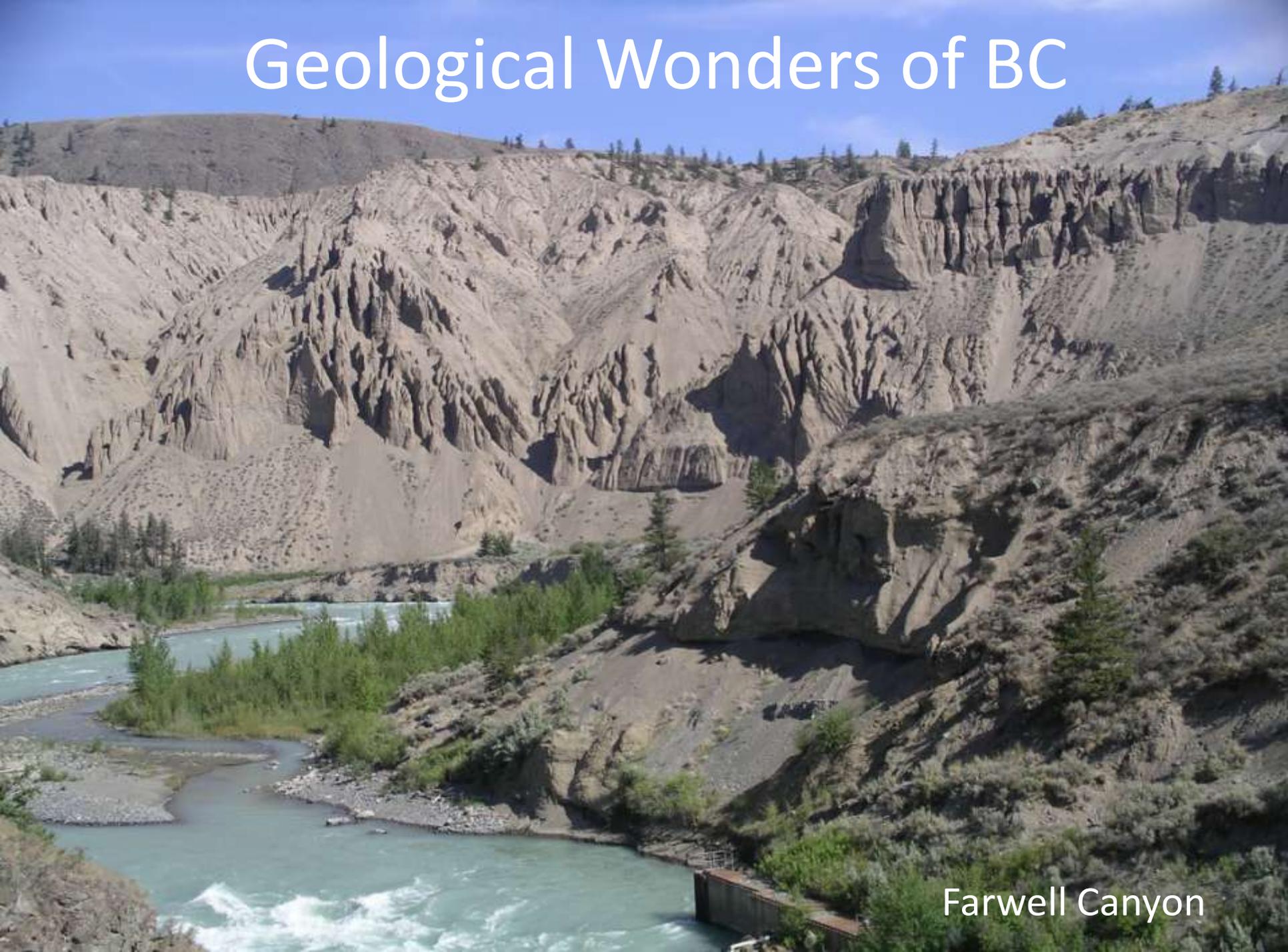


Geological Wonders of BC



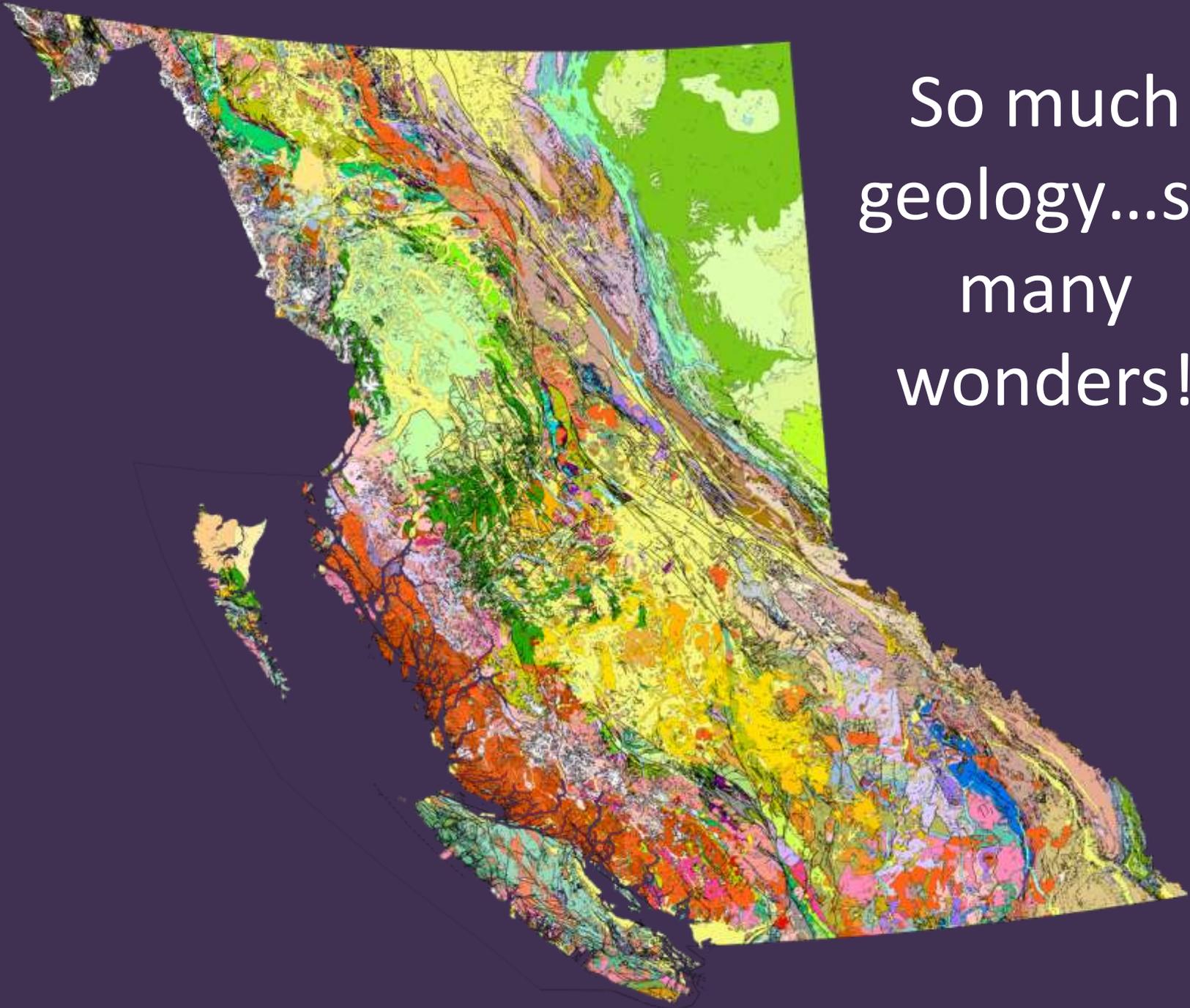
Farwell Canyon

Wonder: an emotion comparable to surprise that people feel when perceiving something rare or unexpected

1

Tags for 12 wonders for your geo-bucket list

So much
geology...so
many
wonders!

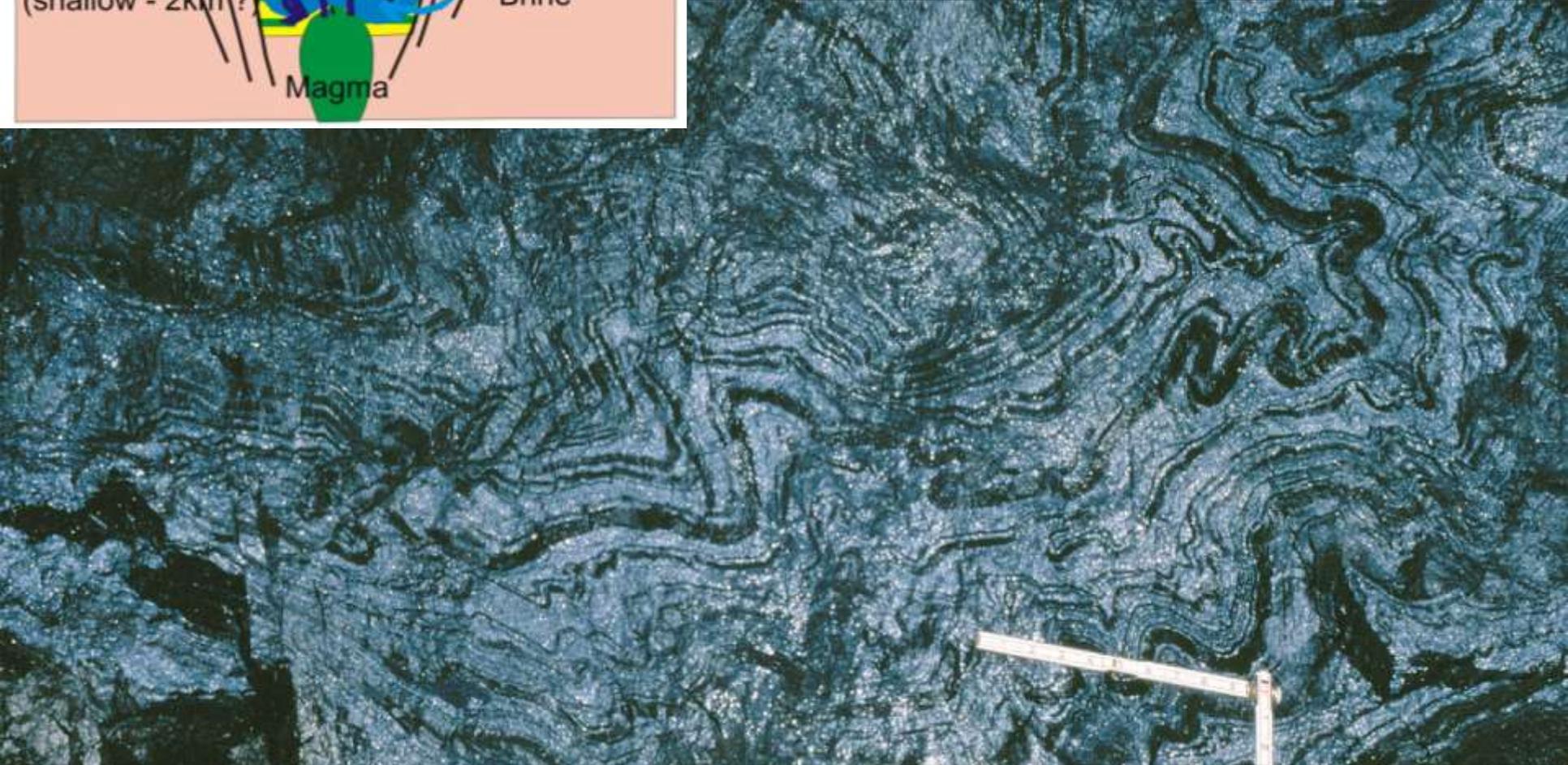
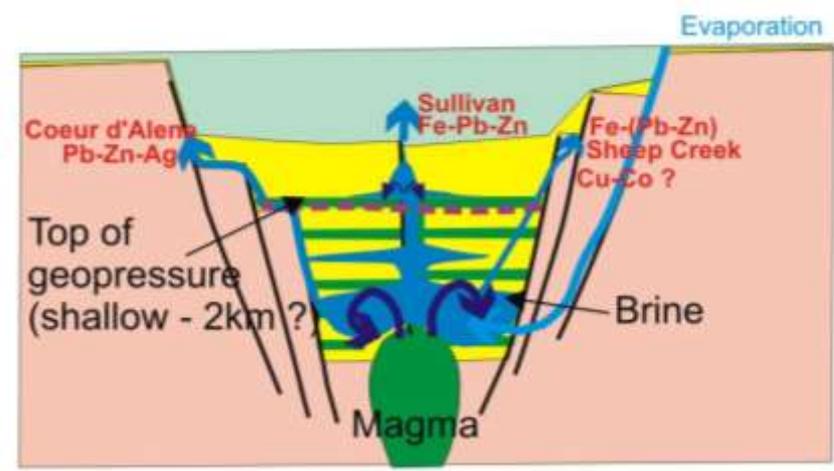


Sullivan Ore body



Main portal of the Sullivan mine near Kimberley when the mine was newly driven in 1915. The mine yielded over \$42 billion in metals over its life

Sullivan is a sedimentary exhalative (SEDEX) deposit formed around 1.5 Ga ago



Since burial, geologic forces have affected the deposit...at depth the sulphides behaved more like tooth paste.

1

Burgess Shale

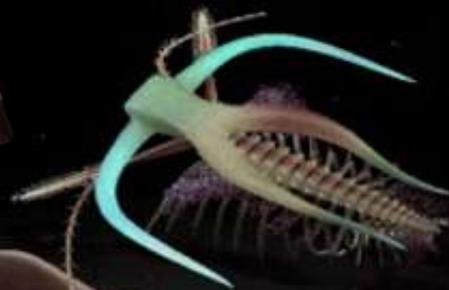
“the world’s most significant fossil discovery”



Marrella splendens



Specimen length
(ex. ant.) = 20 mm





505 Million years ago *Ottoia prolifica* ate a
Haplophrentis carinatus

(maximum width of the worm = 1.2 cm)

Reconstructions of two "weird wonders" from the Burgess Shale



Odontogriphus (left, fossil length = 8 cm) and *Nectocaris* (right, fossil length = 4 cm, excluding tentacles),

BC's Contribution to Lagerstätten



Portalia mira: of uncertain affinity

Jade

...an alteration product of ultramafic (high magnesium and iron, low silica) rock that is commonly called serpentinite...



