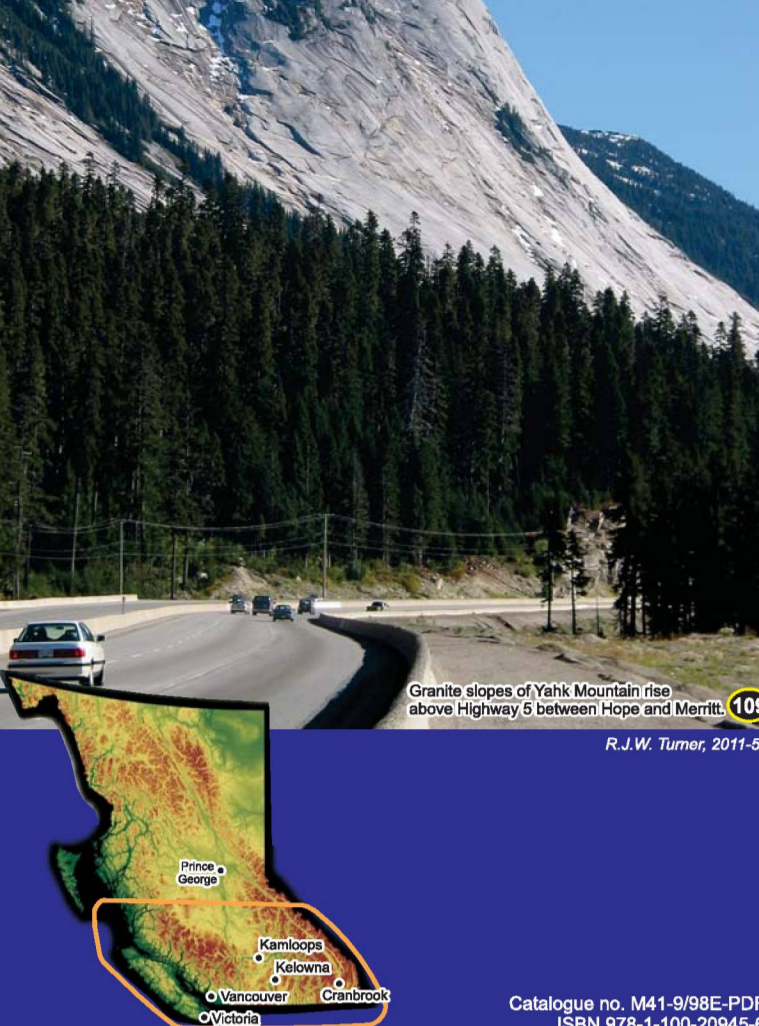


Southern British Columbia

Geological Landscapes Highway Map

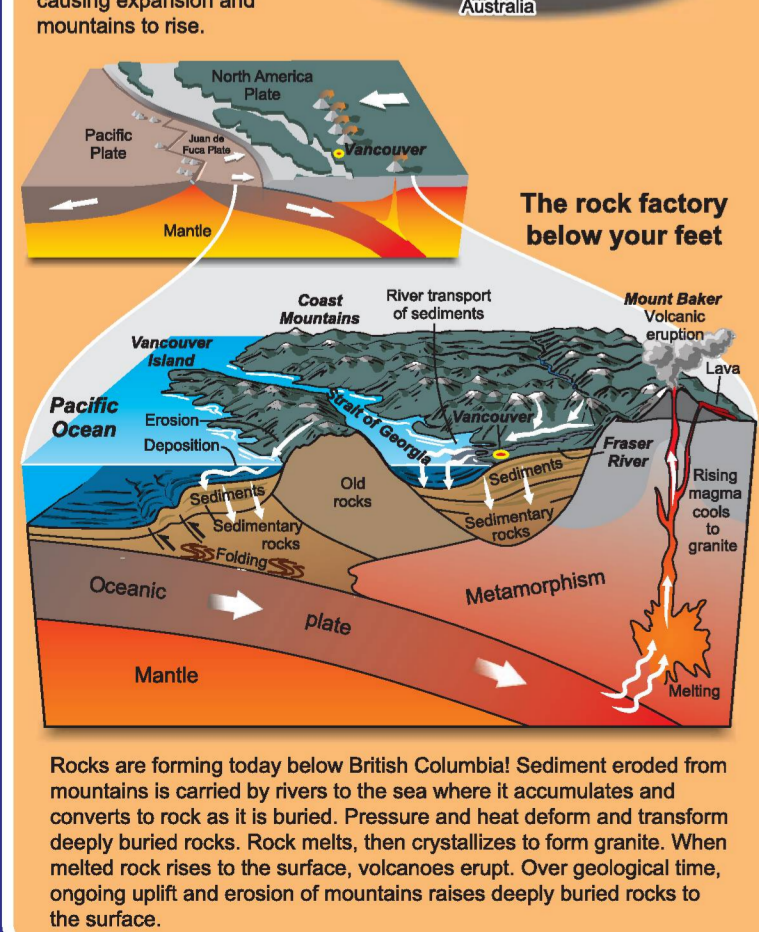
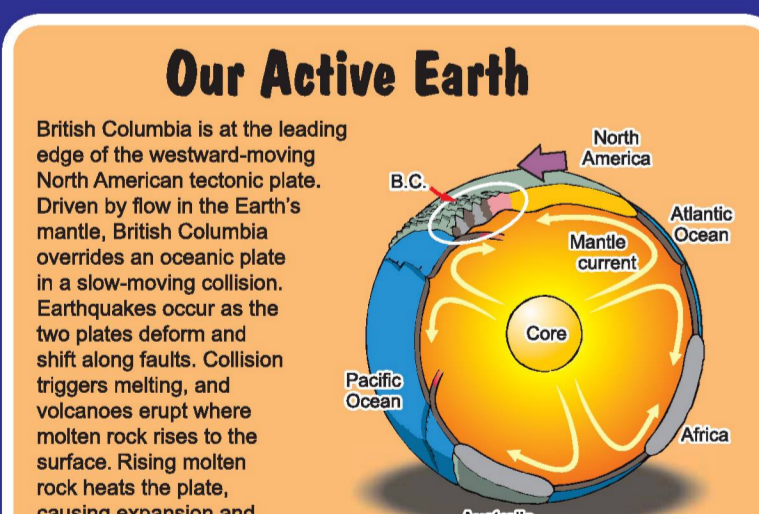


Gravels slopes of Frank Mountain rise above Highway 6 between Hope and Merritt. R.J.W. Turner, 2011-639



Geological Survey of Canada Popular Geoscience 98E (also British Columbia Geological Survey Geofile 2012-9)

For more information www.nrsn.gc.ca
www.maplife.ca



Bella Coola valley

Highway 20 follows the steep-walled Bella Coola valley to the ocean. During the Ice Age, glaciers deeply scoured all of the C.O.C. coastal river valleys. As glaciers melted, the ocean floor raised these valleys, creating long finger-like inlets.

The Bella Coola River dumps its load of sand and mud to form an ecologically rich estuary where it meets the sea. River-mouth deposition has filled 80 km of inlet since the end of the Ice Age, converting inlet to rich valley.

1 R.J.W. Turner, 2011-558

Chilcotin-Bella Coola

Highway 20 from Williams Lake to Bella Coola

Highway 20 crosses the Chilcotin plateau and Coast Mountains to connect the interior with the coast. Roads lead south across the plateau to beautiful glacier-carved finger lakes along the mountain front.

The road between Tatlayoko and Chilko lakes crosses the plateau with expansive views of the Coast Range.

