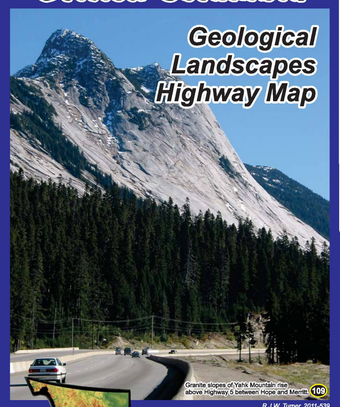
Southern British Columbia

Geological Landscapes Highway Map



Granite slopes of Yahk Mountain rise above Highway 5 between Hope and Merritt. 109

R.J.W. Turner, 2011-539

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planetearth
Earth Sciences for Society

Highway 3 near Midway follows the grassland valley of the Kettle River. 50

R.J.W. Turner, 2011-527

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

For more information
www.nrcan.gc.ca
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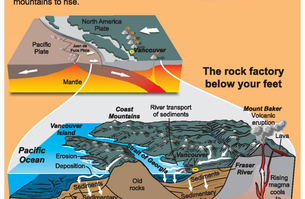
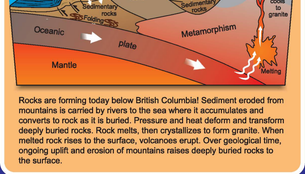
Our Active Earth

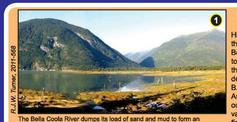
British Columbia is at the leading edge of the westward-moving North American tectonic plate. Driven by flow in the Earth's mantle, British Columbia overrides an oceanic plate in a slow-moving collision. Earthquakes occur as the two plates deform and shift along faults. Collision triggers melting, and 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 forming today below 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.



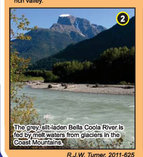
The Bella Coola River dumps its load of sand and mud to form an ecologically-rich estuary where it meets the sea. River-mouth deposition has filled 80 km of inlet since the end of the Ice Age, converting inlet to rich valley. 1

R.J.W. Turner, 2011-566

Bella Coola valley

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

R.J.W. Turner, 2011-600



The grey silt-laden Bella Coola River is fed by melt waters from glaciers in the Coast Mountains. 2

R.J.W. Turner, 2011-525

The deep waters of the Atnarko River reflect the colour of glaciers in the headwaters of Tweedsmuir Park. Here, the river is carving a deep canyon through bear-inhabiting taiga in the last valley before it joins the Bella Coola River. 3

R.J.W. Turner, 2011-554

R.J.W. Turner, 2011-522

3a

Grizzly bear at Atnarko Fisheries project

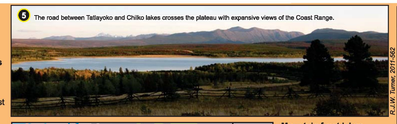
West of Hadimash Pass, Highway 20 descends from high plateaus to the deep Bella Coola valley. 4

R.J.W. Turner, 2011-523

Chilcotin–Bella Coola

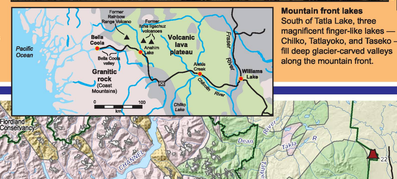
Highway 20 from Williams Lake to Bella Coola

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.



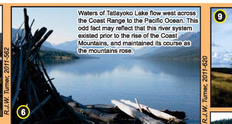
5 The road between Tatlayoko and Chilko lakes crosses the plateau with expansive views of the Coast Range.

R.J.W. Turner, 2011-522



Mountain front lakes

South of Tatla Lake, three magnificent finger-like lakes — Chilko, Tatlayoko, and Taseko — fill deep glacier-carved valleys along the mountain front.



Waters of Tatlayoko Lake flow west across the Coast Range to the Pacific Ocean. This odd fact may reflect that this river system existed prior to the rise of the Coast Mountains, and maintained its course as the mountains rose.

