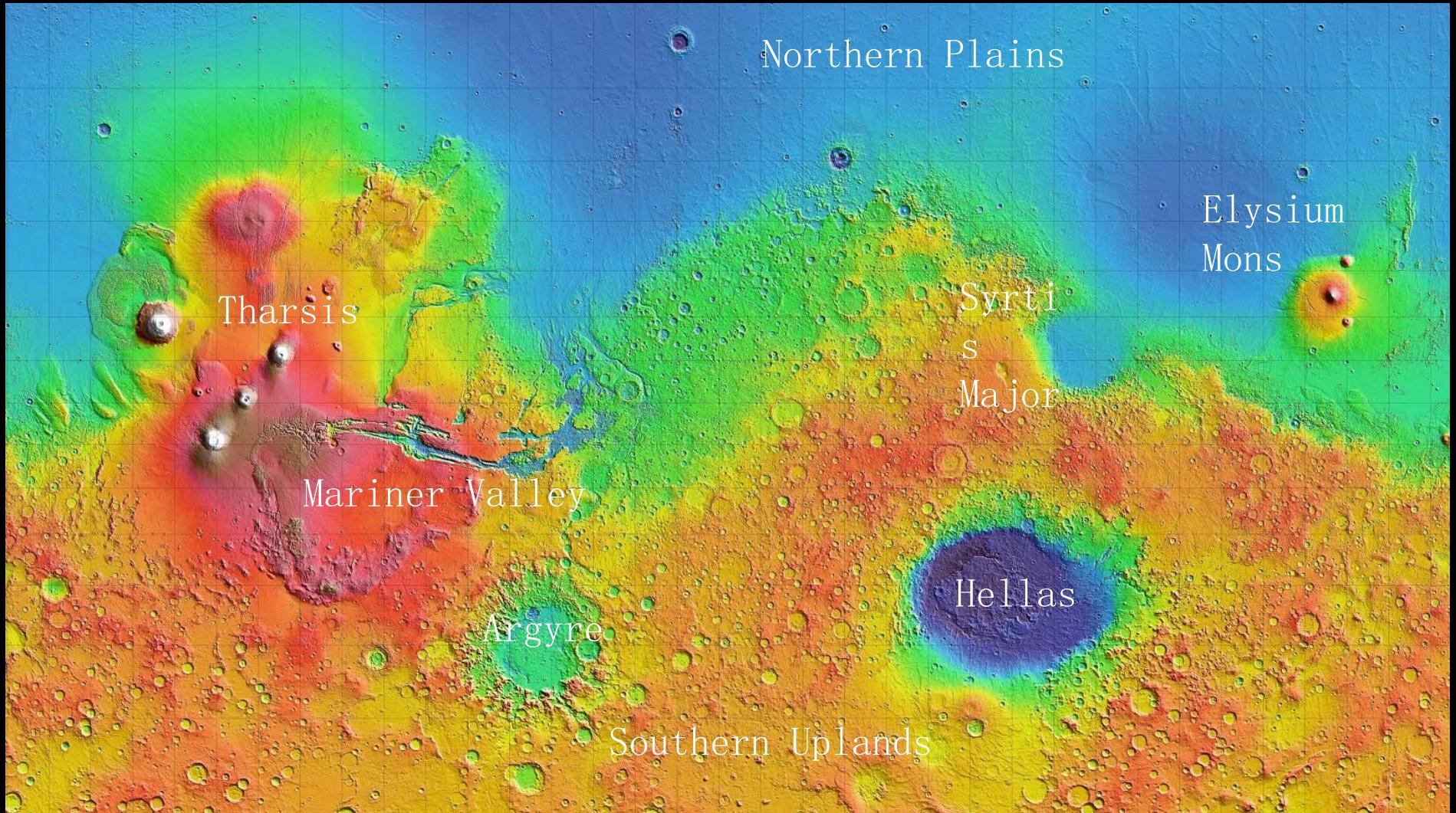


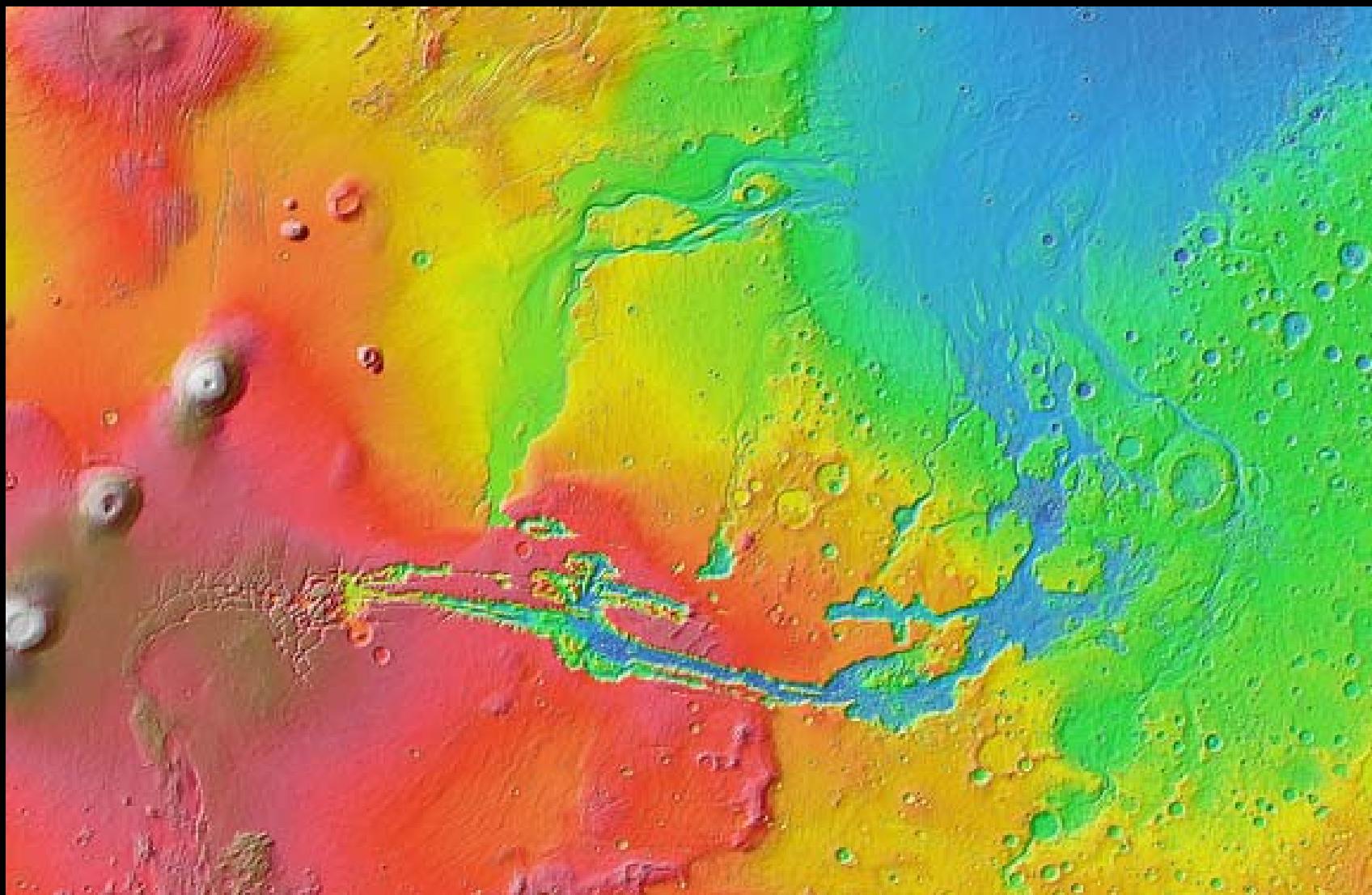
# Voyage to “Mars”