Waters of Tatlayoko Lake flow west across the Chilcotin plateau to the Pacific Ocean. This old flat valley reflects that the river system eroded prior to the rise of the Coast Mountains, and maintained its course as the mountains rose.

At Farnell Canyon, the glacier-fed Chilcoot River has cut a deep canyon with terraces and hoodoos in the deposits of Ice Age silt, gravel, and glacial debris.

2 R.J.W. Turner, 2011-559

Plateau country

Highway 20 crosses the Chilcotin plateau, an ancient lowland raised by Earth forces and smoothed by outpourings of lava 5 to 20 million years ago.

At Farnell Canyon, the glacier-fed Chilcoot River has cut a deep canyon with terraces and hoodoos in the deposits of Ice Age silt, gravel, and glacial debris.

3 R.J.W. Turner, 2011-560

Fraser-Thompson

Highways 1 and 99

This diverse region ranges from rainforest to dry grassland to alpine. Rivers and glaciers carved the mountains from sandstone, shale, marble, granite, and even jade. Highway 1 follows the deep canyons of the clear-flowing Thompson and muddy Fraser, while Highway 99 rises to the subalpine as it crosses a pass west of Lillooet.

Mount Meager volcano is Canada's most dangerous mountain. In August 2010, its flank collapsed forming Canada's second largest landslide. Landslides are frequent on its steep volcanic slopes, and giant mudflows descended the Pemberton valley in ancient times. Mount Meager was eroded 2000 years ago in a large eruption of ash and hot avalanches.

