lobes (axial and side regions).  
**unconformity**: a surface that represents a gap in the geological record, such as a period of erosion of strata.

Refer to the chart on reverse for ages of geological time periods and eras cited.