**... 14,000 km across Canada – and the  
Channelled Scablands of Washington State**

# Martian geography ...



# Outflow Channels ...



NASA

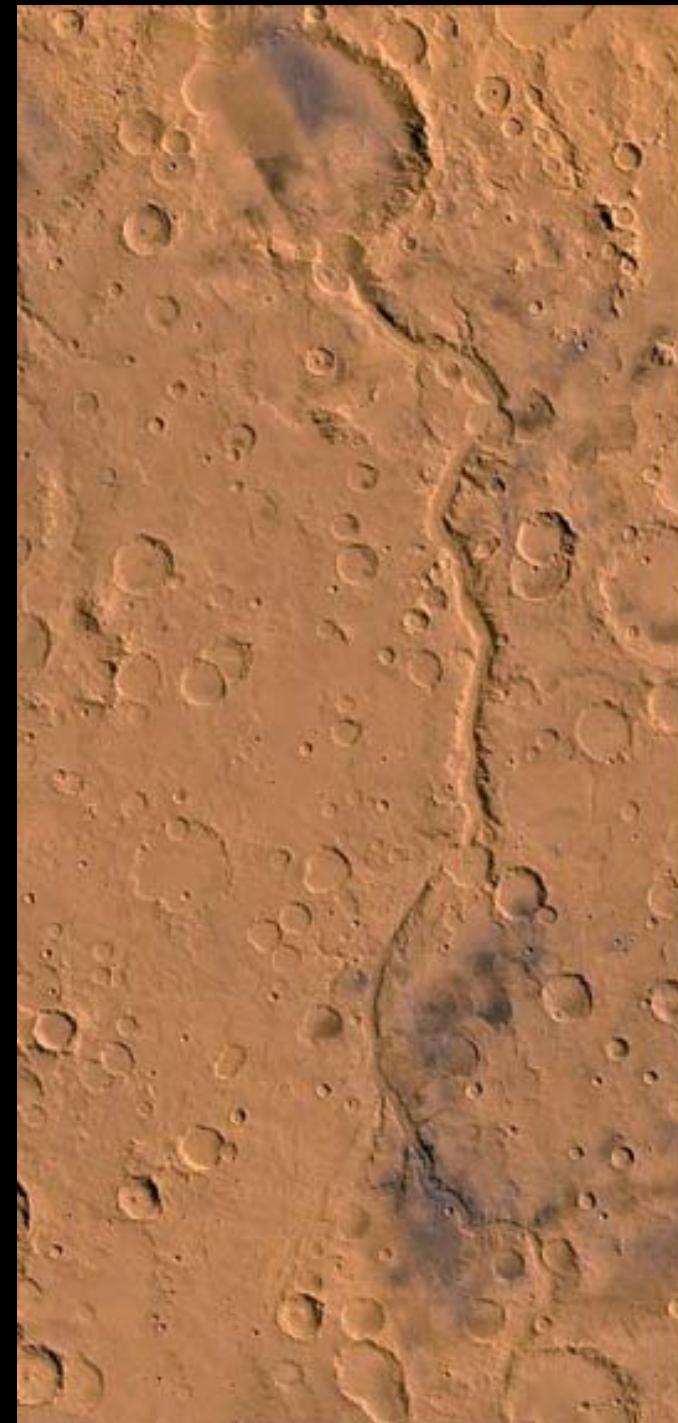
# Ma'adim Vallis

A curvilinear, flat bottomed channel

Steep sides ...