The heavy sediment load carried by the Fraser River at Lillooet, B.C. is moved from nearby mountains into the river by sand and mud.

Highway 99 follows the deep and narrow canyons of the Fraser River. Large blocks of silt are on display in Lillooet. Silt is moved from nearby mountains into the river by sand and mud.

Spring-fed lakes in Marble Canyon have striking white sand and green waters. Lime-rich groundwater seeps while lime mud on the lake floor, creating the colours.

Many rivers flow within narrow canyons flanked by flat-topped terraces. Terraces are remnants of the Ice Age when glacial rivers filled valleys with thick deposits of sediment. Today's rivers have carved canyons in this thick sediment.

End of the Ice Age

Today

The glacier-fed Fraser River flows into the muddy Fraser River. Lillooet Rapids on the Fraser River impedes migrating salmon and create an important fishing site for First Nations.

Downstream of Spences Bridge, the Thompson River flows through a rock canyon, such as that of Spence Park. The river flows from Kamloops Lake, which acts as a giant settling pond, so the river water is deep.

At Hell Gate the Fraser River is deeper than wide as a cut through walls of hard granite. A landslide in 1913 blocked the river. A dam was built to regulate and gradually reduced Fraser River silt from about 100,000 tonnes per day to 10,000 tonnes per day.

4 R.J.W. Turner, 2011-561

Vancouver Island

Highways of southern Vancouver Island

Diverse shorelines are the outstanding geological feature of southern Vancouver Island and adjacent Gulf Islands, but there are also clear-water rivers, caves, and even marine reptile displays.

Highway 3 near Midway crosses the grassland valley of the Kettle River.

5 R.J.W. Turner, 2011-627

Sea to Sky

Highway 99 from Vancouver to Whistler

The Sea to Sky route of Highway 99 is dramatic and varied as it passes from a steep-walled inlet, with a historic mine and famous granite wall, to a mountain valley with volcanoes, lava, waterfalls, and glacier peaks.

The Whistler-Blackcomb ski resort provides easy access to the world-class panoramic views of the Coast Range.

Seaward-sloping cracks in granite near Porteau Cove are evidence of deep ice sheets. A landslide here in 2007 blocked the highway for 3 days.

Howe Sound is a glacier-carved fjord. Two kilometres thick, it descended and deepened the valley. When the glaciers retreated, the sea flooded the valley.

Mount Garibaldi (eroded volcano)

Stawamus Chief Mountain

North Shore Stanley Park

Volcano leader

Volcanic rock

Volcanic intrusions

Ice Age sediment

These major landscapes are visible as the Fraser Valley's bridge across the Fraser River. Mountains of bedrock rise above the Fraser valley. Most urban development lies on rolling uplands of Ice Age sediments. Flat lowlands support agriculture, but are prone to flooding.

Different rock and sediment underlie the Sea to Sky corridor and Fraser valley.

6 R.J.W. Turner, 2011-544

Mountain hazards

Between Vancouver and Squamish, the highway hugs the steep walls of a coastal inlet. Engineered works protect against landslide and debris-fall hazards.

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7 R.J.W. Turner, 2011-544

Vancouver Fraser Valley

Highway 1 from Vancouver to Hope

Highway 1 follows the Fraser valley from Hope to Vancouver with views of the Fraser River, steep mountain walls, rich farmlands, Mount Baker volcano, and metropolitan Vancouver. Near Vancouver, the Fraser River pours its water and sediment load into the sea.

Sandstone layers exposed along the shoreline of Stanley Park in Vancouver were horizontal, but tilted southward as the North Shore mountains rose.

Silt (glacial lake bottom)

Sand and gravel (glacial river channels)

Till (glacial debris)

Flat floodplain soils support rich agriculture along Highway 1 near Chilliwack.

Upper Fraser valley

Near Hope, the Fraser River flows from its canyon into a broad valley. The river widens, loses energy, and drops its sediment load, creating gravel bars and islands. Flanking the river is a plain of rich silt and sand, deposited by thousands of years of annual floods.

Charcuterie islands of the Fraser River from Hope to Mission are rich in fish and wildlife habitat, such as those near Harrison Mills.

Mount Baker volcano

Mount Baker has been built by repeated volcanic eruptions of lava and ash, the last during the 1800s. A future eruption could melt glaciers, mobilizing loose volcanic material into deadly mudflows that descend stream valleys, or spread damaging volcanic ash over the Fraser valley.