R.J.W. Turner, 2011-602

6

The Big John on Tatlin Mountain is a Via Ferrata route. Provides a good view of Chilko Lake and Coast Mountains. 7

R.J.W. Turner, 2011-603

The road to Farwell Canyon from Riske Creek crosses rolling grassland plateau.

R.J.W. Turner, 2011-610

9

At Bull Canyon Park, the Chilcotin River has carved a deep canyon with terraces and hoodoos in thick deposits of ice Age silt, gravel, and glacier debris. 8

R.J.W. Turner, 2011-605

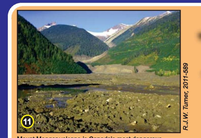
At Farwell Canyon, the glacier-fed Chilcotin River has cut a deep canyon with terraces and hoodoos in thick deposits of ice Age silt, gravel, and glacier debris.

R.J.W. Turner, 2011-608

10

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.

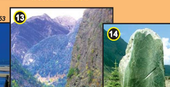


Mount Meager volcano is Canada's most dangerous mountain. In August 2010, its flank collapsed forming Canada's second largest landslide. Landslides are frequent on its weak volcanic slopes, and giant mudflows descended the Pemberton valley in ancient times. Mount Meager also erupted 2400 years ago in a large eruption of ash and hot avalanches. 11

R.J.W. Turner, 2011-589

R.J.W. Turner, 2011-553

The heavy sediment load carried by the Lillooet River is filling Lillooet Lake. Active erosion of Mount Meager volcano feeds the river with sand and mud. 12



Highway 99 follows the deep and steep-walled river-cut canyon of Cayoosh Creek, near Lillooet. 13

R.J.W. Turner, 2011-619

Large blocks of rock are on display in Lillooet Gorge in eroded river deposits. Mountains that contain ultramafic rocks from the Earth's mantle. 14

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 rivers, while Highway 99 rises to the subalpine as it crosses a pass west of Lillooet.

Highway 99 cuts through the Marble Range at Marble Canyon. These limestone rocks formed 200 million years ago in oceans near Asia but today lie within British Columbia. 16

R.J.W. Turner, 2011-609

Spring-fed lakes in Marble Canyon have striking white shallows and green waters. Lime-rich groundwaters deposit white lime mud on the lake floor, creating the colours. 17

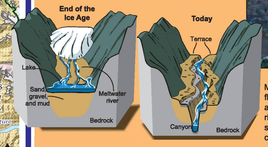
R.J.W. Turner, 2011-591

The Bridge River near Lillooet flows within a canyon flanked by 18

R.J.W. Turner, 2011-633

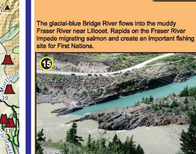
River terraces

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.



The glacial-blue Bridge River flows into the muddy Fraser River near Lillooet. Rapids on the Fraser River impede migrating salmon and create an important fishing site for First Nations. 15

R.J.W. Turner, 2011-617

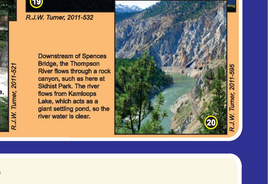


At Hells Gate, the Fraser River is deeper than wide as it cuts a 500 m-wide gorge through walls of hard granite. A landslide into the river in 1913 blocked salmon migration and dramatically reduced Fraser River salmon stocks for 50 years. 21

R.J.W. Turner, 2011-621

Downstream of Spences Bridge, the Thompson River flows through a rock canyon, such as here at Skihist Park. The river flows from Kamloops Lake, which acts as a giant settling pond, so the river water is clear. 20

R.J.W. Turner, 2011-626

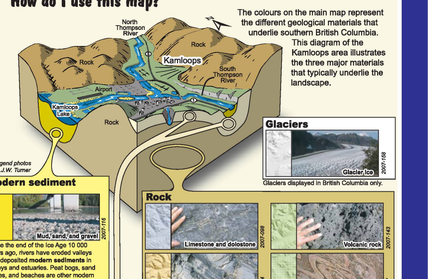


The glacial sediment load of Mount Meager has created a 3300 m-long delta in Harrison Lake, Hemlock Valley, and Mount Breakenridge. 24

R.J.W. Turner, 2011-596

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.