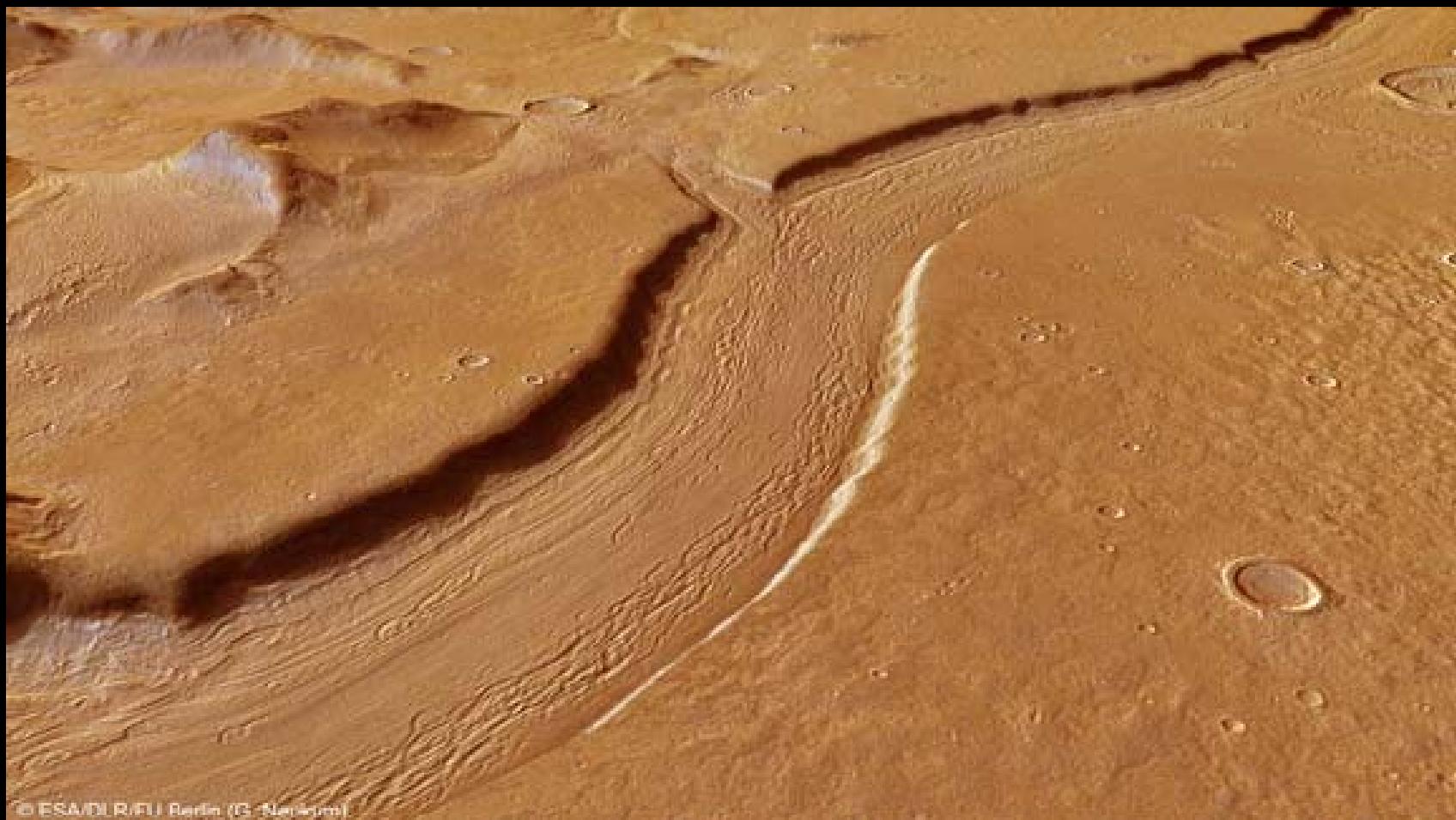
No tributaries ... not a “classical” river valley

*Emptied into Gusev Crater  
... home to the Spirit rover*



NASA

# Reull Vallis ...



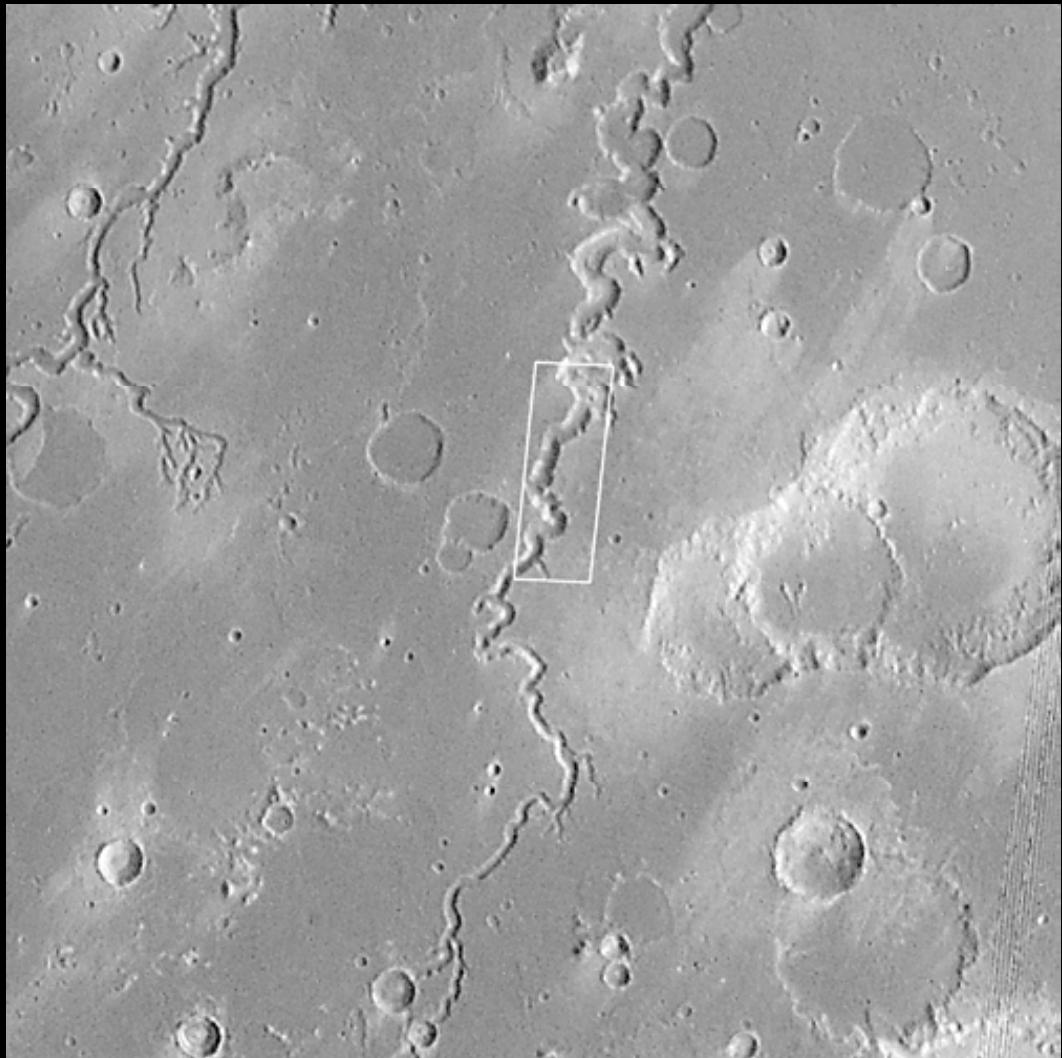
A curvilinear, flat bottomed channel

Steep sides ...