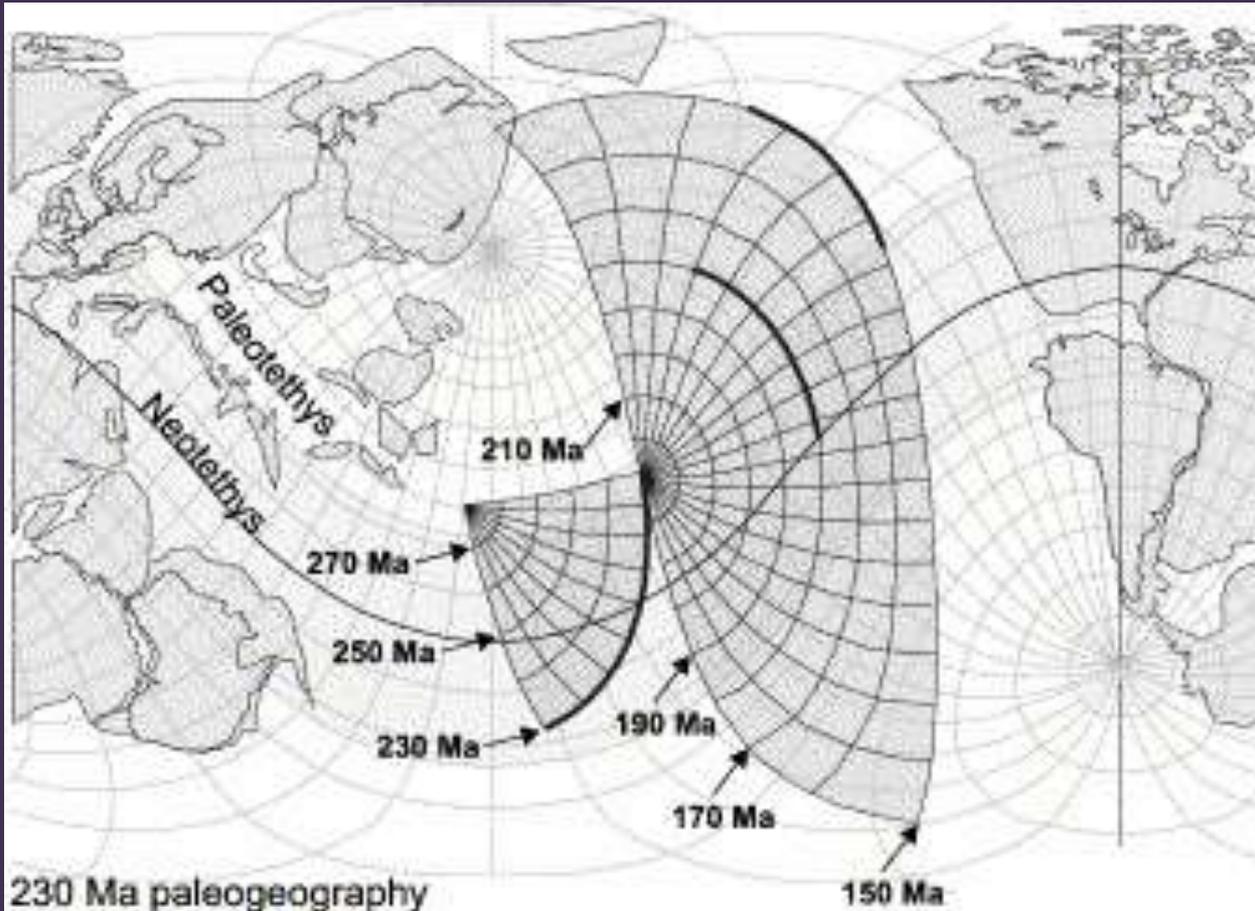
BC's Provincial Gemstone

Jade Buddha for Universal Peace



Aldergrove BC

The Curious Cache Creek Terrane



It is characterized by an oceanic-rocks containing Tethyan-type fusulinid bearing limestone

Terrane: a crustal block or fragment that is typically bounded by faults and that has a geologic genesis distinct from those of surrounding areas.

Geologic Realms... whoa!

Realms
= regions of origin

The oceanic terranes, shown in red, are “bookmarks” that separate island arc and pericratonic blocks from each other.

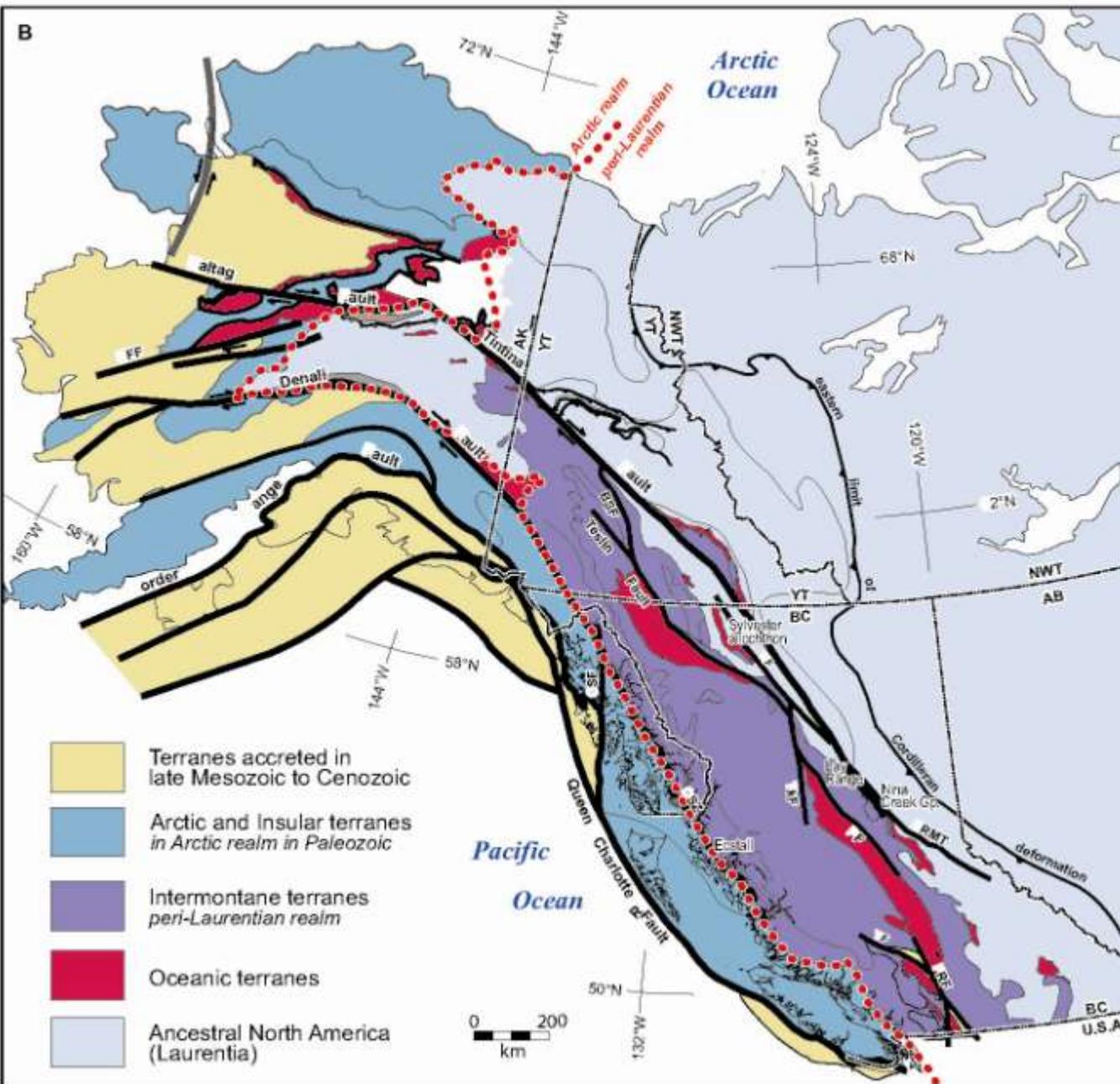


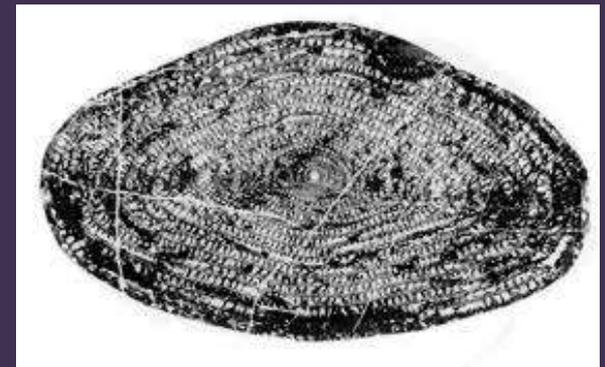
FIGURE 1 CONTINUED.

Hey, Ancient Rice?

The **Fusulinida** is an extinct order within the Foraminifera in which the tests (shells) are composed of tightly packed, secreted microgranular calcite



Yabeina colubiana in limestone



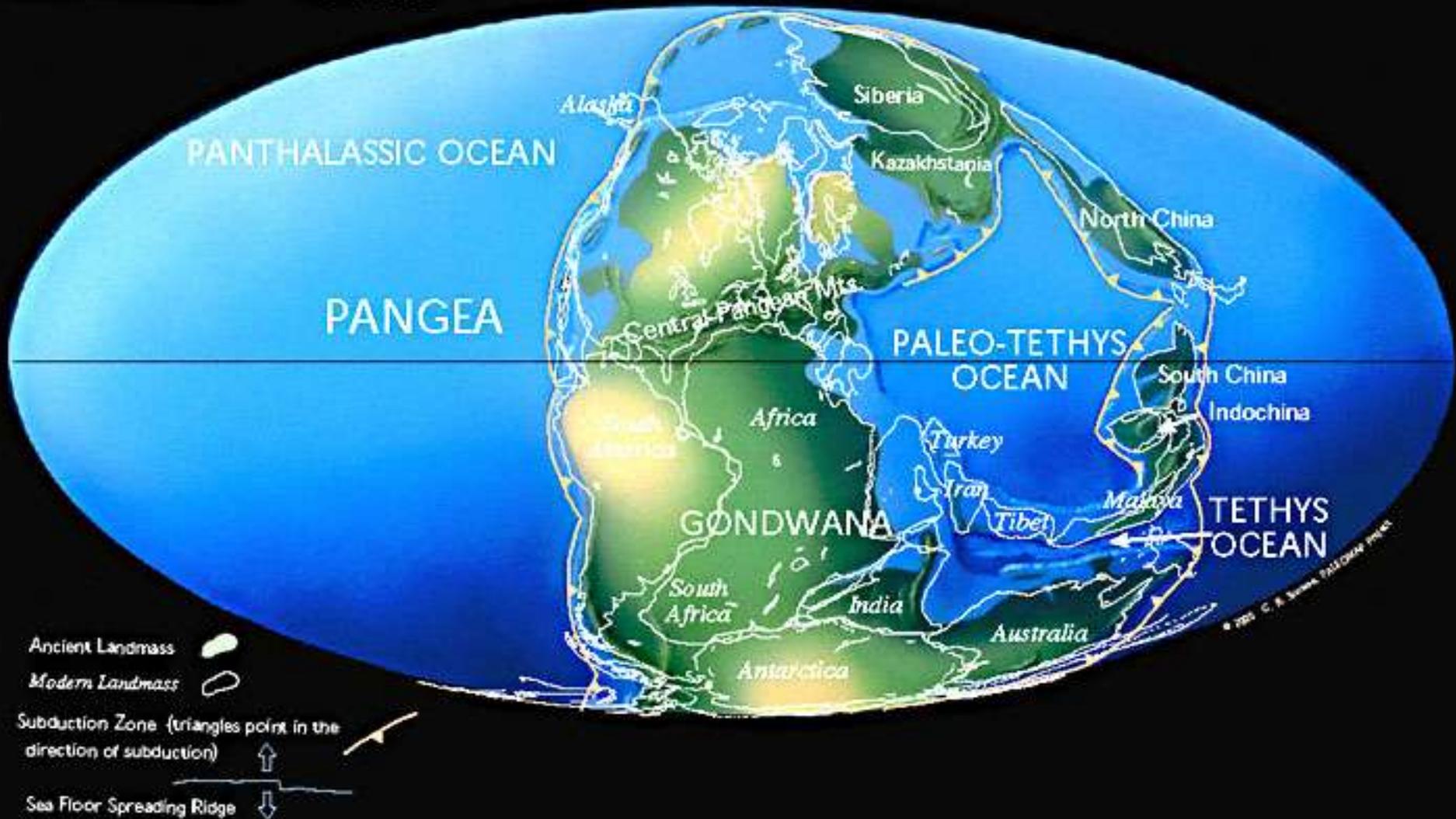
This cannot be...

Terrane theory was first proposed by Jim Monger of the Geological Survey of Canada and Charlie Rouse in 1971 as an explanation for a set of fusilinid fossils found in central British Columbia.

The two geologists proposed that the fossils in question had been part of an assemblage of rocks that had migrated across the Pacific Ocean to their present location.

Cache Creek terrane contains remnants of the Mississippian to Jurassic Tethys Ocean

Late Permian 255 Ma



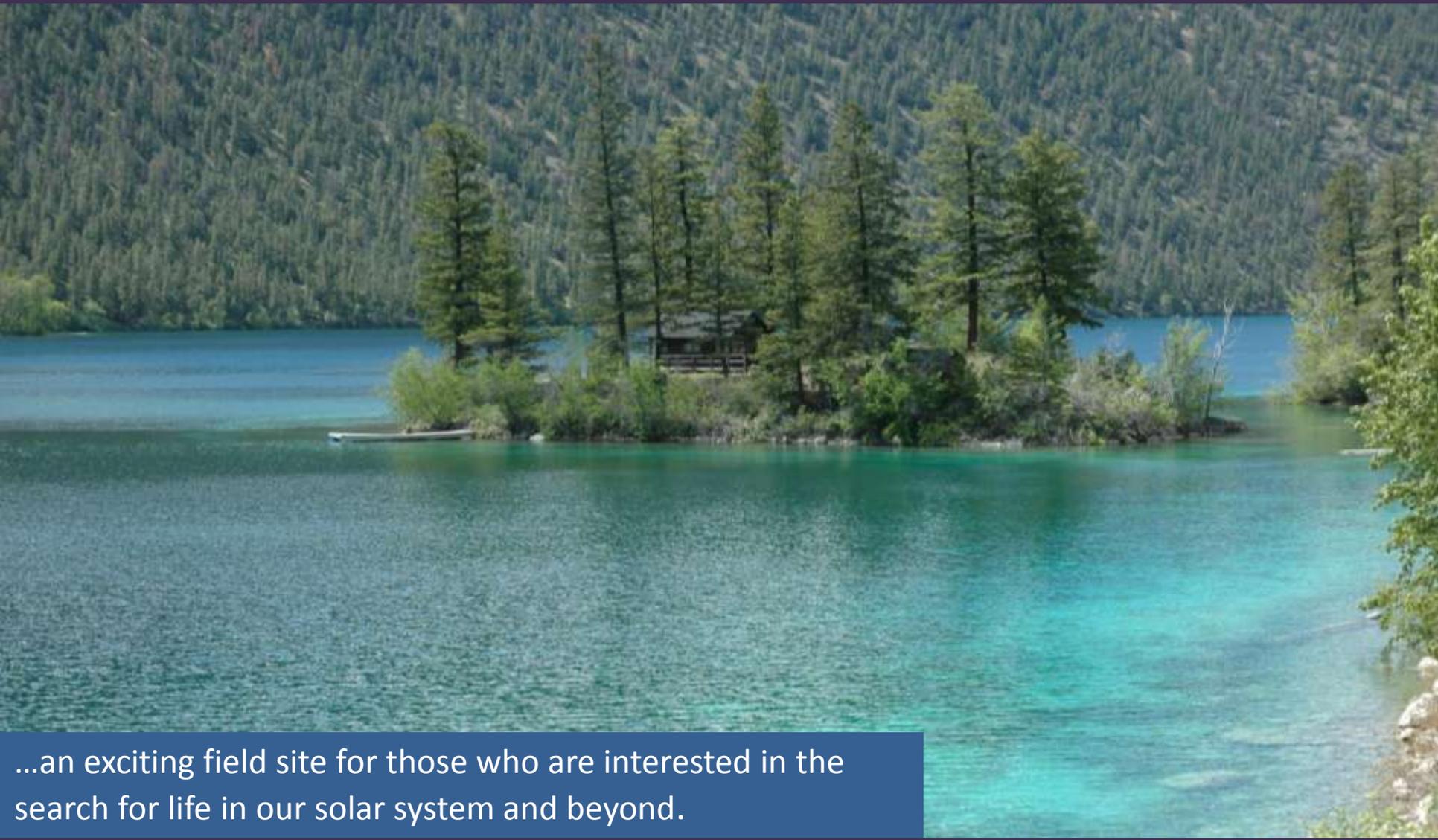
Many wonders
of this world are
found under
water that
covers over 70%
of earth...as
seen here.