Volcanic hazards

8 R.J.W. Turner, 2011-551

How do I use this map?

The colours on the main map represent the different geological materials that underlie southern British Columbia. This diagram of the Kamloops area illustrates the three major materials that typically underlie the landscape.

Glaciers

Glaciers displayed in British Columbia only.

Rock

Modern sediment

Since the end of the Ice Age 10 000 years ago, rivers have eroded valleys and deposited modern sediments in valleys and estuaries. Peat bogs, sand dunes, and beaches are other modern sediments.

Ice Age sediment

Ice Age sediments form an overlying rock throughout much of British Columbia. They were deposited during the Ice Age when continental glaciers, similar to those in Antarctica today, covered most of Canada.

Rock of the Earth's crust consists of igneous, sedimentary, and metamorphic rocks. Igneous rocks are commonly buried beneath on plains.

Legend

Population

Major roads, paved

Major roads, unpaved

Minor roads, paved

Minor roads, unpaved

Ferry route

Provincial parks and park boundaries

Location of photograph

Mines (producer, past producer)

Hot springs

Volcanoes

Tsunami coast

The outer coast of Vancouver Island is vulnerable to tsunamis generated by seafloor earthquakes in the north Pacific Ocean. The last damaging tsunami was in 1964.

Underground karst features available at the Limestone Caves Park east of Nanaimo.

Other rock

9 R.J.W. Turner, 2011-536

Gulf Islands

Different varieties of resistant sandstone and less-resistant shale create the elongate islands, ridges, valleys, and bays characteristic of the Gulf Islands.

Most Pacific air causes heavy snowfalls that create extensive glaciers in the Coast Range. Glaciers are in retreat due to climate change, but are visible from Highway 99 north of Squamish.

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10 R.J.W. Turner, 2011-544

Britannia mine

The former Britannia mine is now the BC Museum of Mining. The copper ores were mined for 70 years and produced metal worth \$1.3 billion. Tours are available of the mine, mill, and water-treatment plant.

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Volcanic hazards

12 R.J.W. Turner, 2011-551

Marble Canyon

Highway 99 cuts through the Marble Canyon. These limestone rocks formed 200 million years ago in a shallow sea that today is within British Columbia.

Spring-fed lakes in Marble Canyon have striking white sand and green waters. Lime-rich groundwater seeps while lime mud on the lake floor, creating the colours.

Many rivers flow within narrow canyons flanked by flat-topped terraces. Terraces are remnants of the Ice Age when glacial rivers filled valleys with thick deposits of sediment. Today's rivers have carved canyons in this thick sediment.

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Today

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At Hell Gate the Fraser River is deeper than wide as a cut through walls of hard granite. A landslide in 1913 blocked the river. A dam was built to regulate and gradually reduced Fraser River silt from about 100,000 tonnes per day to 10,000 tonnes per day.

13 R.J.W. Turner, 2011-561

Volcano country

Highway 99 between Squamish and Whistler passes through a chain of volcanoes. Weak volcanic slopes are a potential landslide hazard.

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16 R.J.W. Turner, 2011-551

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18 R.J.W. Turner, 2011-561

Our Active Earth

British Columbia is at the leading edge of the westward-moving North American tectonic plate. Driven by flow in the Earth's mantle, British Columbia overrides an oceanic plate in a slow-moving collision. Earthquakes occur as the two plates deform and shift along faults. Collision triggers melting, and volcanoes erupt where molten rock rises to the surface. Rising molten rock heats the plate, causing expansion and mountains to rise.

The rock factory below your feet

Rocks are formed today below British Columbia. Sediment eroded from mountains is carried by rivers to the sea where it accumulates and converts to rock as it is buried. Pressure and heat deform and transform deeply buried rocks. Rock melts, then crystallizes to form granite. When melted rock rises to the surface, volcanoes erupt. Over geological time, ongoing uplift and erosion of mountains raises deeply buried rocks to the surface.

19 R.J.W. Turner, 2011-558

Cariboo—Wells Gray

Plateau country
Central British Columbia is a high plateau bound by mountains to the east and west. Highway 97 between Clinton and Williams Lake travels through the 'Cariboo', the name given to the southeastern part of the plateau. Highway 5 at Clearwater provides access to the eastern plateau in Wells Gray Park.

Wells Gray Park
Famous for its waterfalls, canyons, and ancient volcanic sites on the edge of the plateau. Rivers and streams carve the plateau as waterfalls, over time these waterfalls have cut backward, creating deep canyons in the lava layers that underlie the plateau.