Very few tributaries ... not a "classical"  
river valley

ESA

# Nanedi Vallis ...



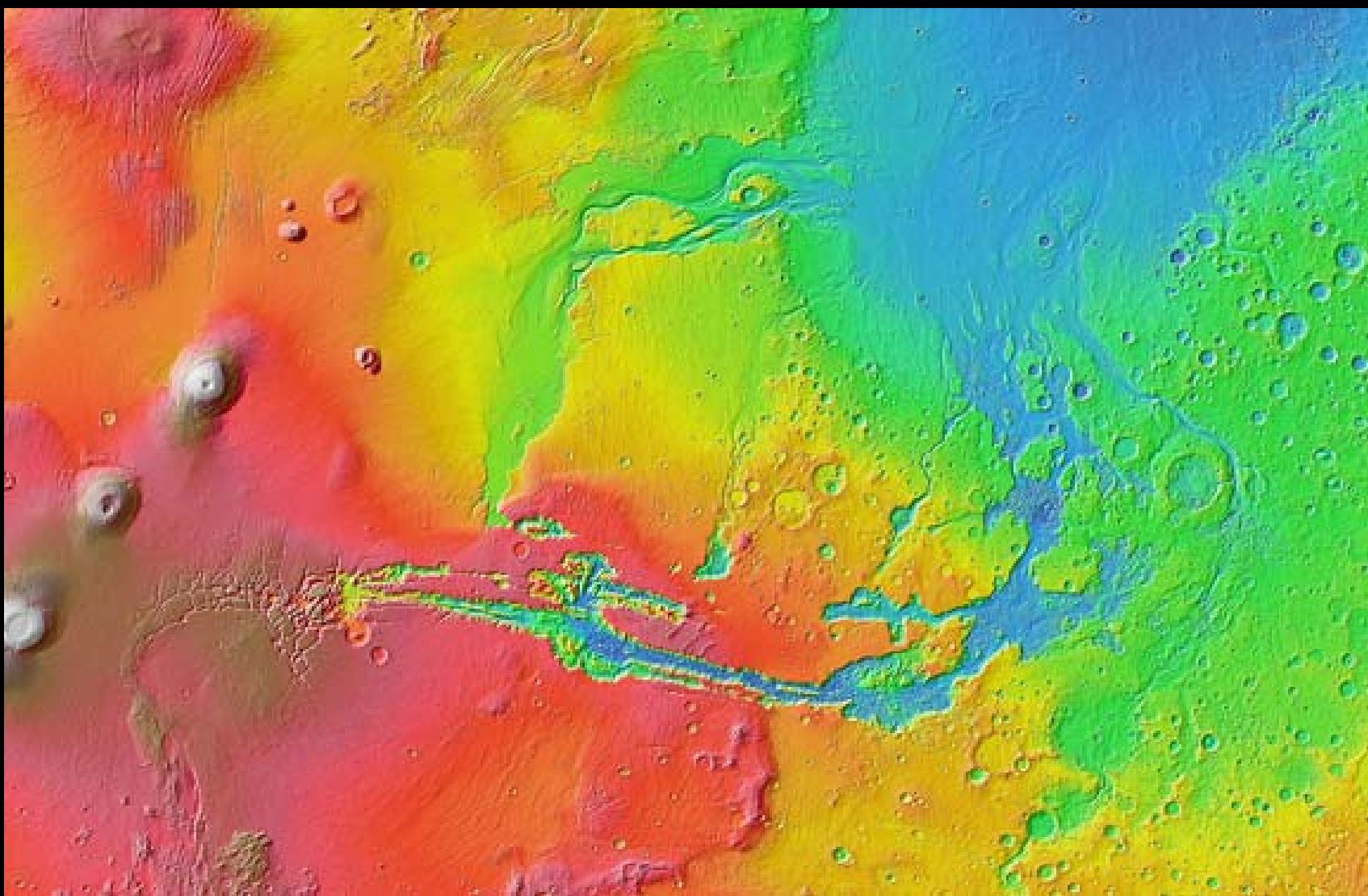
Few tributaries

Odd looking "meanders"