Photo Credit: Donnie Reid

2

Hey, Pavilion Lake and Cache Creek Limestone



...an exciting field site for those who are interested in the search for life in our solar system and beyond.

Pavilion Lake

Fossil microbialites represent some of the earliest remnants of life on ancient Earth, and were common from ~2.5 billion to 540 million years ago

Finding modern, accessible locales for microbialites is a unique opportunity

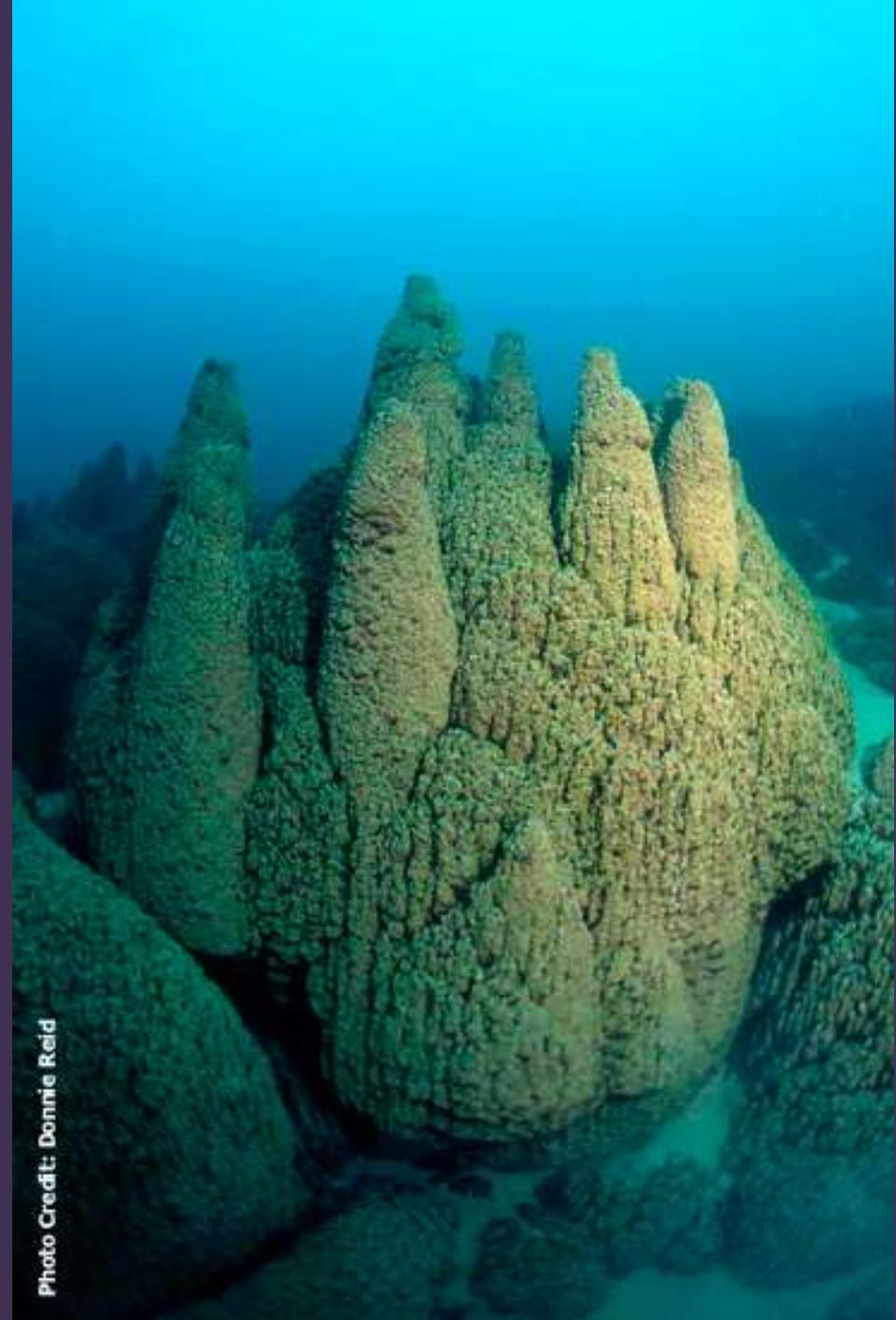


Photo Credit: Donnie Reid



Photo Credit: Donnie Reid

Scientists...and their toys

The Highland Valley Deposits

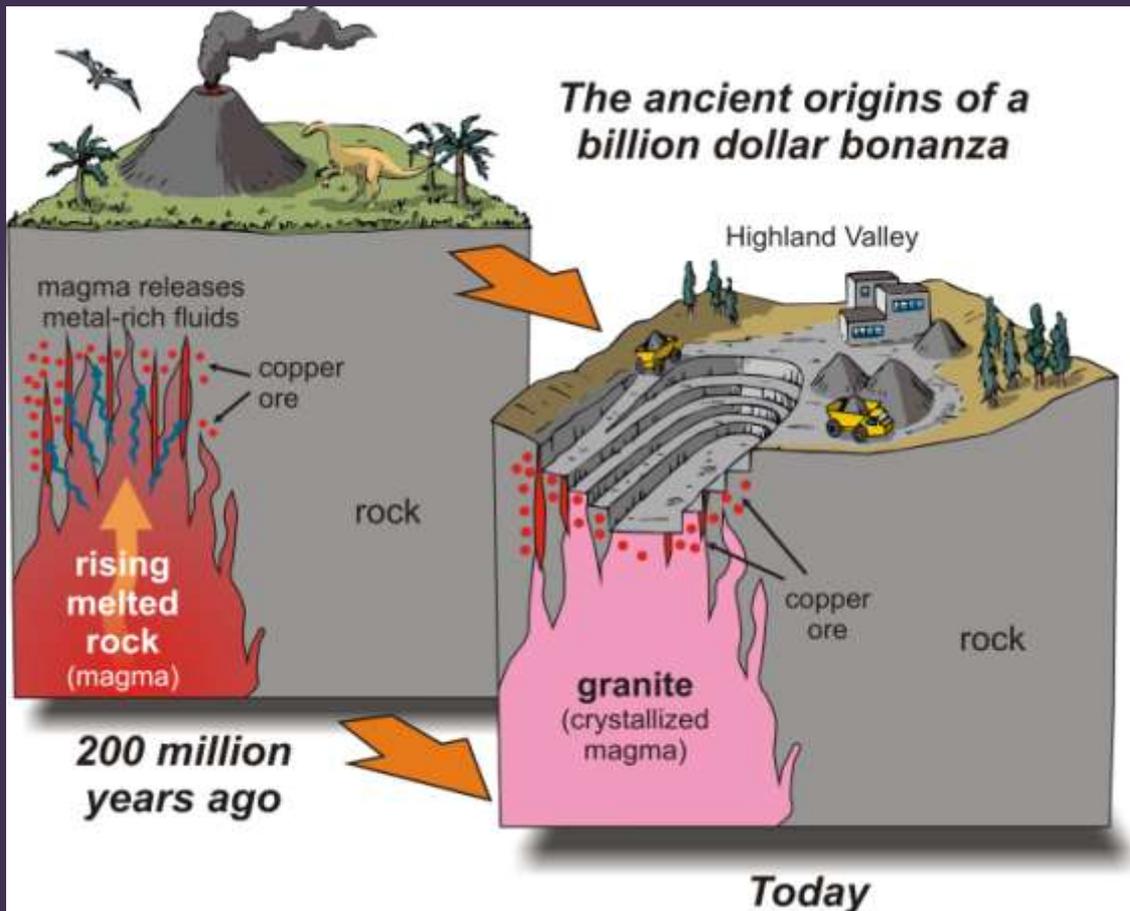
Bethlehem

Highmont

Lornex

Valley

JA



- Exploration began about 1896 in the Highland Valley area and accelerated after the discovery of surface showings at the O.K. deposit (later called Alwin and then Dekalb)
- From the 1920's until 1953, the Highland Valley area was largely inactive.
- Bethlehem was in production between 1962

3



Valley Pit, Started in 1982

Ed Frey photo



Canada's Biggest Base Metal Mine

- Over 50 years of essentially continuous mining
 - Mining suspended from May 15-August 30, 1999
 - 12 billion pounds copper*
 - 200 million pounds molybdenum
 - 270,00 oz gold
 - 44 million oz silver
- March 2013 gross value of almost \$45 billion
- Recent investments of over \$800 million
- \$25 million exploration in 2013

674 Mt at 0.29% Cu, 0.008% Mo (P+P)

*MINFILE estimates

Western Interior Seaway

The Cretaceous was a period with a relatively warm climate, resulting in high sea levels and numerous shallow inland seas



BC grew tremendous coal deposits!



Likely several billion tonnes left. BC's highest value natural resource?

Hudson's Hope had visitors



Hadrosaurs

Early Cretaceous ornithopod cousins

Queensland, AU



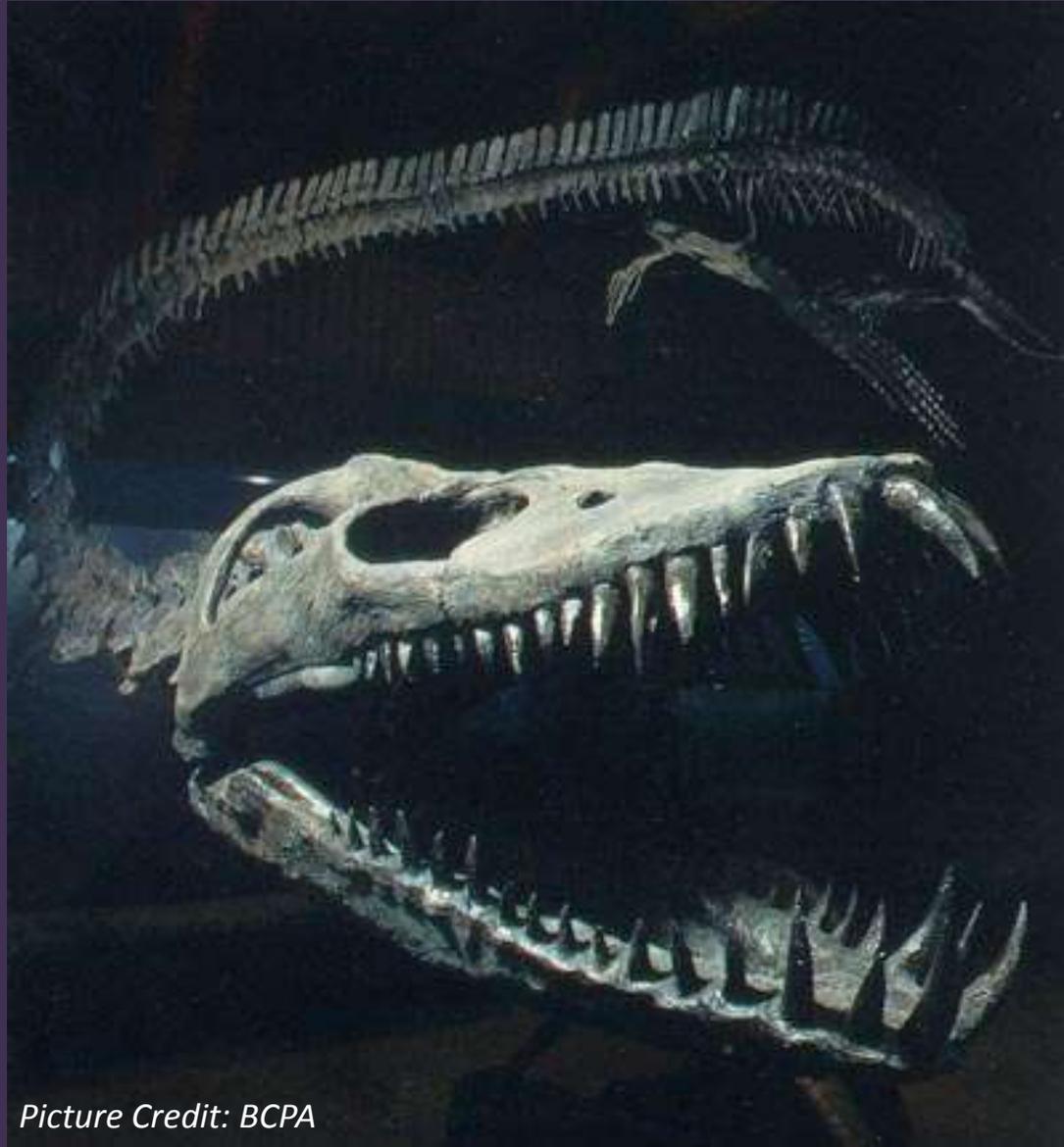
Amblydactylus gethingi

Gething Creek, BC



5

Courtenay got an *Elasmosaurus*



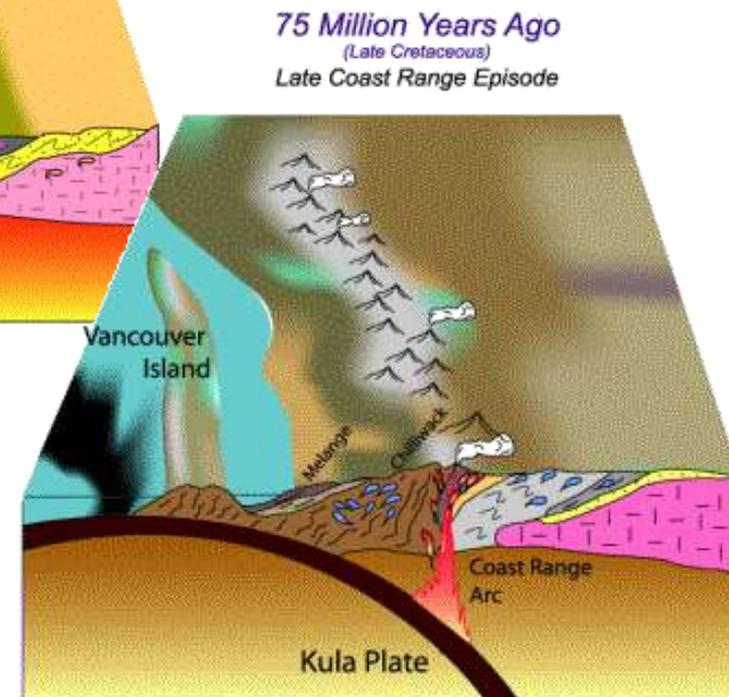
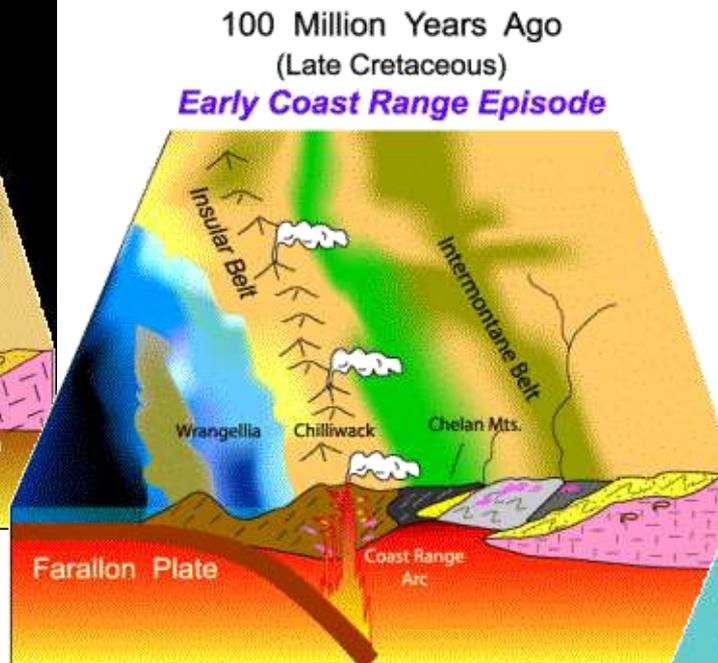
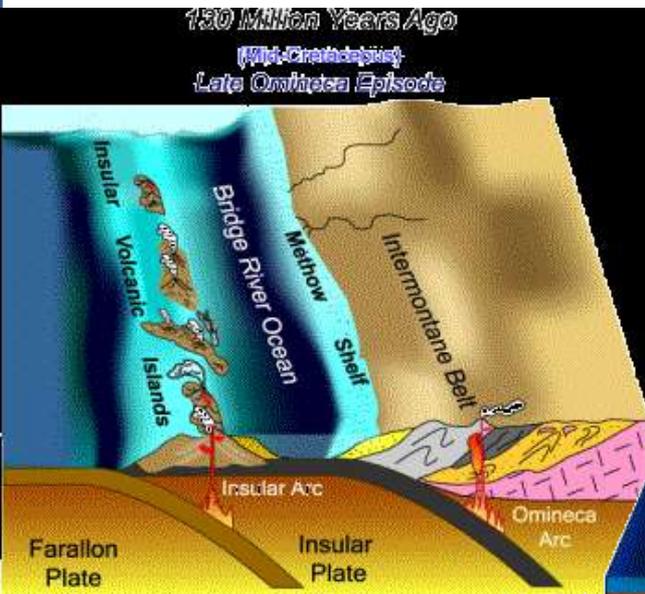
- 46 ft in length
- 71 neck vertebrae