Why is the plateau flat?
The plateau is an ancient shield raised by Earth's crust and smoothed by subsequent erosion. It is 5 to 20 million years old.

B.C.'s lava plateau
Ancient lava flows, trapped during cooling, give the appearance of rock sponges.

Overhanging lip
Horseshoe Falls has slowly eroded upstream over the last 1000 years, leaving behind a canyon floor that is 1000 years old.

Upper canyon
Sparhawk Creek flows from a narrow canyon, over Sparhawk Creek Falls, and into a larger canyon. Steep canyon walls form because the rock breaks along abundant vertical cracks in the lava.

Lower canyon
Sparhawk Creek flows from a narrow canyon, over Sparhawk Creek Falls, and into a larger canyon. Steep canyon walls form because the rock breaks along abundant vertical cracks in the lava.

Ice Age river
Though dry today, Cham canyon was cut by a former glacial river and waterfall at the end of the Ice Age.

Kamloops—Shuswap

Big valleys and lakes
From Cache Creek to Sicamous, Highway 1 follows the Thompson and South Thompson river valleys through dry grasslands past Kamloops Lake and the city of Kamloops, and eastward by farms and forests to the glacier-carved Shuswap Lake.

Cache Creek
Cache Creek, flowing from the Columbia Mountains, scoured older volcanic rocks and deposited them in the Cache Creek valley. The Cache Creek valley was formed during the Ice Age, when the Cache Creek valley was scoured out by the Cache Creek river.

Volcanic rock
A fault fossil in mudstone.

McBee fossil beds
The McBee fossil beds near Cache Creek are a managed fossil collecting site. Leaf, flower, insect, and fish fossils are preserved in 50 million year old mudstone that formed in an ancient lake beside a volcano. Volcanic eruptions later buried the mudstone with its fossils.

Highland Valley mine
Highland Valley mine, near Logan Lake, is Canada's largest copper mine. Tours are available for the mine, its mill, and the reclaimed mined areas. There is also a viewpoint along Highway 97C.

Active mining
Active mining.

How B.C. was built: an analogy

180 million years ago. As the Atlantic Ocean began to open, North America moved westward and collided with nearby ocean floor and volcanic islands, in a process somewhat like a bulldozer pushing soil and boulders from a field.

Today, B.C.'s landmass is a collision zone of deformed volcanic islands, seafloor, and North America continental margin.

B.C.—North America's leading edge

Highway 3 crosses the 1900s Hope landslide, the largest landslide in western Canada. The wide landslide road is a remnant of the former Highway 3, by as much as 70 m of rock debris.

Local First Nations called 'Shuswap'
The former Shuswap First Nation is located on the Shuswap Plateau. Layers of dark volcanic intrusions and grey mudstone exposed on the valley walls create the stripes.

Red ochre bluffs give Princeton its early name 'Vermillion Falls'
Ancient underground fires in coal seams baked adjacent mudstone, converting iron minerals to red ochre. First Nations used this red ochre as pigment in green paint for ceremonies and rock art.

White Lake, west of Chagnac Falls
completely evaporates in summer, leaving behind a dry lake bed of white mineral salts.

Legend

Population

- 50,000 or more
- 10,000-50,000
- 5,000-10,000
- 1,000-5,000
- 500-1,000
- 0-500

Location of photograph

Mines (producer, past producer)