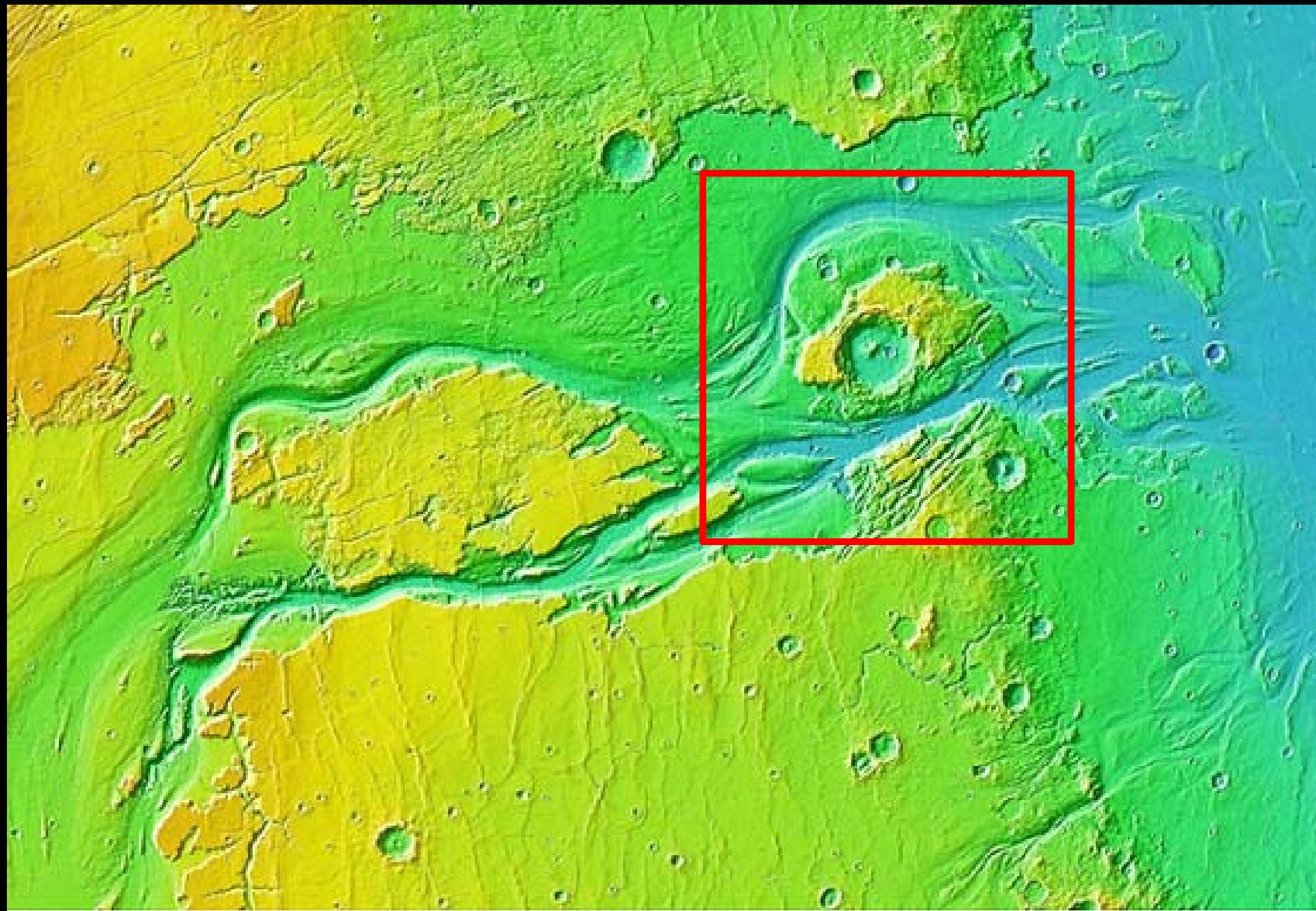
*NASA*

# Kasei Valles ...



NASA

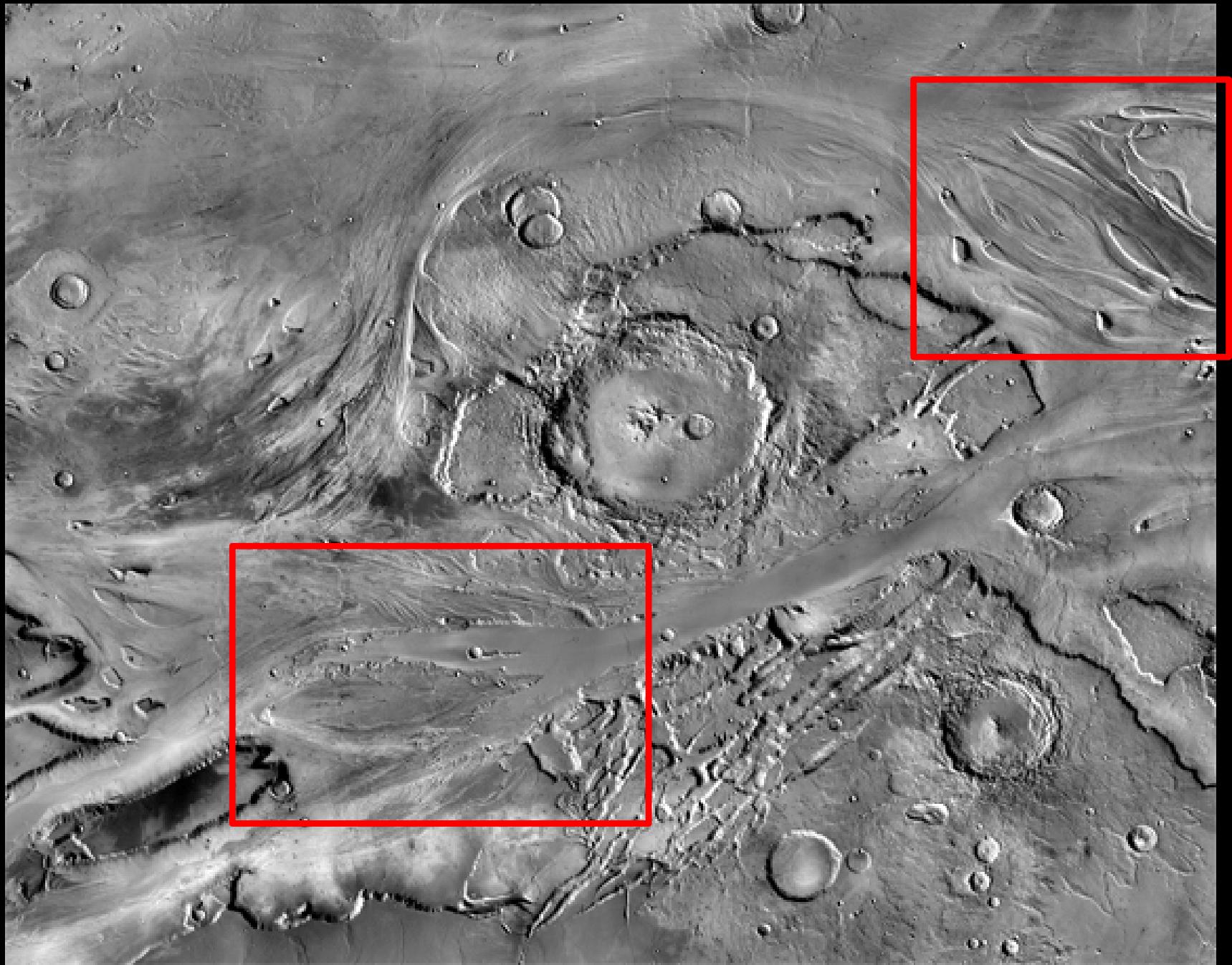
# Kasei Valles ...