Elasmosaurus plastica



Coast Range Batholith



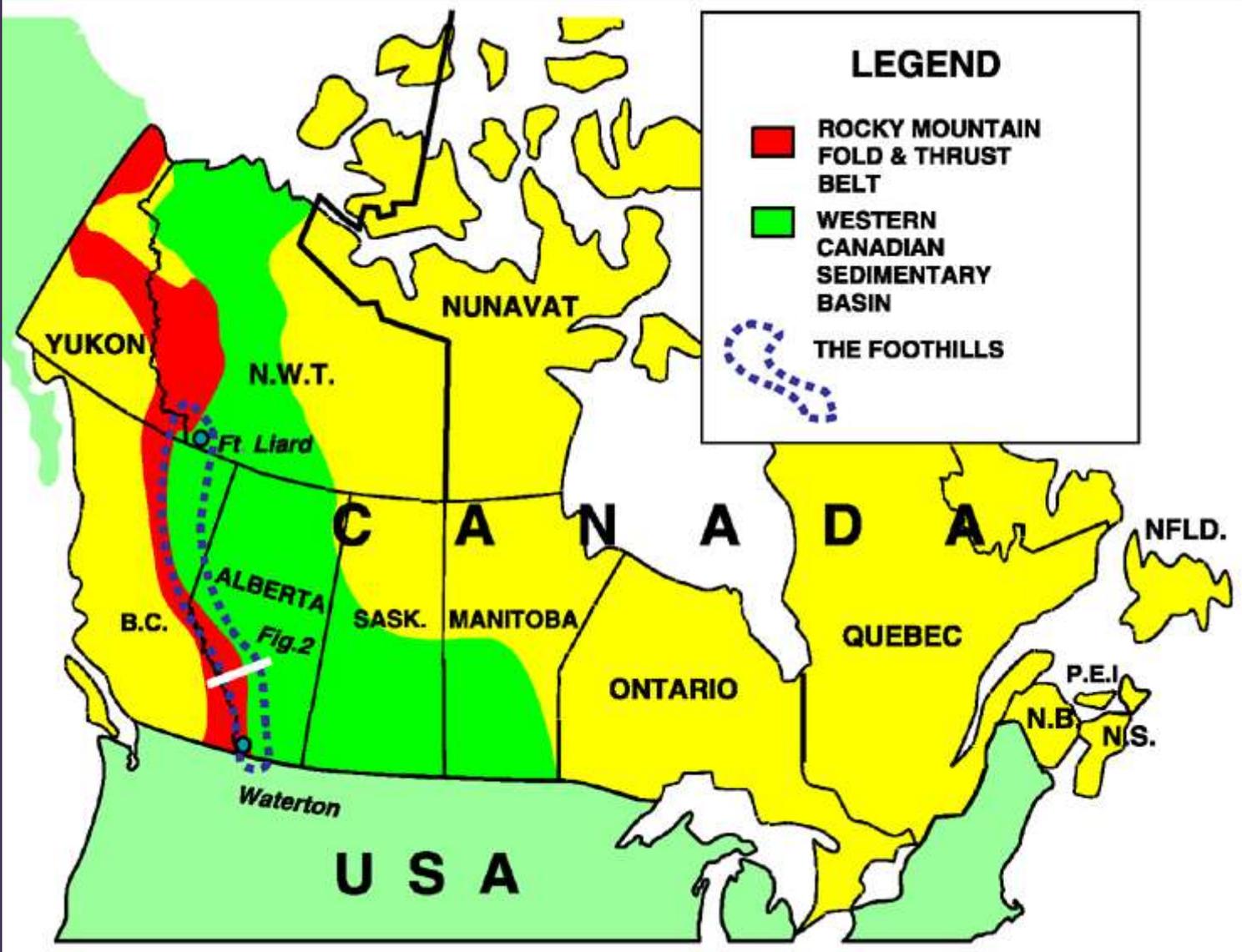
The Insular islands welded to the edge of the continent by molten rocks that cooled to form the Coast Range “Batholith”—the **largest single body of granitic rocks** in America: from Snoqualmie Pass in Washington to Southeast Alaska

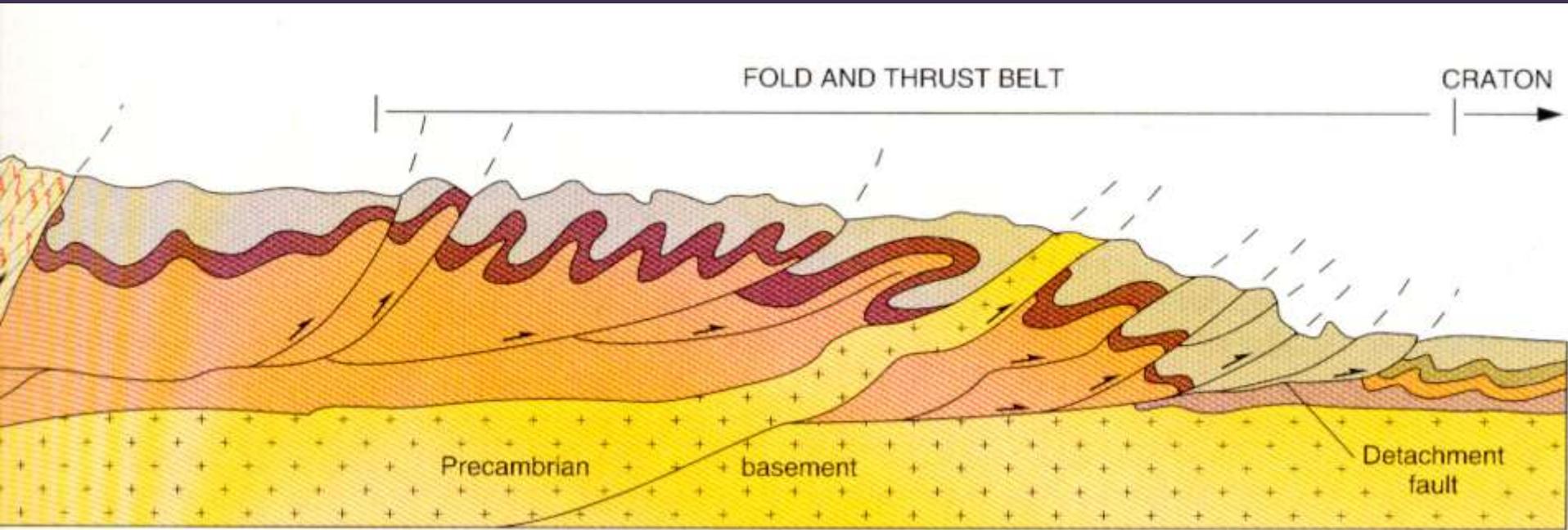


The "Chief" at Squamish



Rocky Mtn Fold and Thrust Belt

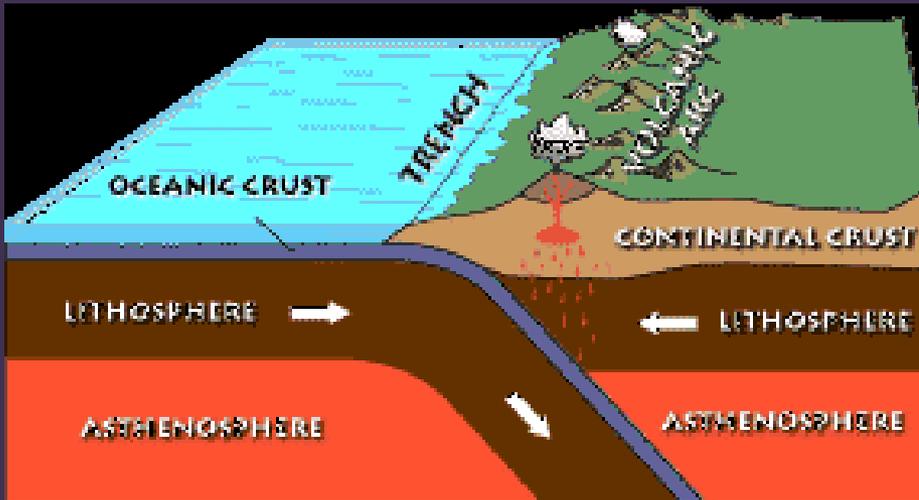




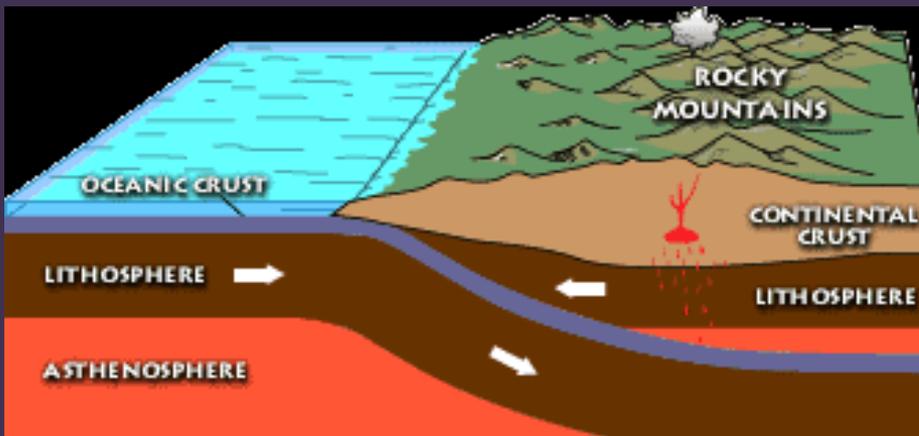
For the Canadian Rockies, the mountain building is analogous to a rug being pushed on a hardwood floor: the rug bunches up and forms wrinkles (mountains)

Laramide Orogeny (~80-35 Ma)

...forces and events leading to a deformation of the Earth's lithosphere due to the engagement of tectonic plates



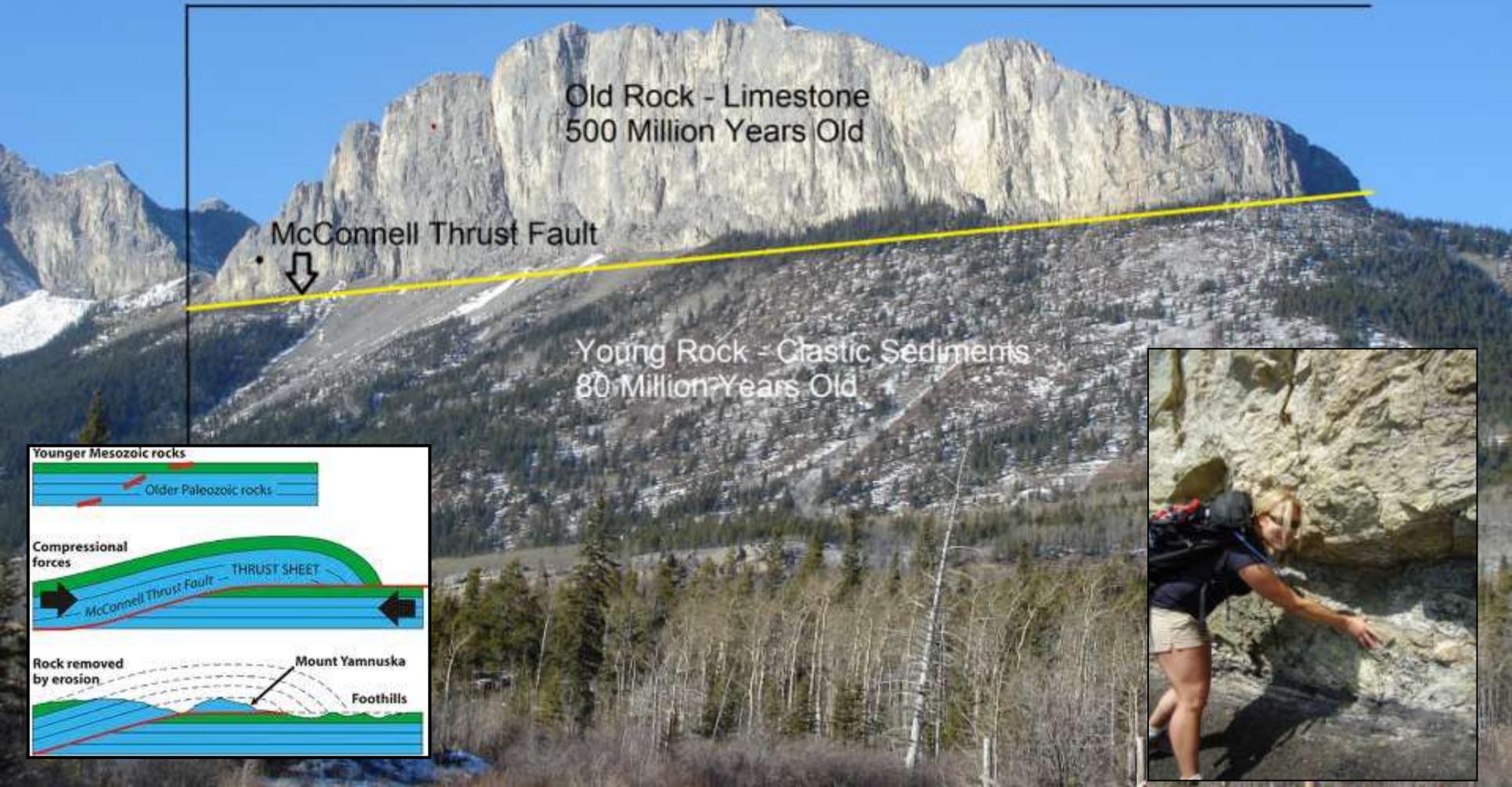
The oceanic plate typically sinks at a fairly high angle (somewhat exaggerated here). A volcanic arc grows above the subducting plate



This sketch shows the plate tectonic setting during the growth of the Rocky Mountains (Laramide orogeny).