All legend photos by R.J.W. Turner

Modern sediment

Mud, sand, and gravel

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

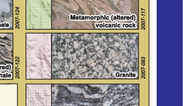
Silt (glacial lake bottom)

Sand and gravel (glacial river channels)

Till (glacial debris)

Ice Age sediments form a widespread blanket 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.

Glaciers



Glacier ice

Glaciers displayed in British Columbia only.

Rock

Rock of the Earth's crust underlies all of British Columbia. It is widely exposed at surface in mountainous areas, but is commonly buried beneath thick layers of sediments in valleys and on plateaus.

Legend

Population

- 50 000 or more
- 10 000–50 000
- 5000–10 000
- 1000–5000
- 500–1000
- 0–500

- Major roads, paved
- Major roads, unpaved
- Minor roads, paved
- Minor roads, unpaved
- Ferry route
- Provincial parks and park boundaries
- 13 Location of photograph

Mines (producer, past producer)

37 1=Bitternite (copper), 2=Ingerbelle (limestone), 3=Copper Queen (copper), 4=Gillies Bay (limestone), 5=Bubber Bay (limestone), 6=Mount Washington (copper), 7=Quinsam (coal), 8=Myra Falls (copper), 9=Zeballos (gold), 10=Mortlath Bay (pyrophyllite), 11=Benson Lake (limestone), 12=Island Copper (copper), 13=Argyle Bay (silica), 14=Mount Meager (pumice),15=Pioneer (gold),16=Bralorne (gold),17=Congress (gold),18=Blackdome (gold), 19=Nazko (aggregate), 20=Cinnabar (copper), 21=Gil (gold), 22=Mount Polley (copper), 23=Ashley Creek (gold), 24=Red Lake (fullers earth); 25 =Ranchlands (zeolite), 26 =Pavilion Limestone (limestone), 27=Walhachin Quarry (railroad ballast), 28 =Ashcroft (aggregate),29=Highland Valley Copper (copper), 30=Lornex (copper), 31=Highmont (copper), 32=Bethlehem (copper), 33=Afton (copper),34=Iron Mask (copper),35=Ajax (copper), 36=Cogmont (copper),37=Basin Coal (coal),38=Ingerbelle (copper),38b =Copper Mountain (copper), 69=Pride of Emory (nickel),70=Boss Mountain (molybdenum),71=Bullion Pit (gold)

12 **Hot springs**

1=Harrison, 2=Clear Creek, 3=August Jacob's, 4=Sloquet, 5=Pitt River, 6=Skookumchuck, 7=Pebble Creek, 8=Meager Creek, 9=Hot Springs Cove, 10=Sheemahant, 11=Thorsen Creek, 12=Eucott Bay, 13=Nascall

3 **Volcanoes**

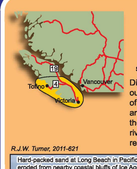
1=Mount Garibaldi, 2=Opal Cone, 3=Clinker Peak, 4=The Table, 5=Mount Price, 6=Black Tusk, 7=Tricouni SW, 8=Logger's Lake, 9=Mount Fee, 10=Mount Cayley, 11=Ring Mountain, 12=Elaho Valley 1, 13=Elaho Valley 4, 14=Elaho Side Valley, 15=Mount Meager, 16=Salal Glacier, 17=Sham Hill, 18=Franklin Glacier, 19=Silverthrone Caldera, 20=Helmet Peak, 21=Kitasu Hill, 22=Anahim Hill, 23=Cindercone, 24=Nana Peak, 25=Mount Scot, 26=Hunlo Mountain, 27=Rocky Mountain, 28=Mount Downton, 29=Chilcotin Creek Cone, 30=Satah - North, 31=Satah Mountain – East, 32=Nazko Cone, 33=Ishilkoo Cone, 34=Ginin Creek Cone, 35=Abbott Creek Cone, 36=Spanish Mump, 37=Boss Mountain, 38=Jack's Jump, 39=McLeod Hill, 40=Mosquito Mound, 41=Fallonn, 42=White Horse Bluff, 43=Lone Butte, 44=Tin Cup Mountain