NASA

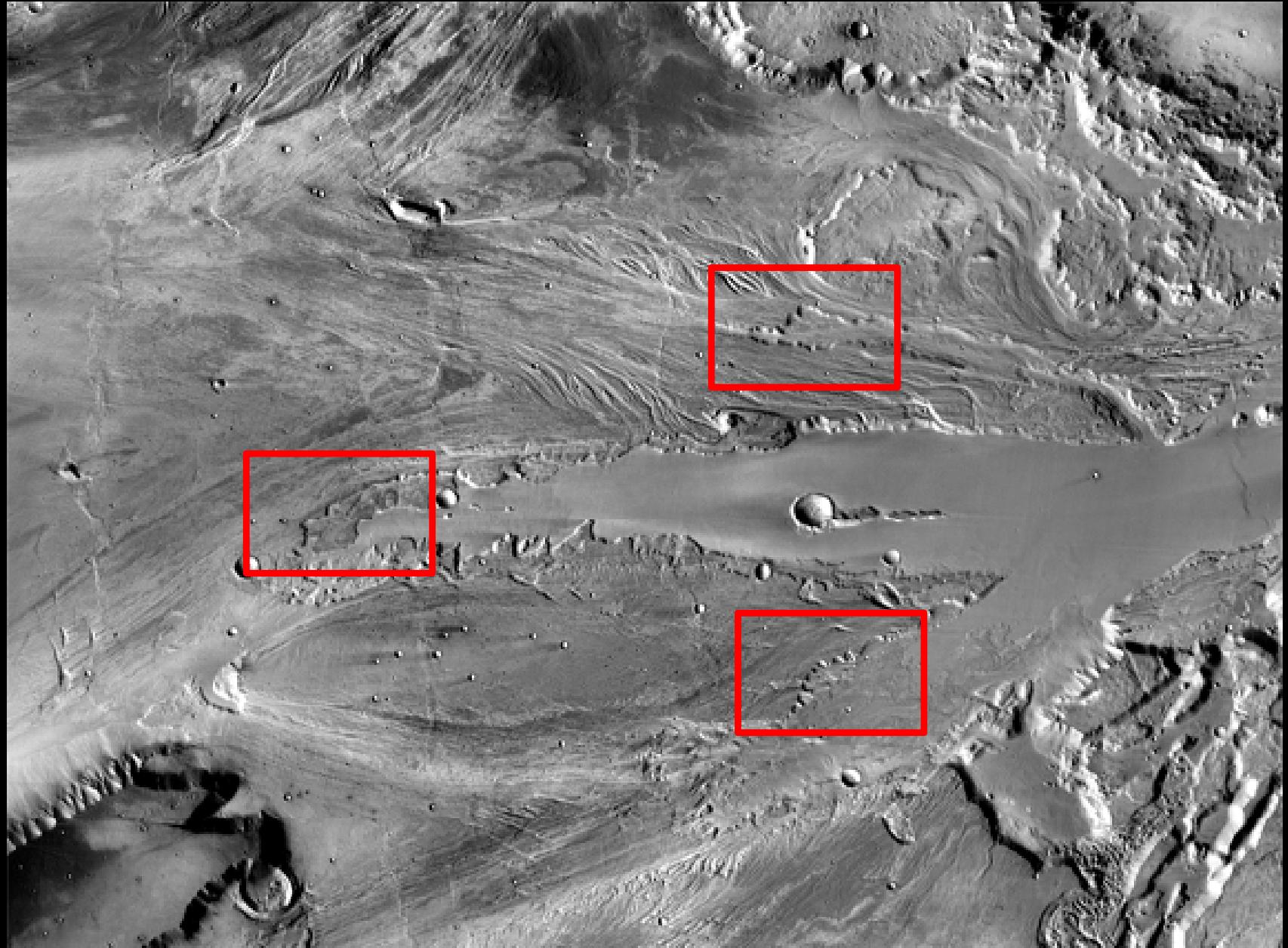
# Kasei Valles

...



# Kasei Valles

...