The angle of the subducting plate is significantly flatter, moving the focus of melting and mountain building much farther inland than is normally expected.

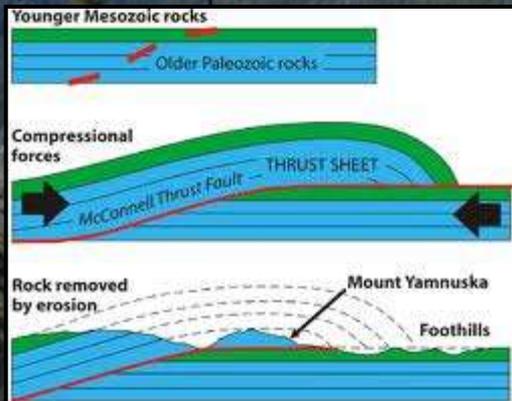
McConnell figured this out in 1887



Old Rock - Limestone
500 Million Years Old

McConnell Thrust Fault

Young Rock - Clastic Sediments
80 Million Years Old



Folded Mtn, Muncho Lake

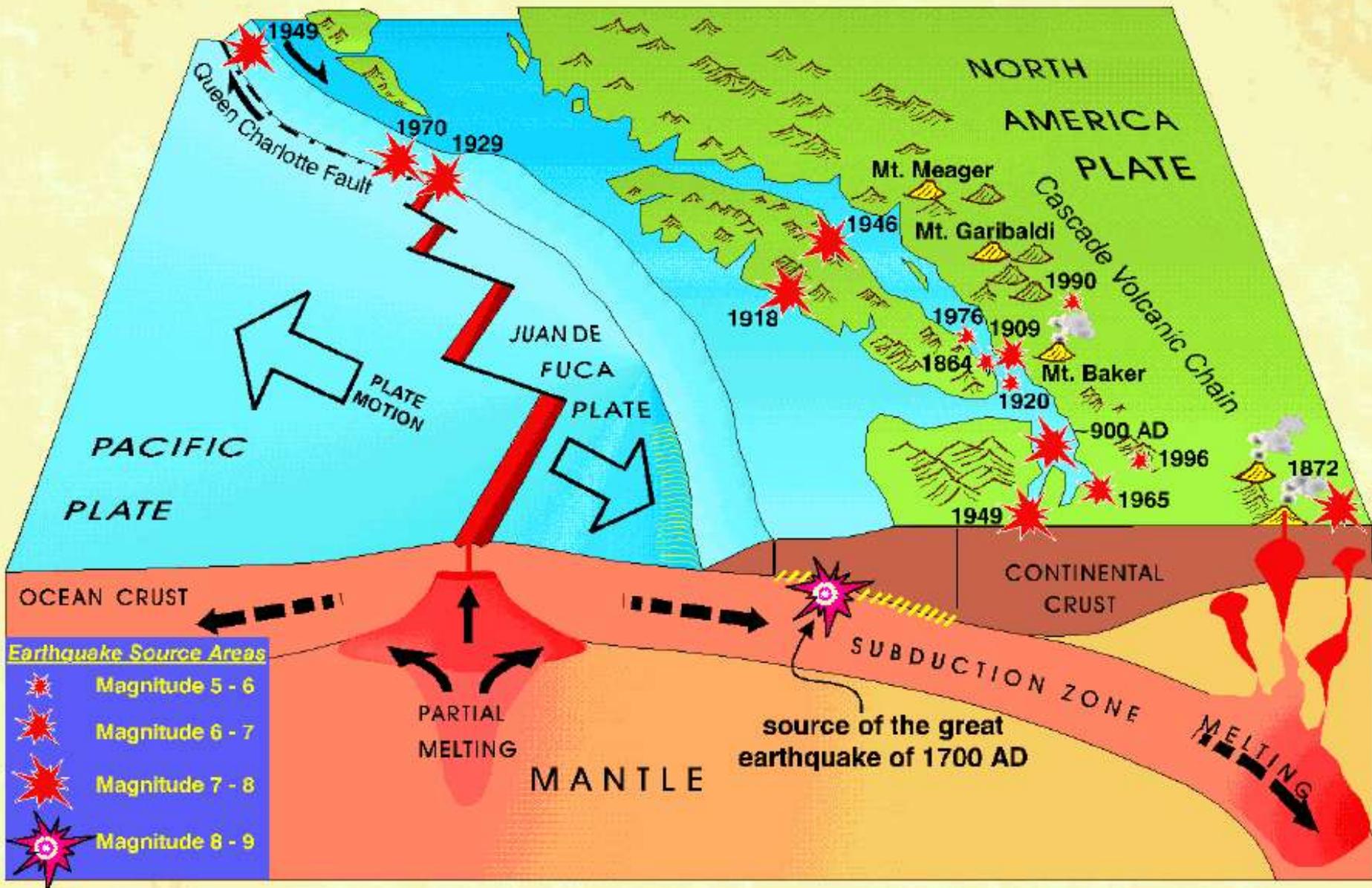


6

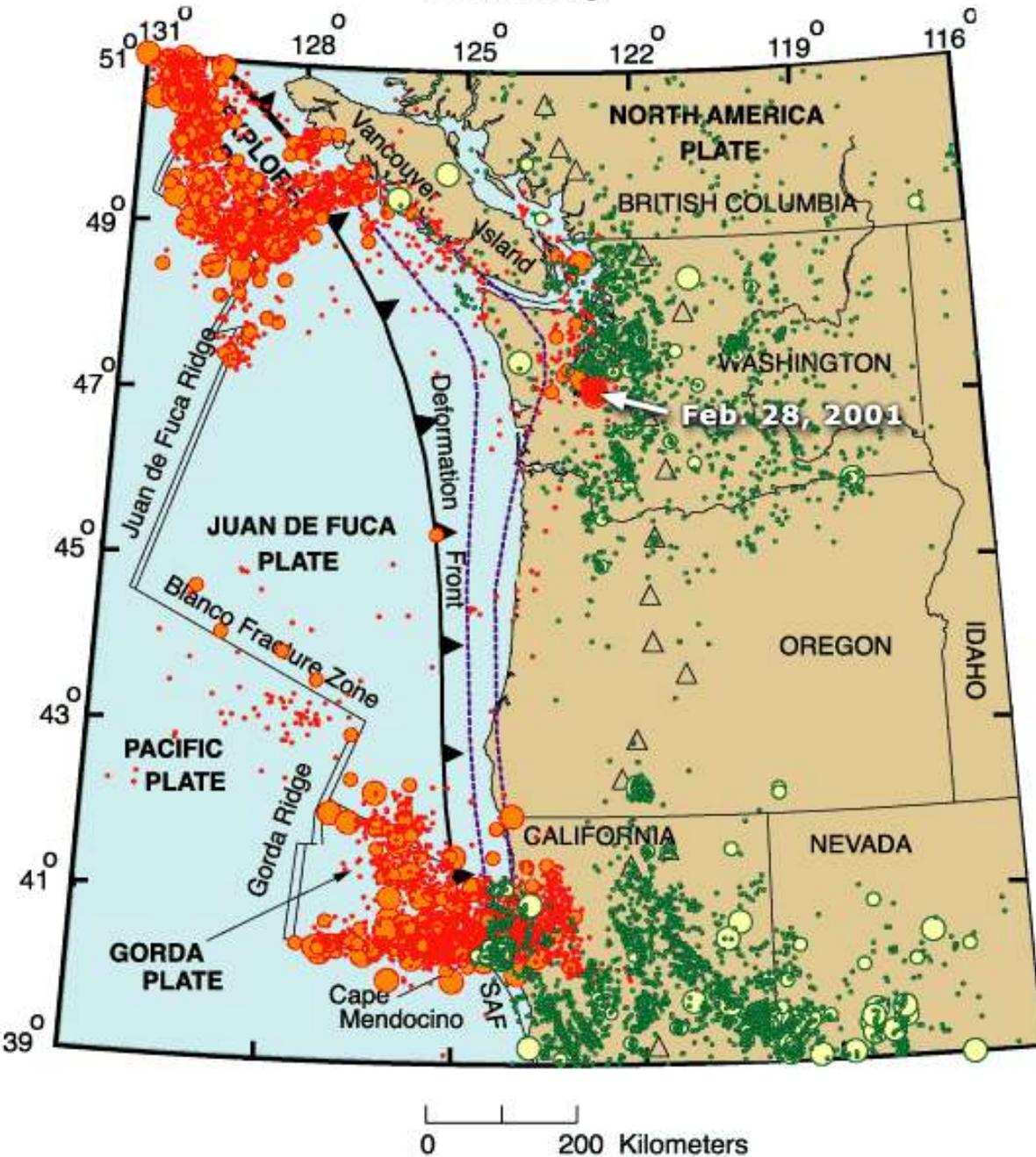


Mount Robson (12,972 ft)

The Shaky Shaky West Coast

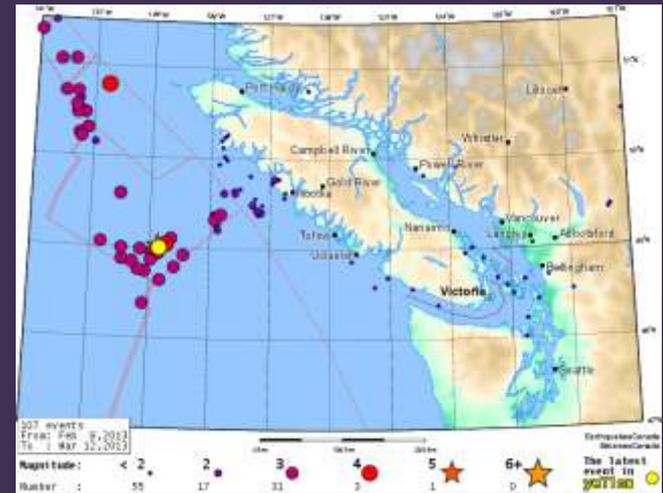


Seismicity



modified from Weaver and Shedlock, 1996

Told ya it was shaky



Feb 9-March 12, 2013 (107 events)

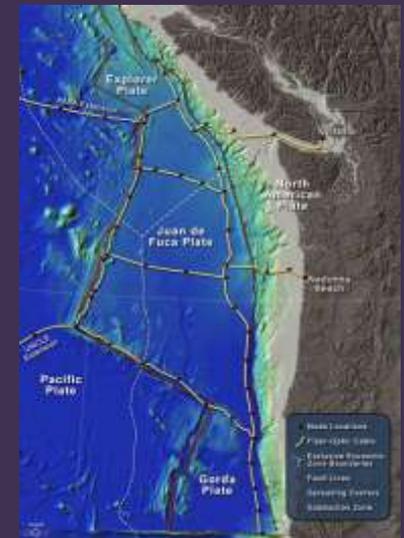
...we'd best keep an eye on this...