25 0 25 50 kilometres

Vancouver Island

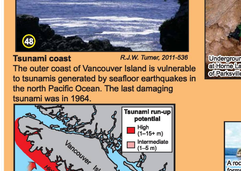
Highways of southern Vancouver Island

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.



R.J.W. Turner, 2011-621

Hard-packed sand at Long Beach in Pacific Rim National Park Reserve is eroded from nearby coastal bluffs of Ice Age sand and gravel. 48



Ocean waves have carved the rocky shoreline at Amphitrite Point near Ucluelet into low islands and reefs. 49

R.J.W. Turner, 2011-536

Tsunami coast

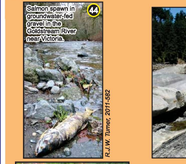
The outer coast of Vancouver Island is vulnerable to tsunamis generated by seafloor earthquakes in the north Pacific Ocean. The last damaging tsunami was in 1964.

Sand carried to the sea by the Englishman River is eventually deposited as beaches at Parksville. 41

R.J.W. Turner, 2011-578

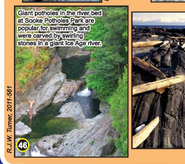
The flat rock platform at Botanical Beach near Port Renfrew has been carved by ocean waves. Tidal pools contain rich intertidal life. 47

R.J.W. Turner, 2011-571



Salmon spawn in groundwater-fed gravel in the Goldstream River near Victoria. 44

R.J.W. Turner, 2011-582



Giant potholes in the river bed at Sooke Potholes Park are circular depressions that were carved by swirling stones in a giant Ice Age river. 46

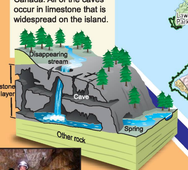
R.J.W. Turner, 2011-551

Grooves and polish on shoreline rocks at Beacon Hill Park in Victoria reflect the action of Ice Age glaciers 15 000 years ago. 45

R.J.W. Turner, 2011-520

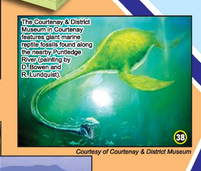
Caves

Vancouver Island has the highest density of caves in Canada. All of the caves occur in limestone that is widespread on the island.



Underground tours are available at Horne Lake Caves Park east of Parksville. 40

S.E.B. Irwin, 2011-549



The Courtenay & District Museum in Courtenay features giant marine reptile fossils found along the nearby Trumpeter River (painting by D. Brown and R. Longridge). 39

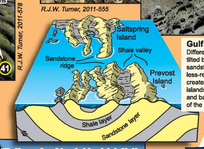
Courtesy of Courtenay & District Museum

A rock formed of ancient gravel forms coastal bluffs at Hartwell Park on Horrby Island. 38

R.J.W. Turner, 2011-555

Honeycomb weathering of shoreline sandstone, such as here on Gabriola Island, reflects the combined action of water, salt, and sun that mobilize and redistribute soluble mineral cement.

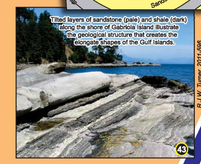
R.J.W. Turner, 2011-544



R.J.W. Turner, 2011-568

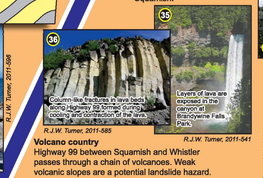
Gulf Islands

Differential erosion of tilted beds of resistant sandstone and less-resistant shale create the elongate islands, ridges, valleys, and bays characteristic of the Gulf Islands.