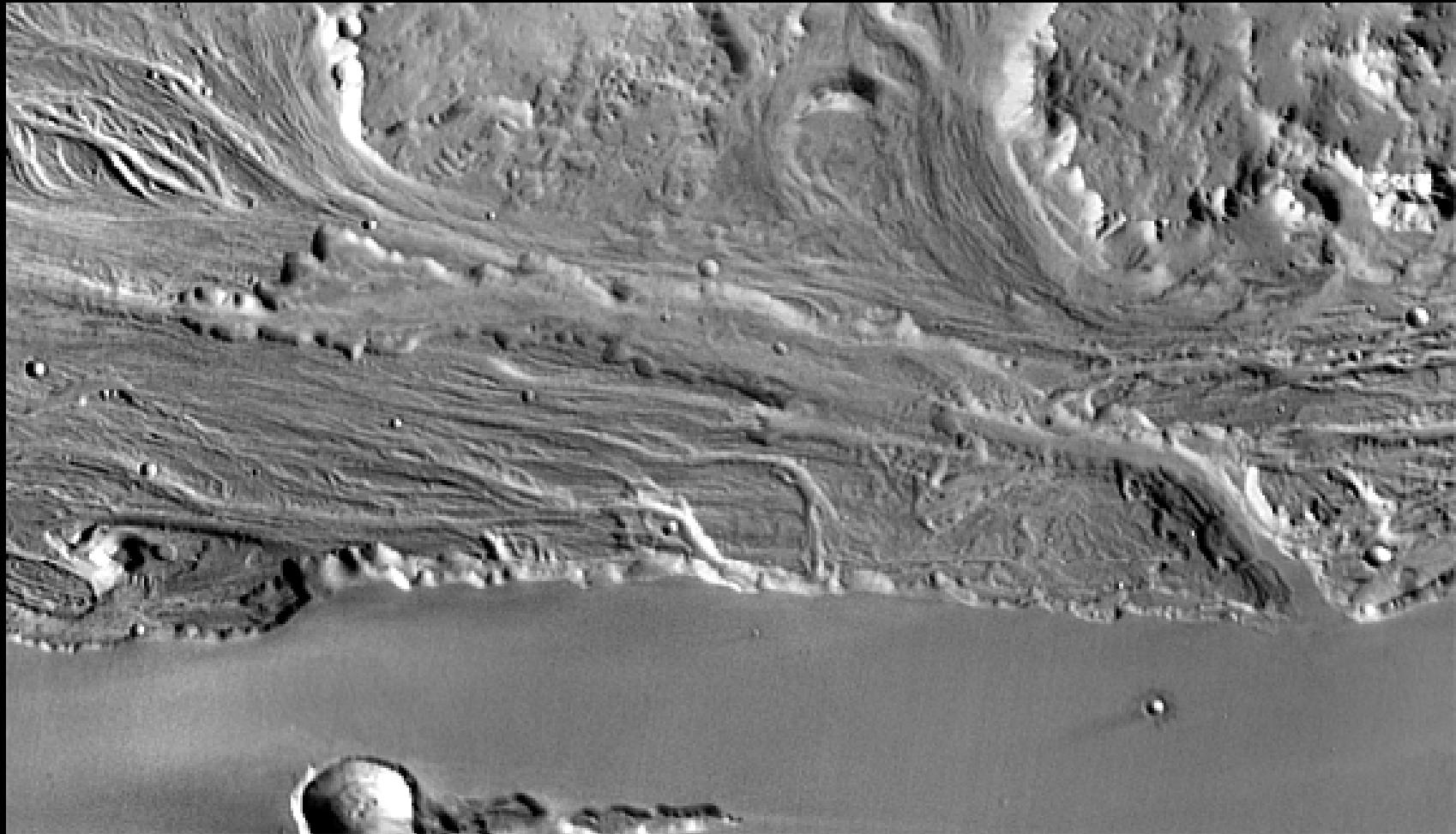
NASA

Niagara Falls ... *erosion @ 1 km per 1000 yrs*



# Kasei Valles

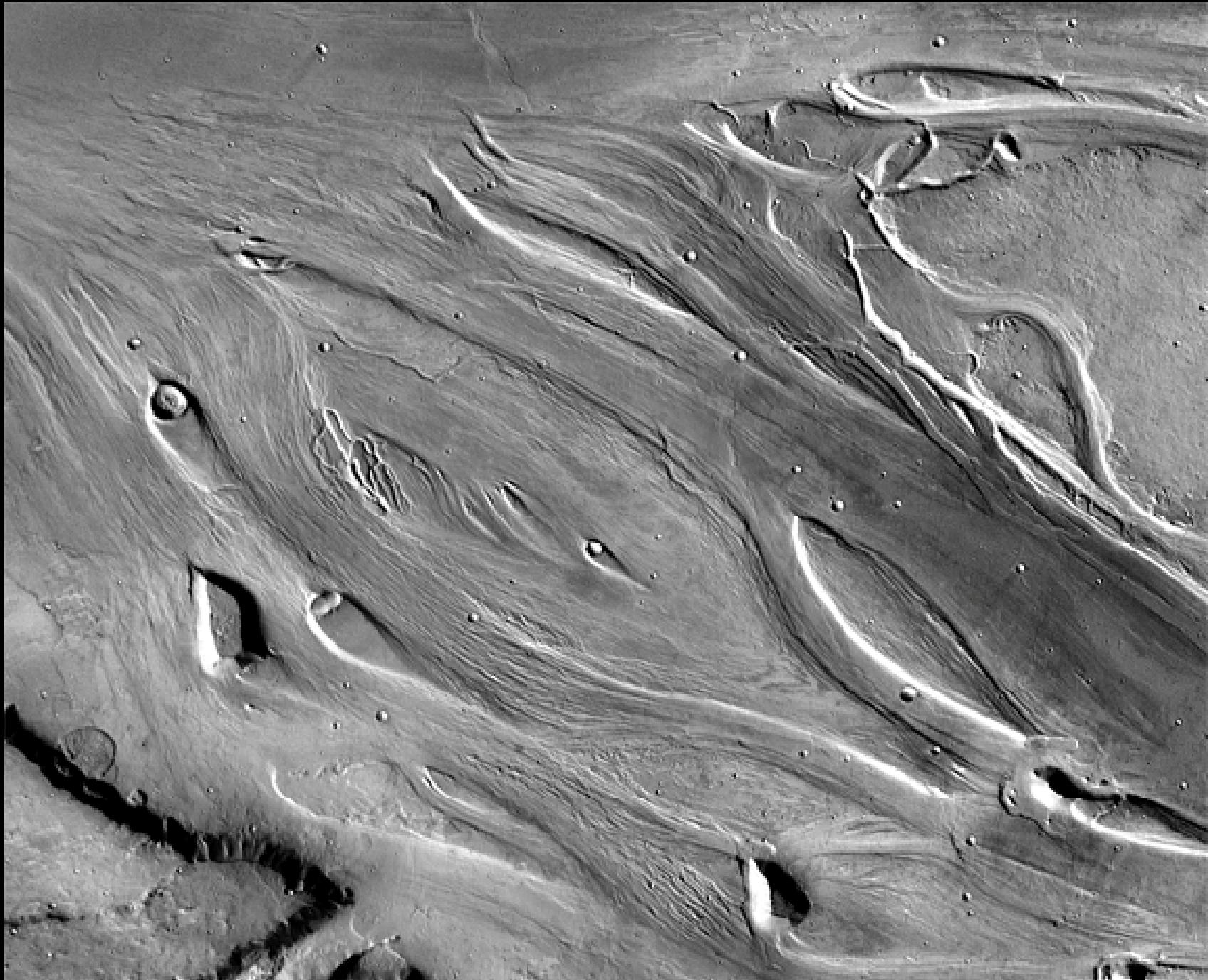
...



NASA

# Kasei Valles

...



Ma'adim

Ma'Adim VALLIS  
(floor near south end looking north)

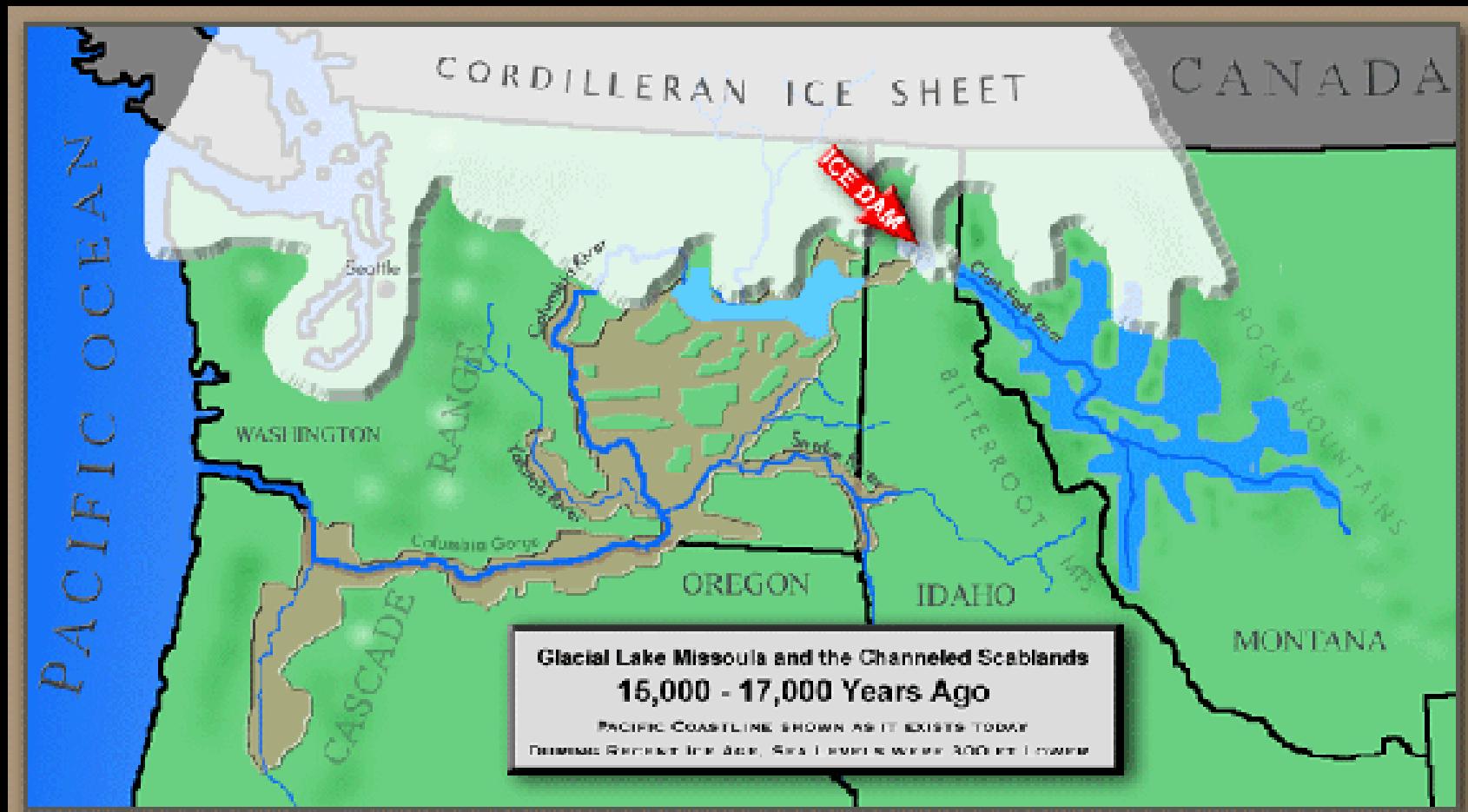
Why "catastrophic"  
?