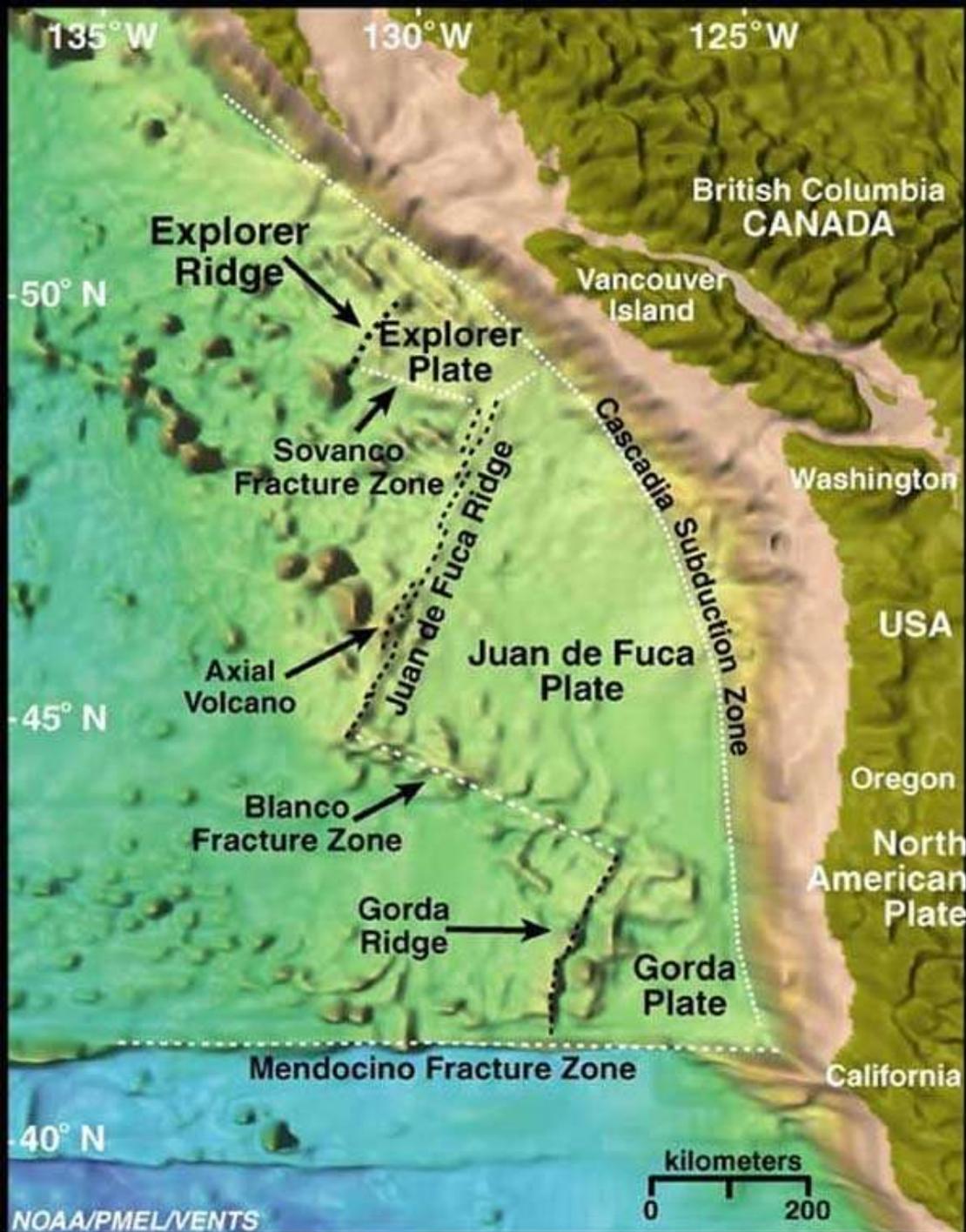
NEPTUNE Canada Observatory



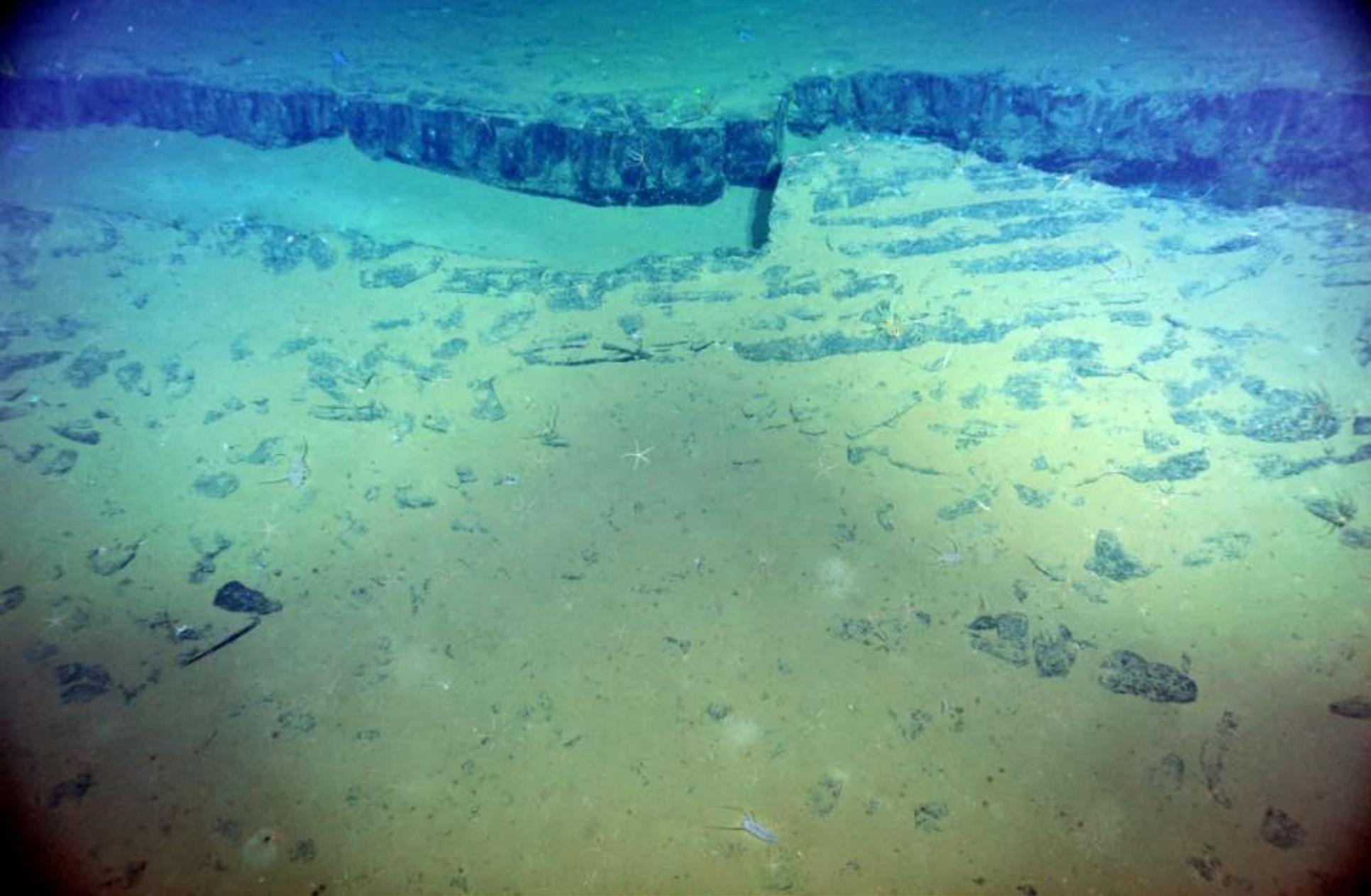
A regional cabled ocean network gathering live data from a rich constellation of instruments

...and the folks down south too





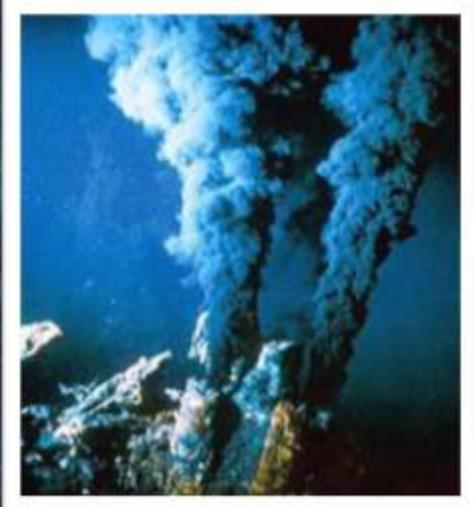
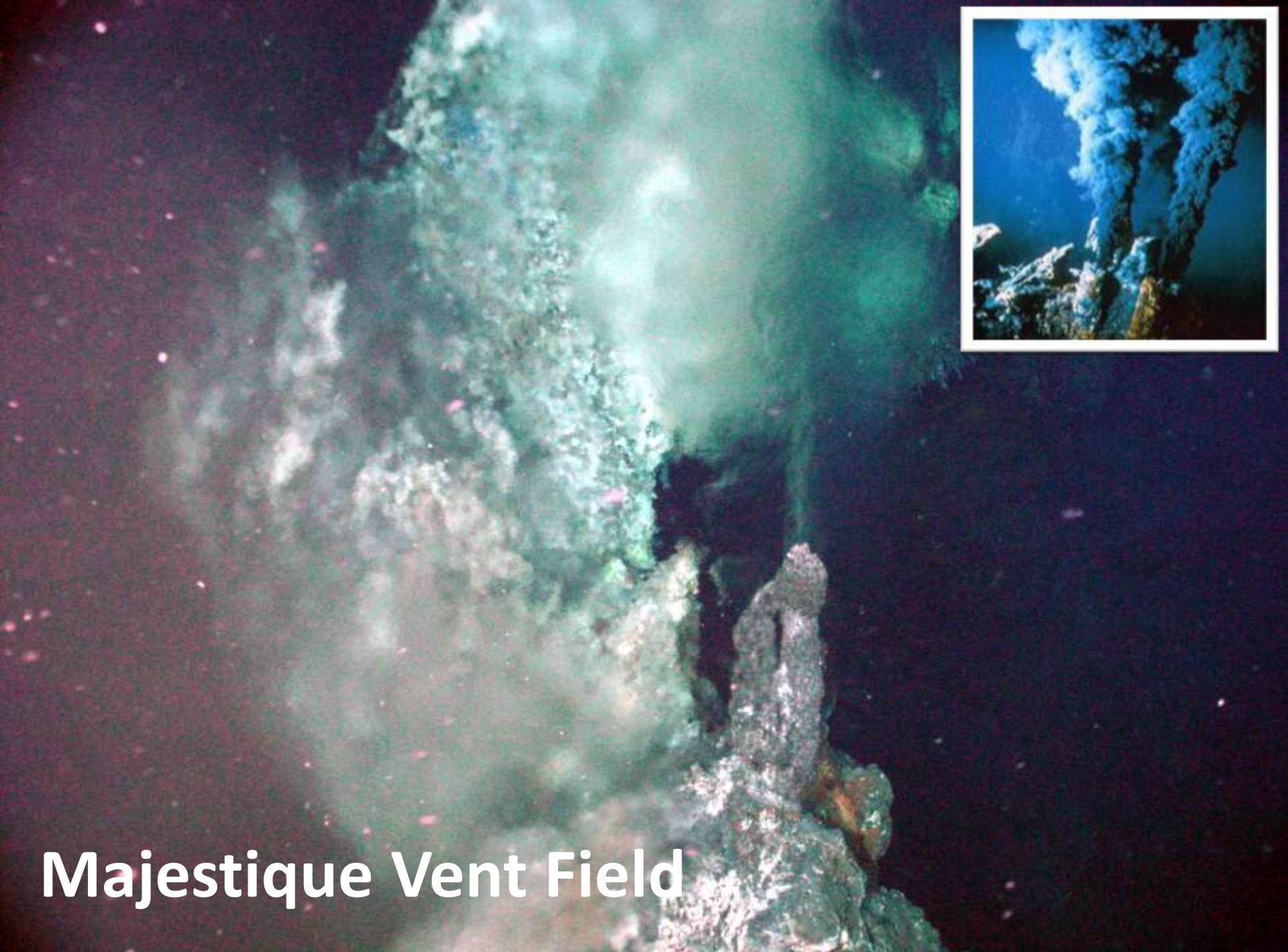
Take a couple kilometers of water away and things are right there



Large Seafloor Rift



Skate flying past the Trawl Resistant Frame at Endeavour. (Depth: 2321m)



Majestique Vent Field

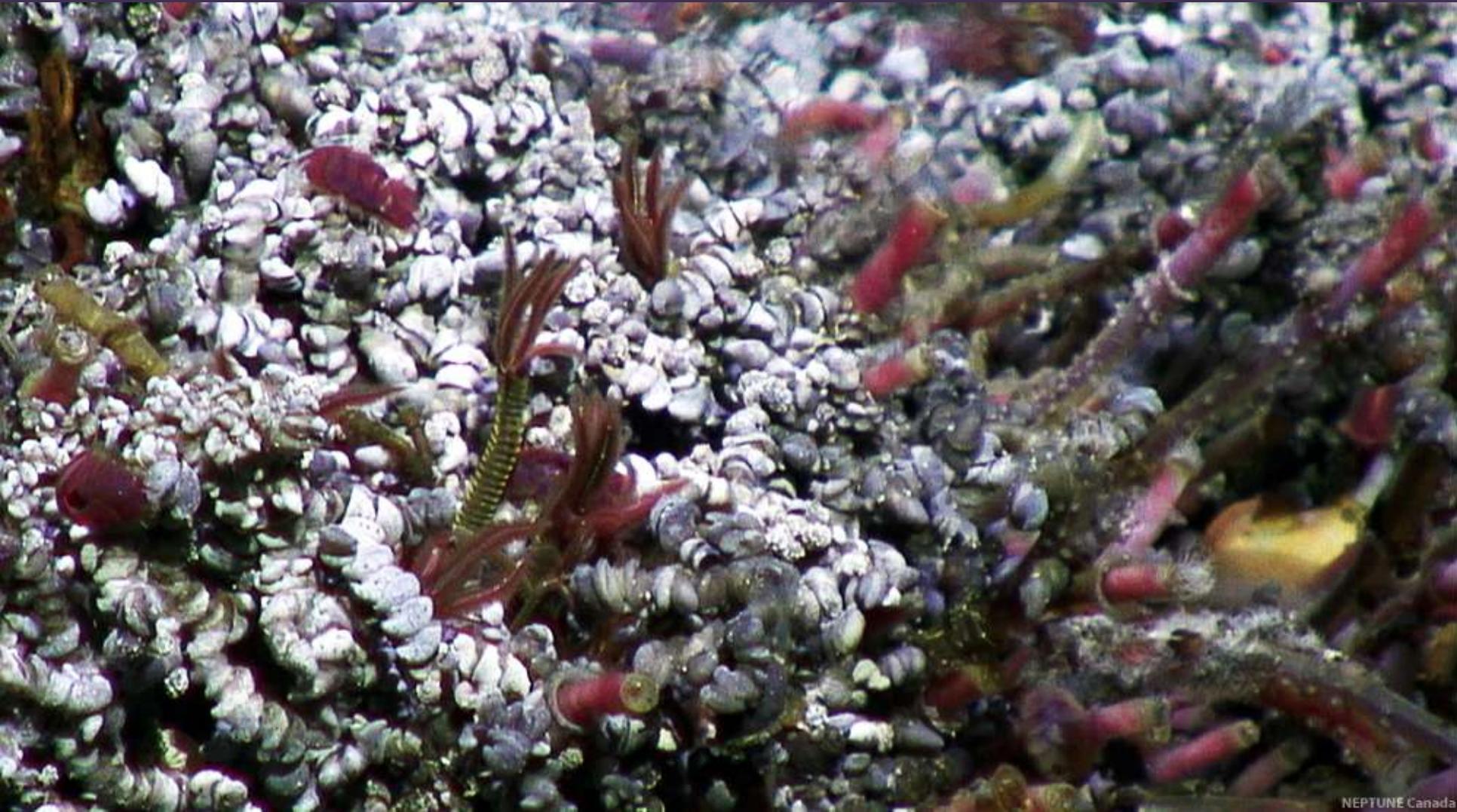
Tubeworms cover Zooarium, a lower-temperature sulfide chimney





Deep-sea octocorals or soft corals

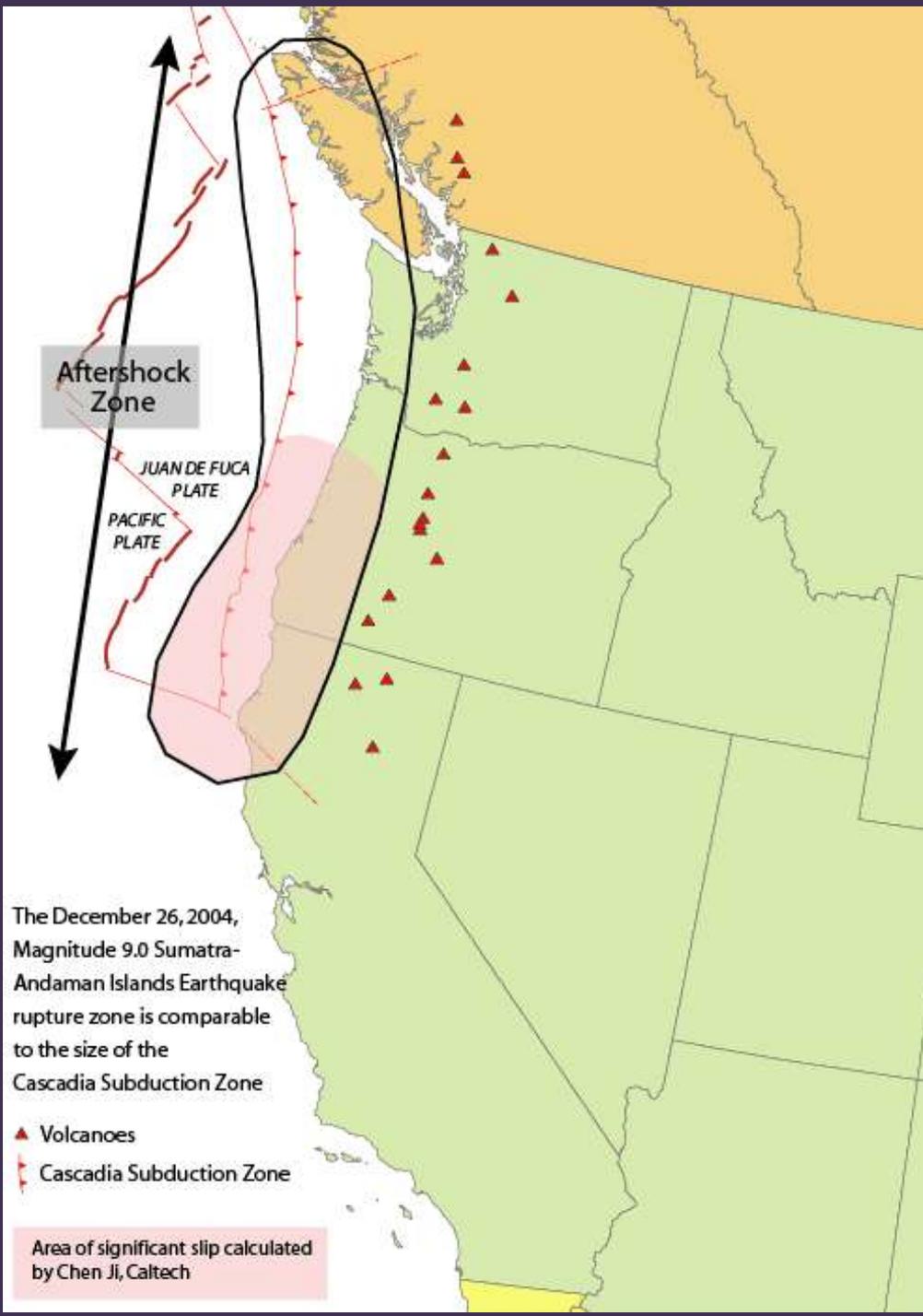
Tubeworms, scale worms and limpets thrive in
the hot sulfide-laced waters of Grotto Vent
(Depth: 2189m.)