Tilted layers of sandstone (pale) and shale (dark) along the shore of Gabriola Island illustrate the geological structure that creates the elongate shapes of the Gulf Islands. 43

R.J.W. Turner, 2011-566



Columnar-like fractures in lava beds along Highway 99 formed during the cooling and contraction of the lava. 36

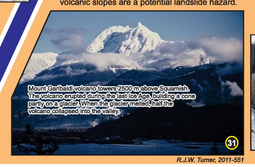
R.J.W. Turner, 2011-565

Layers of lava are exposed in the canyon at Brandywine Falls Park. 35

R.J.W. Turner, 2011-541

Volcano country

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



Mount Garibaldi volcano towers 2000 m above Squamish. The volcano erupted during the last Ice Age, building a cone-shaped volcano. Later, a glacier carved half the volcano's cone into the valley. 31

R.J.W. Turner, 2011-551

Stawamus Chief Mountain
Howe Sound
Squamish
Chief Mountain
Shannon Falls
Shannon Falls flows down the granite cliffs of Stawamus Chief. 32

R.J.W. Turner, 2011-581

Granite outcrops along Highway 99, in the area of Stawamus Chief Mountain, are sculpted and polished by Ice Age glaciers. 33

R.J.W. Turner, 2011-534

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.

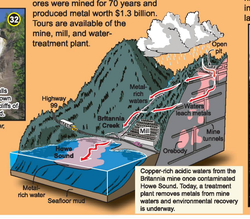
The Whistler Blackcomb ski resort provides easy access to alpine walks with panoramic views of the Coast Range. 37

R.J.W. Turner, 2011-602

R.J.W. Turner, 2011-565

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.



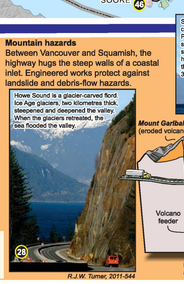
Copper-rich acidic waters from the Britannia mine once contaminated Howe Sound. Today, a treatment plant removes metals from mine waters and environmental recovery is underway.

Coast Mountains

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.

Mountain hazards

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



Different rock and sediment underlie the Sea to Sky corridor and Fraser valley. 28

R.J.W. Turner, 2011-544

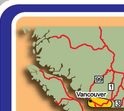
Seaward-sloping cracks in granite near Porteau Cove are stabilized by long steel bolts. A landslide here in 2007 blocked the highway for 3 days. 29

R.J.W. Turner, 2011-912

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 waters 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. 26

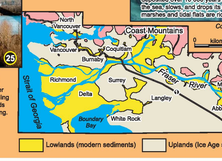
R.J.W. Turner, 2011-552

Ski areas on the North Shore mountains provide views across Vancouver, Stanley Park, and Strait of Georgia to Vancouver Island. 27

R.J.W. Turner, 2011-535

The Fraser delta is a flat-topped pile of sand and silt. Deposited over 10 000 years by the Fraser River, it extends the sea's shore and drops its load of sediment. Shoreline marshes and tidal flats are rich wildlife and bird habitat.

Courtesy of Gallano Conservancy

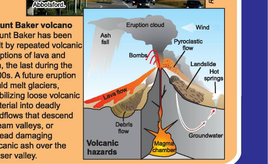


Three major landscapes are visible at the Highway 1 bridge across the Fraser River. Mountains of bedrock rise above the Fraser valley. Most urban development lies on rolling uplands of Ice Age sediments. Flat lowlands support agriculture, but are prone to flooding.

Lowlands (modern sediments) | Uplands (Ice Age sediments) | Mountains (bedrock)

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.



Flat floodplain soils support rich agriculture along Highway 1 near Chilliwack. 22

R.J.W. Turner, 2011-590

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.

Channels and islands of the Fraser River from Hope to Mission are rich fish and wildlife habitat, such as these near Harrison Mills. 23

R.J.W. Turner, 2011-628