- 22—Mount Polley (copper), 23—Kintyre Creek (gold), 24—Red Lake (copper), 25—Fraser Canyon (copper), 26—Pavilion Limestone (limestone), 27—Walden Quarry (pavilion limestone), 28—Adairton (copper), 29—Highgate Valley (copper), 30—Lorne (copper), 31—Highgate (copper), 32—Bellefleur (copper), 33—Alton (copper), 34—Iron Mask (copper), 35—Star (copper), 36—Cameron (copper), 37—Beacon Hill (copper), 38—Copper Mountain (copper), 39—Kootenay (copper), 40—Nobels (copper), 41—Bancroft (copper), 42—Harpur Ranch (limestone), 43—Glenora (copper), 44—Mowich (zinc), 45—Mount Brunsford (magnesium), 46—Fraser (copper), 47—Fraser (copper), 48—Fraser (copper), 49—Fraser (copper), 50—Fraser (copper), 51—Fraser (copper), 52—Fraser (copper), 53—Fraser (copper), 54—Fraser (copper), 55—Fraser (copper), 56—Fraser (copper), 57—Fraser (copper), 58—Fraser (copper), 59—Fraser (copper), 60—Fraser (copper), 61—Fraser (copper), 62—Fraser (copper), 63—Fraser (copper), 64—Fraser (copper), 65—Fraser (copper), 66—Fraser (copper), 67—Fraser (copper), 68—Fraser (copper), 69—Fraser (copper), 70—Fraser (copper), 71—Fraser (copper), 72—Fraser (copper), 73—Fraser (copper), 74—Fraser (copper), 75—Fraser (copper), 76—Fraser (copper), 77—Fraser (copper), 78—Fraser (copper), 79—Fraser (copper), 80—Fraser (copper), 81—Fraser (copper), 82—Fraser (copper), 83—Fraser (copper), 84—Fraser (copper), 85—Fraser (copper), 86—Fraser (copper), 87—Fraser (copper), 88—Fraser (copper), 89—Fraser (copper), 90—Fraser (copper), 91—Fraser (copper), 92—Fraser (copper), 93—Fraser (copper), 94—Fraser (copper), 95—Fraser (copper), 96—Fraser (copper), 97—Fraser (copper), 98—Fraser (copper), 99—Fraser (copper), 100—Fraser (copper).

Highway 1—Mountain National Parks

Some of the most remarkable mountain scenery in British Columbia can be observed along Highway 1 in Mount Revelstoke, Glacier, and Yoho national parks, and along Highway 55 in Kootenay National Park. Many road-side stops and well-maintained trails allow you to explore features of interest.

Glaciers
Glaciers dissolved in British Columbia only.

Ice Age sediment
Silt (glacial lake bottom), Sand and gravel (glacial river channel), Till (glacial debris), Metamorphic (altering) sandstone and siltstone, Granite, Gneiss, Ultramafic rock (ancient ocean pillow).

Rock
Limestone and dolomite, Sandstone and shale, Metamorphic (altering) sandstone and siltstone, Granite, Gneiss, Ultramafic rock (ancient ocean pillow).

Mount Revelstoke National Park of Canada
The access road to Mount Revelstoke National Park of Canada provides panoramic views of the Columbia River Valley and Kootenay National Park.

Kootenay National Park of Canada
Three different springs along Highway 93 in Kootenay National Park of Canada represent different groundwater plumbing systems in the Earth. All are fed from surface waters.

Yoho National Park of Canada
A hike up the Incline Trail provides a view of the setting of Takahewa Falls. The green lamellae from a hydrothermal vent in the deep glacial canyon Yoho River valley.

Glacier National Park of Canada
The Glacier House Trail in Glacier National Park of Canada provides spectacular views of the Yoho and the rugged peaks of the Selkirk Mountains.

Glacier rock flour
creates the opaque turquoise colour of Emerald Lake. The world famous Burgess Shale locality is visible on the ridge high above the lake.

Clive Lake is fed by cold spring waters that rise from the mud in the lake floor, reflecting sunlight and giving the lake its bright green colour.

Hot water from deep in the Earth flows from deep in the Earth to the surface through faults and fractures.

Viewpoint just south of Radium look across the Rocky Mountain Trench to Golden, within the Rocky Mountain Trench.

Rocky Mountain Trench—Crowsnest Pass

Highways 95 and 93 follow the Rocky Mountain Trench from the U.S.A. border north to Golden, passing forests and farms, grasslands and wetlands, big rivers, lakes, and hot springs. In contrast, Highway 3 cuts across the grain of the mountains and follows smaller valleys through the Rockies to Alberta.

How the Rockies formed
1) Collision with Pacific Ocean
2) Mountain building (180 to 60 million years ago)
3) Erosion (60 million years ago to today)

West Kootenay
West Kootenay is a diverse landscape of forest, glacial peaks, big lakes and rivers, pasture and farms, hot springs, and ghost towns. Fine heritage buildings in Nelson, Kaslo, Roseland, and Trail reflect the wealth produced by historic silver and gold mines.

Okanagan valley—Boundary
The Okanagan valley is famous for its large lakes, agriculture, and dry landscapes. The valley follows an ancient fault in the Earth's crust that has been eroded by rivers and ice age glaciers. To the east along Highway 3 is the Boundary country with a rich history of mining.

Highway 3—Similkameen
Highway 3 winds from Hope, over the Cascade Mountains, past former mining towns of Princeton and Hedley, to grasslands and the rich agricultural fields of the Similkameen River valley.

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