1700 Cascadia Earthquake

This is the site of recurring megathrust earthquakes at average intervals of about 500 years, including the Cascadia Earthquake of 1700

- magnitude 8.7 to 9.2
- fault rupture about 1,000 km long
- average slip of 20 meters



Rocky Mountain Trench

1,600 km long by-product of faulting



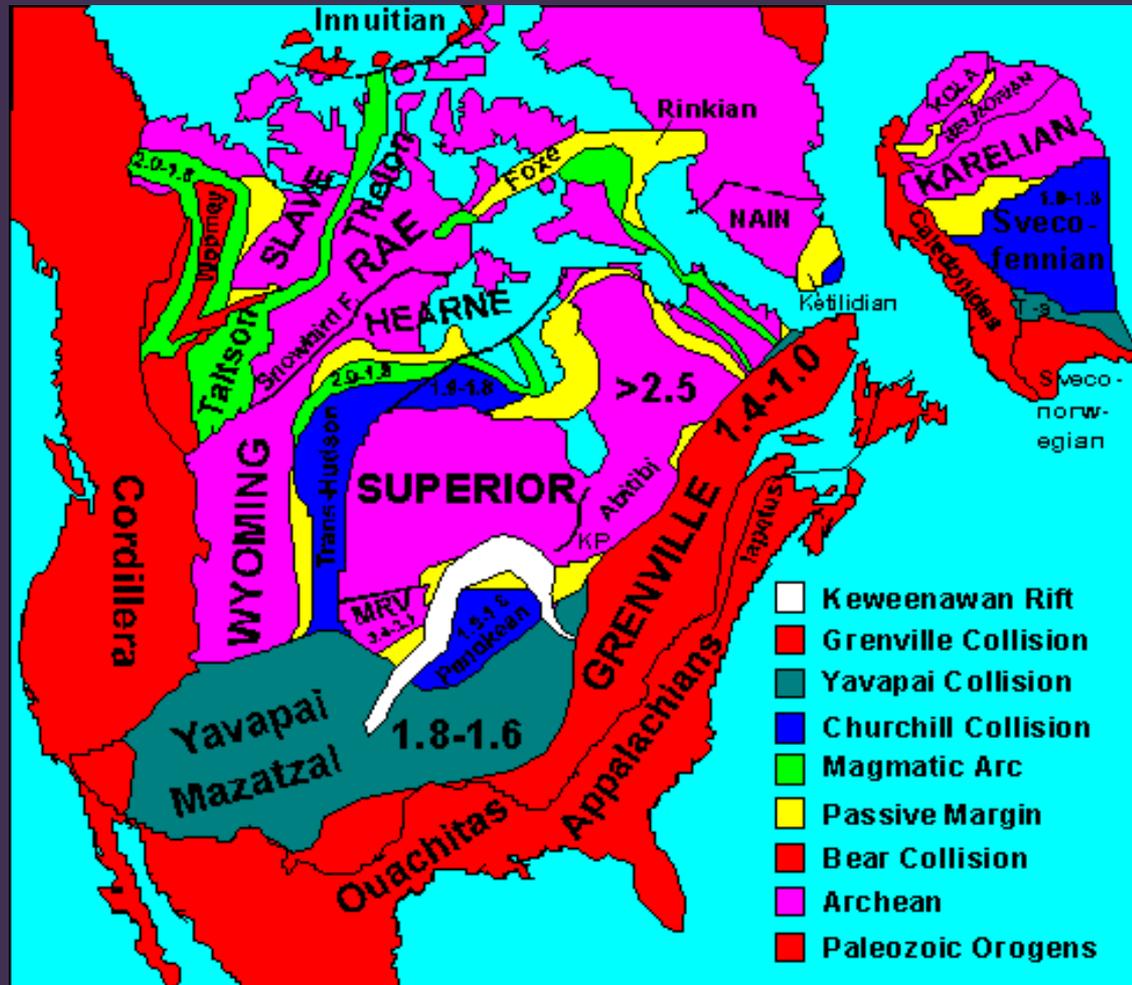
W.A.C. Bennett dam produces about 40% BC's power



Photo by
Max Fanderl
www.DiscoveryWeb.com

How does BC's RMT compare?

Mid-Atlantic Ridge	~10000 km
Africa's Great Rift Valley	6000 km
Keweenawan Rift	2000 km
Baltis Vallis (Venus)	6800 km



Keweenawan Rift shown here in white

Tseax/Aiyansh Cone



This volcano erupted in 1325, and again between 1750-1775

Nisga'a Memorial Lava Bed



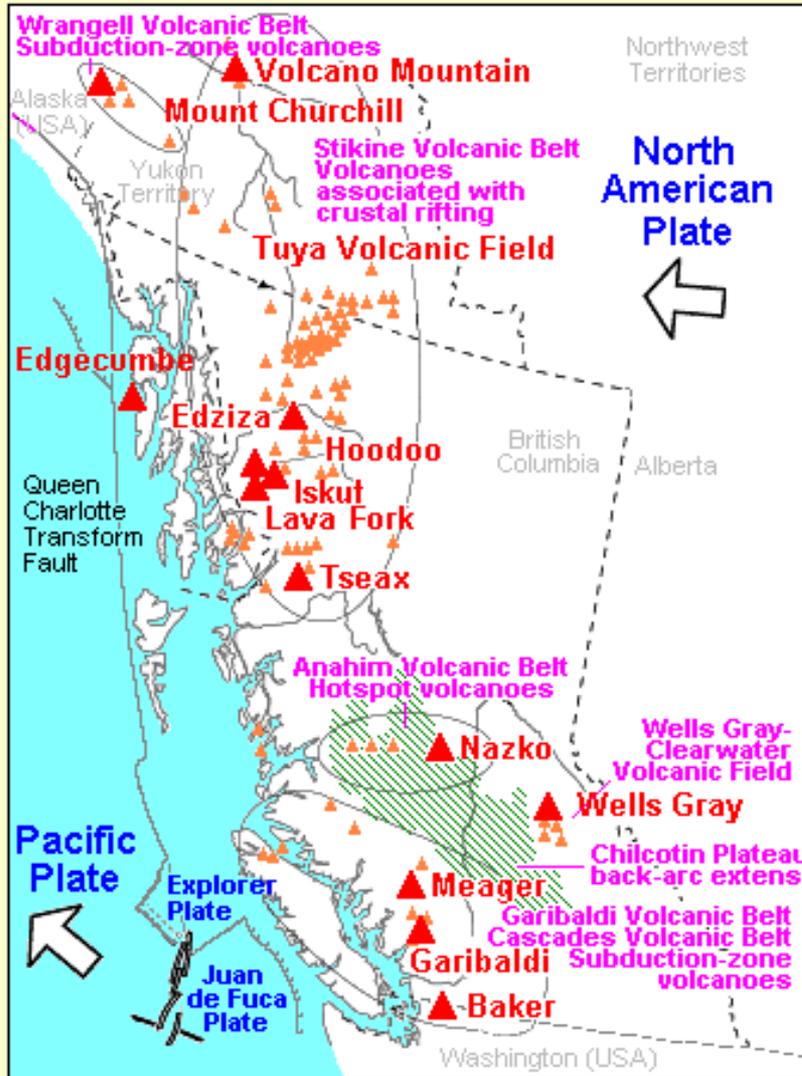
*“...The ground
began to tremble
and shake.
Nature's harmony
had been upset...”*

Nisga'a oral tradition



**Nisga'a Memorial Lava Beds
Tree mould**

Volcanoes and Volcanic Areas of Western Canada



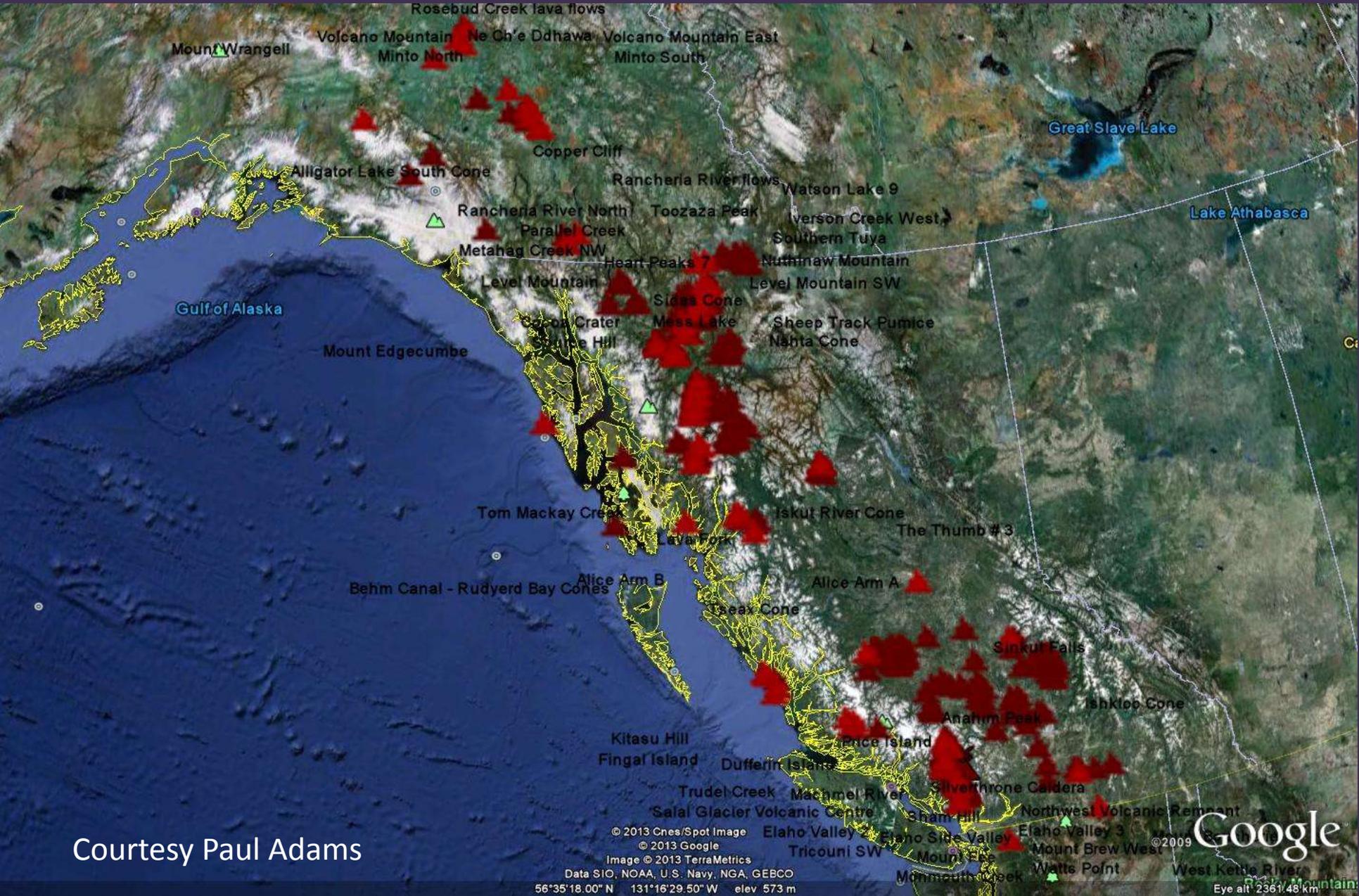
- ▲ Holocene volcanoes
- ▲ Quaternary volcanoes
- ▨ Chilcotin Basalts (general vicinity)
- ← Direction of plate motion

0 100 200 km

Original Map:
Volcanoes and Their
Tectonic Settings in
Western Canada
Natural Resources
Canada Website, 2001

Turns out
there are
volcanoes
everywhere

Volcanoes under 10 million years old



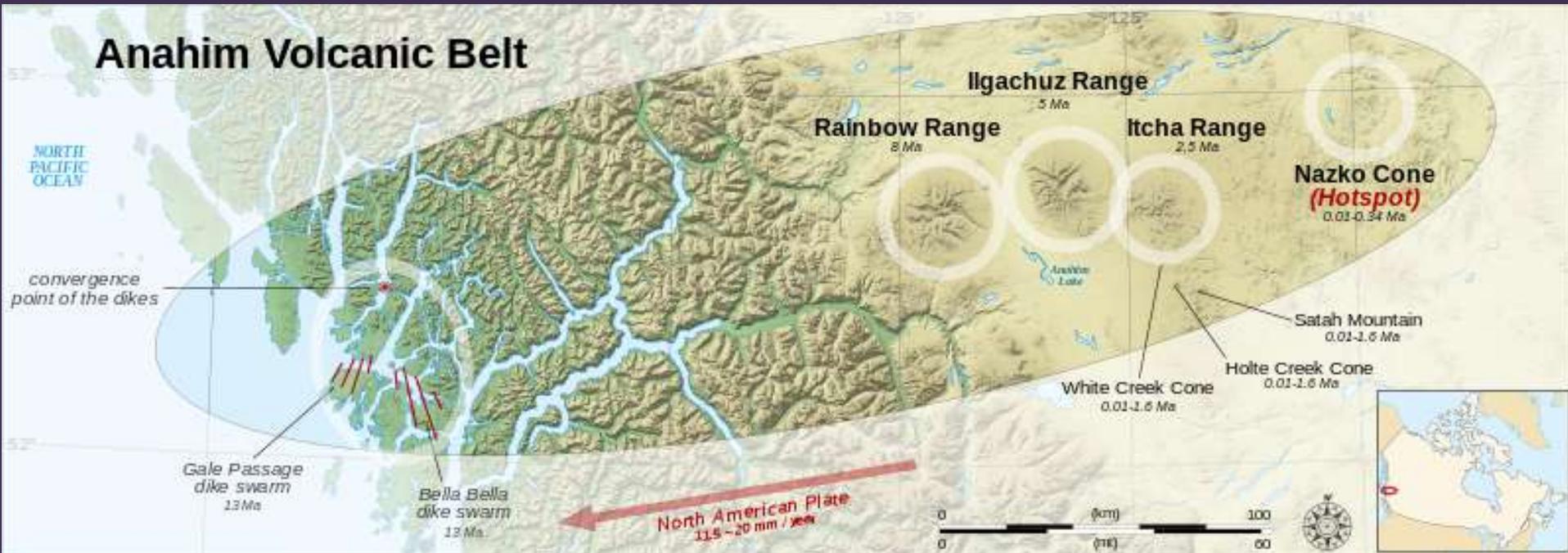
Courtesy Paul Adams

© 2013 Cnes/Spot Image
© 2013 Google
Image © 2013 TerraMetrics
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
56°35'18.00" N 131°16'29.50" W elev 573 m

Google

Eye alt: 2361.48 km

Aloha...Hawaii of the north



Anahim Volcanic Belt



Nazko Cone...a sleepy little volcano, not



Made in Canada: A Tuya



7

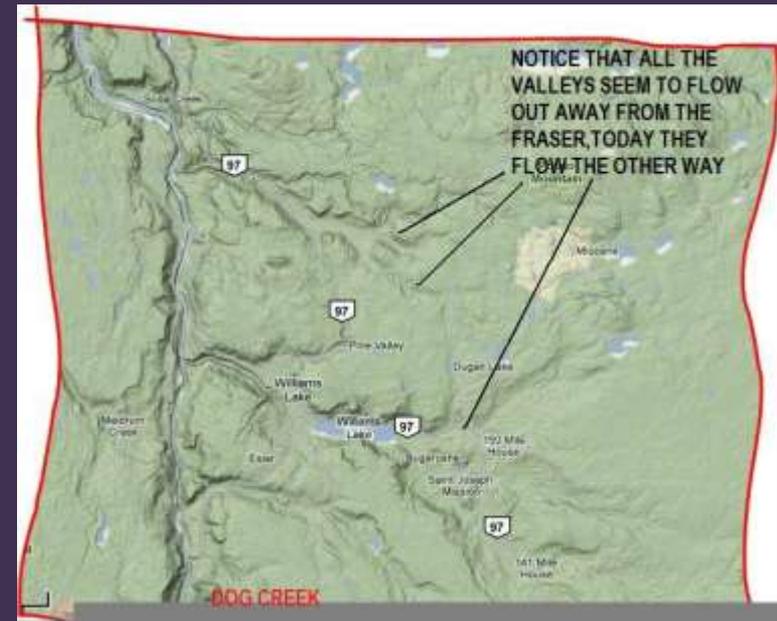
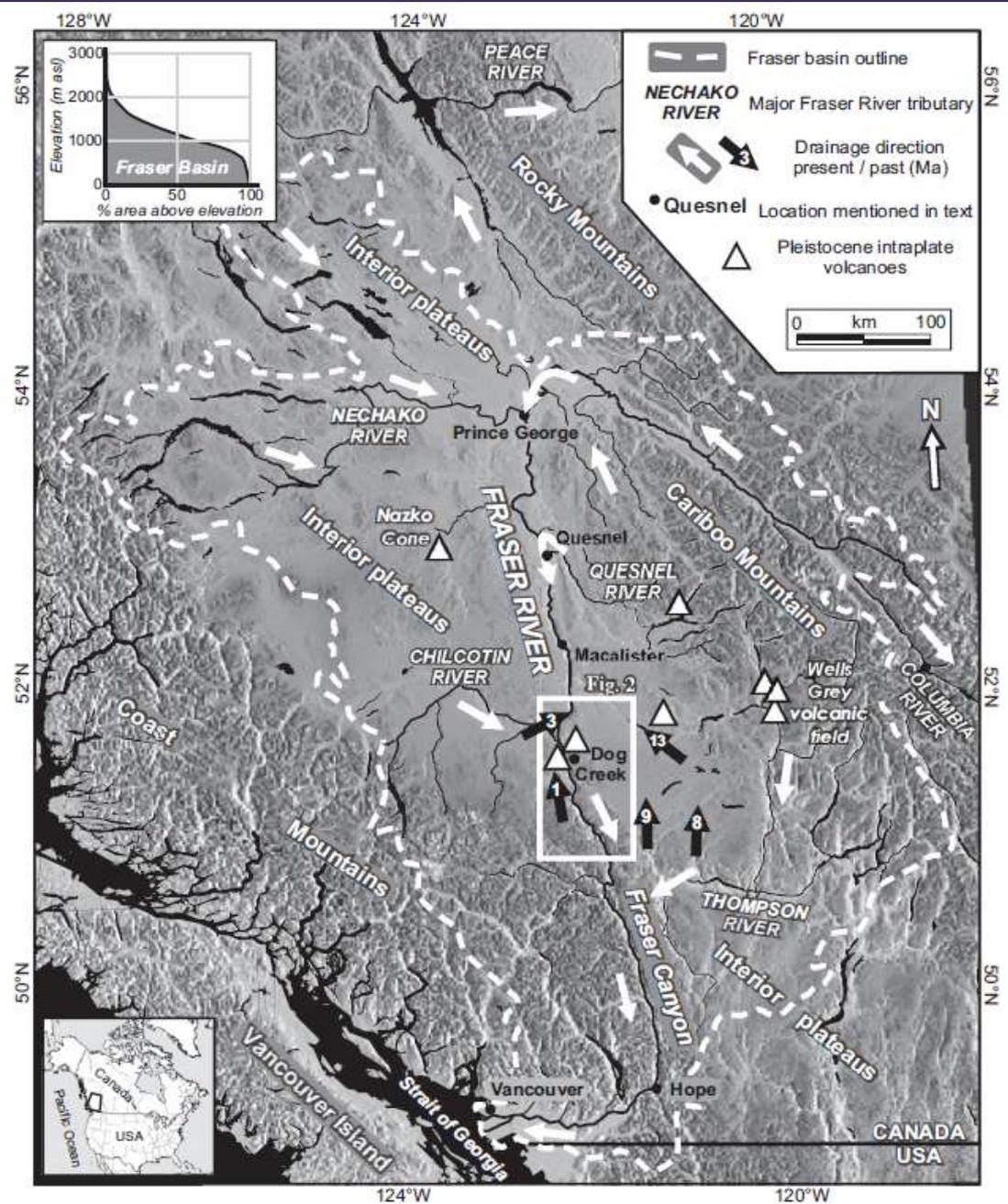
Skoatl Point

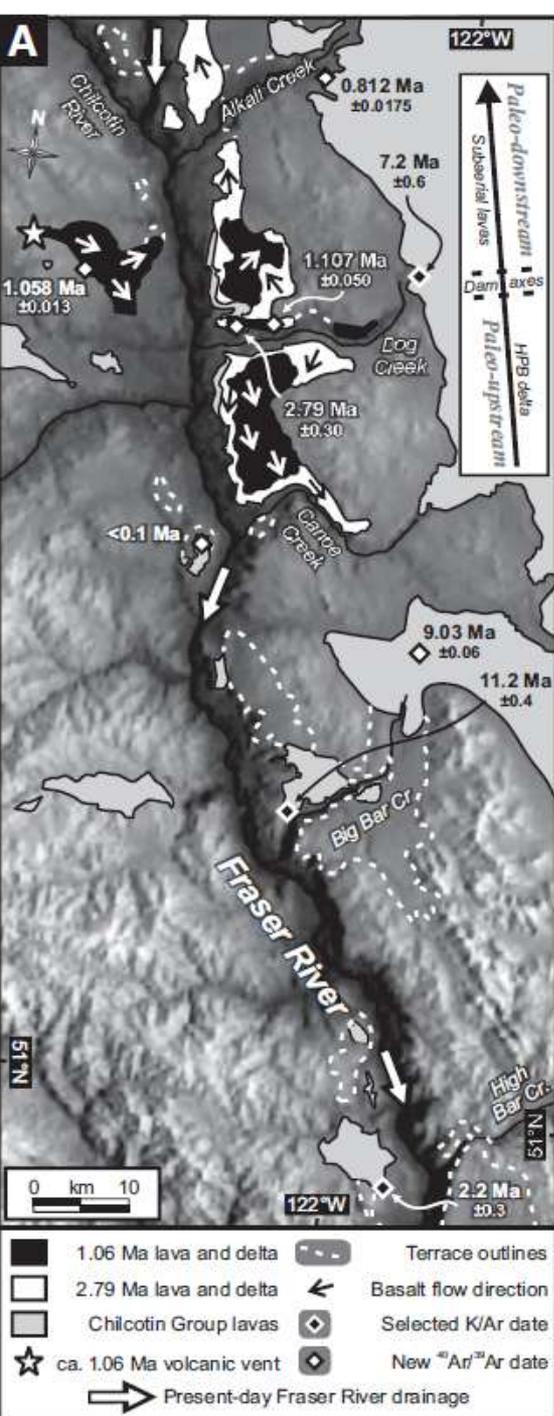


A pretty volcanic plug that easy to get to...let's go Kamloops!



The Northbound Fraser River





“Our results confirm reversal of the Fraser River to a southward drainage and erosion of the (270 km long) Fraser Canyon since 1.06 Ma”

“The hills are riddled with mining tunnels where miners in the 1950's searched for Lost River gold deposit. Glaciers melted to flow into this huge **Lost River** carrying gold from far up stream. Earth's climate warmed and the glaciers disappear as did the Lost River. Next volcanic activity spread a layer of ash and basaltic lava over relatively flat land to form a cap over the river bed. Lastly, we entered into another ice age which melted 10,000 years ago”



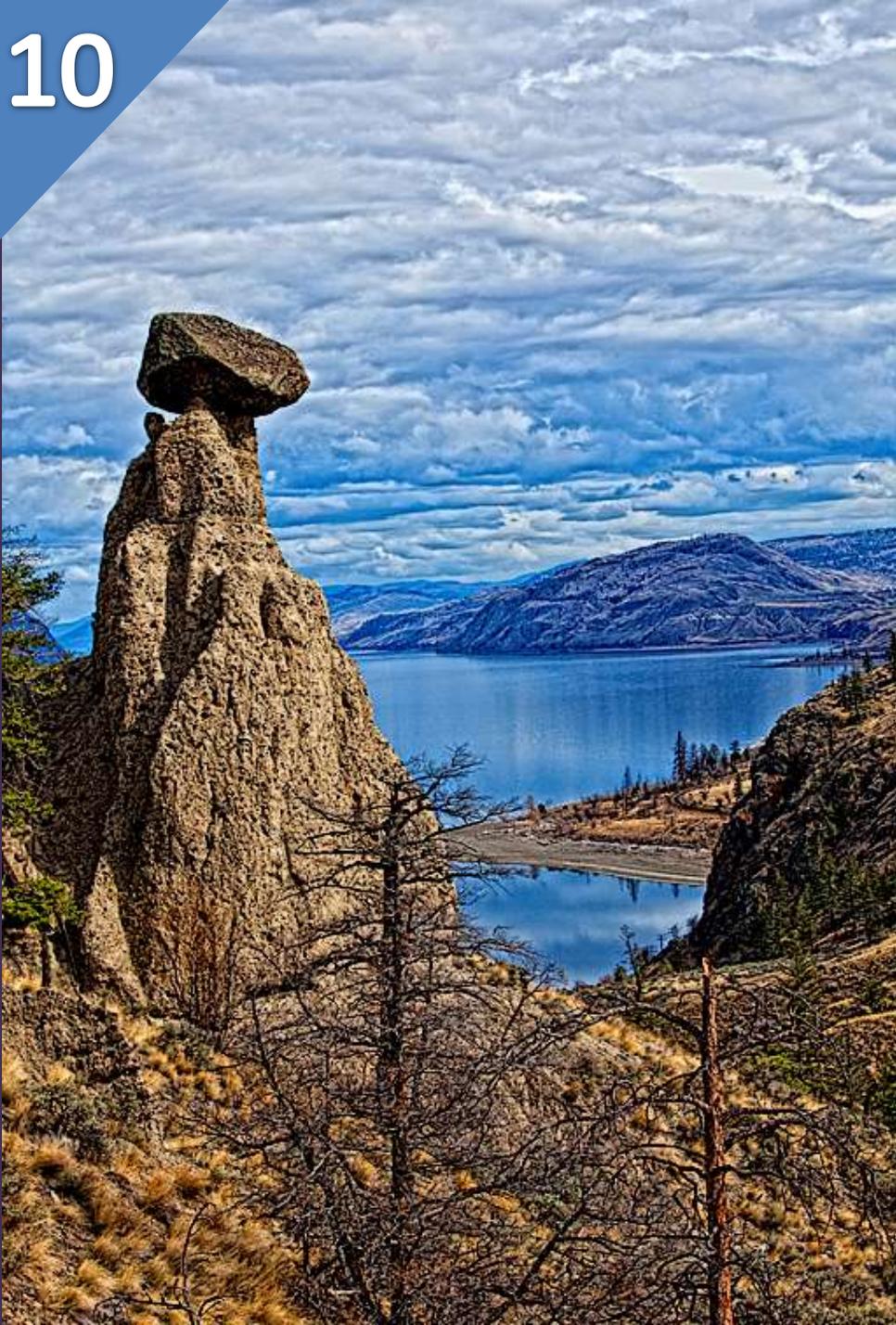
Lytton Jelly Roll

9

Pillar Lake

A 90-foot unique geological conglomerate of dirt and rock that can be reached via a short hike...balancing a precariously perched eight-tonne boulder on its tip.





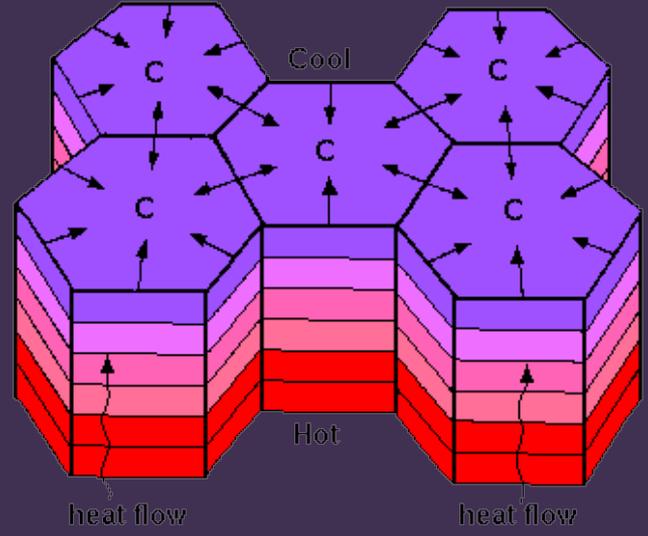
Balance Rock

“The Secwepemc man was stronger and succeeded in lifting rock where all would see it. The Okanagan left the land around the lake, and the two nations never fought again”

Stories of the Secwepemc

11

Columnar Basalts are Everywhere in BC...get out and see some



Pinaus Lake near Falkland



Devil's Woodpile – Cathedral Lake

Whistler



Perkin's Pillar

Mount Meager massif



It fell over in 2005!



Photo from Kirstie Simpson

12 Capricorn Creek Slide August 6, 2010



One of the largest landslides in Canadian history



...estimates suggest that it had a volume of about 40 million cubic metres...the slide travelled at 30 metres per second over a distance of 10 km...

3,000,000 m³ of water pooled behind a dam, which was threatening the Pemberton Valley. ..officials evacuated 1,500 people and placed an additional 2,500 on alert



Registered a 2.6 on the Richter scale





"That's when I realised the whole damn mountain had fallen down."

Ashes to Ashes...



Mt St Helens Yn

Mazama



Ash Source	Years ago
Mount St Helens (Wn)	508
Mount Meager (Bridge River)	2400
Mount St Helens (Yn)	3400
Mount Mazama	6800



BRITISH
COLUMBIA

The Best Place on Earth



Elasmosaur or 'Swan lizard'

Elasmosaur or "Swan lizard", was a large and predatory marine reptile with a long neck and flippers. This marine reptile roamed the waters roughly 80 million years ago during the Cretaceous Period of the Mesozoic Era. Fossils of the elasmosaur have been found near Courtenay on Vancouver Island.

The elasmosaur photo (Swan lizard) is courtesy of Dr. Jim Haggart



Canadoceras (Canadian horn)

Canadoceras, common name "Canadian horn", is a classic example of an ammonite, which is an extinct fossil group that occupied the seas and oceans for a time span greater than the dinosaurs roamed the earth. The Canadian horn, a soft bodied animal similar to clams, snails, octopus or squid, is from the Cretaceous Period during the Mesozoic Era approximately 80 million years ago. These fossils are commonly found on the eastern side of Vancouver Island.

Canadoceras photo (Canadian horn) is courtesy of Dr. Jim Haggart



Marrella splendens (Lace crab)

Marrella splendens, common name "Lace crab", was a joint-legged animal similar to crabs, spiders and other insects found today. The Lace crab lived approximately 530 million years ago during the Cambrian Period in the early Paleozoic Era. Lace crabs are the most common fossil found at the Burgess Shale World Heritage Site in Yoho National Park.

Marrella splendens photo (Lace crab) is courtesy of the Geological Survey of Canada



Yabeina

Yabeina columbiana is an extinct type of single-celled animal that lived approximately 300 million years ago during the Permian Period of the Paleozoic Era. Occurrences of Yabeina Columbiana in North America are rare and unusual, yet these fossils can be found in the Marble Canyon and Hat Creek areas of British Columbia.

Yabeina photos (rock showing several specimens; magnified image of the animal) are courtesy of Dr. Ted Donner

Thank you...your curiosity is my inspiration



Yak Peak on the Coq.

Tim Gage photo

4

Elasmosaurus plastica



Go Blazers!