Computer models !

There are alternative/minority models ...

Dave Knisely

# Channelled Scablands & Glacial Lake Missoula



Once upon a time ~15000 years ago ...

Harlen Bretz ...

*vindicated : 1970s*



# NW Ontario ... *road cuts* !



First, I had  
to get there

...

NW Ontario ... *and rolling topography !*



Prairies ... *curved horizon !*



# Prairies ...



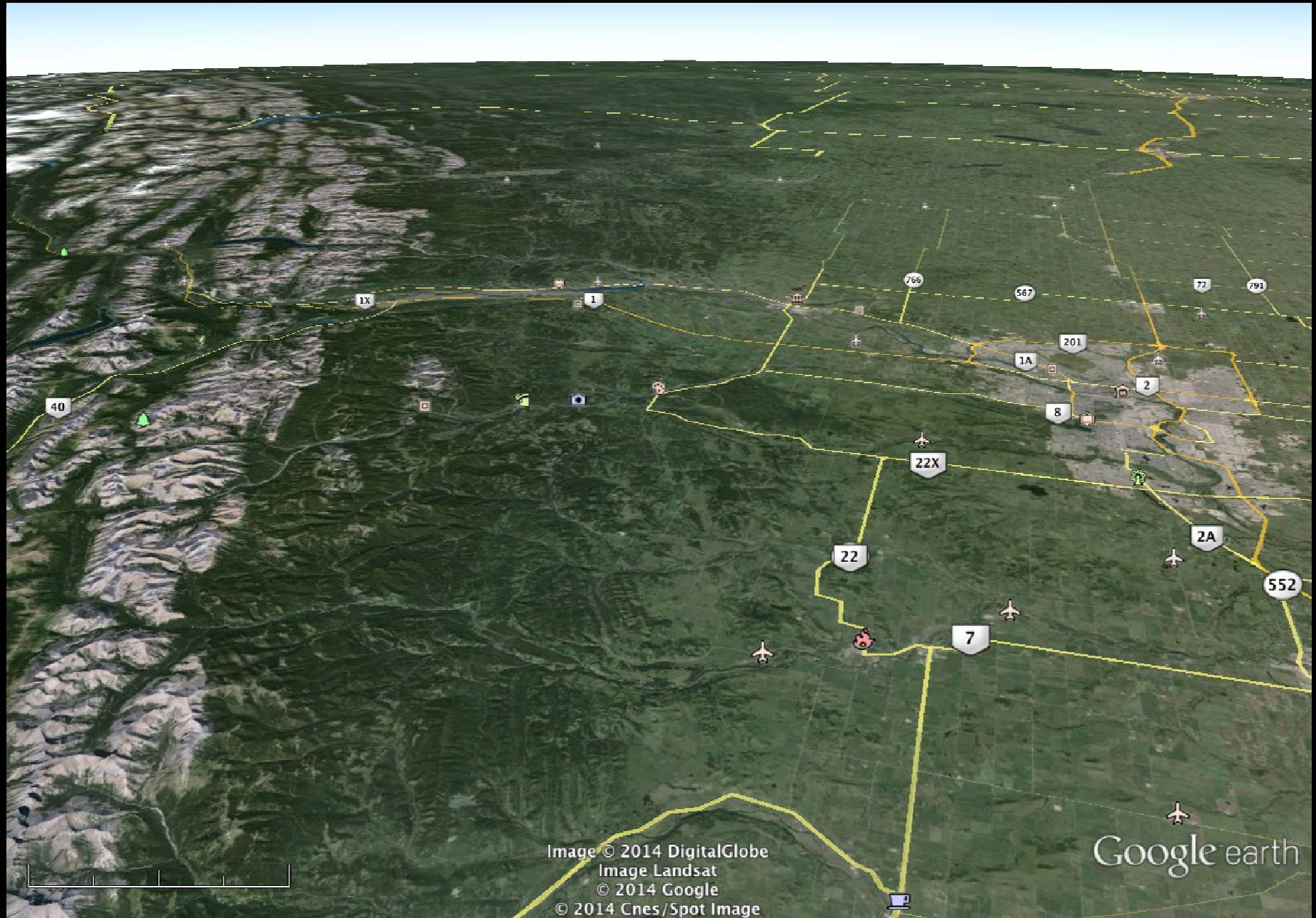
Image S. Alberta MD's and Counties  
© 2014 Google  
Image Landsat

Internet

Rocky Mountain Front ... *abrupt* !



# Rocky Mountain Front ... *abrupt* !



# Yoho National Park ... *the Burgess Shale*

Cambrian “explosion” ~550–500 Ma  
... and extinction !



Hiking up to the Burgess Shale ...



# Burgess Shale ... *Walcott "quarry"*



Burgess sponge ...



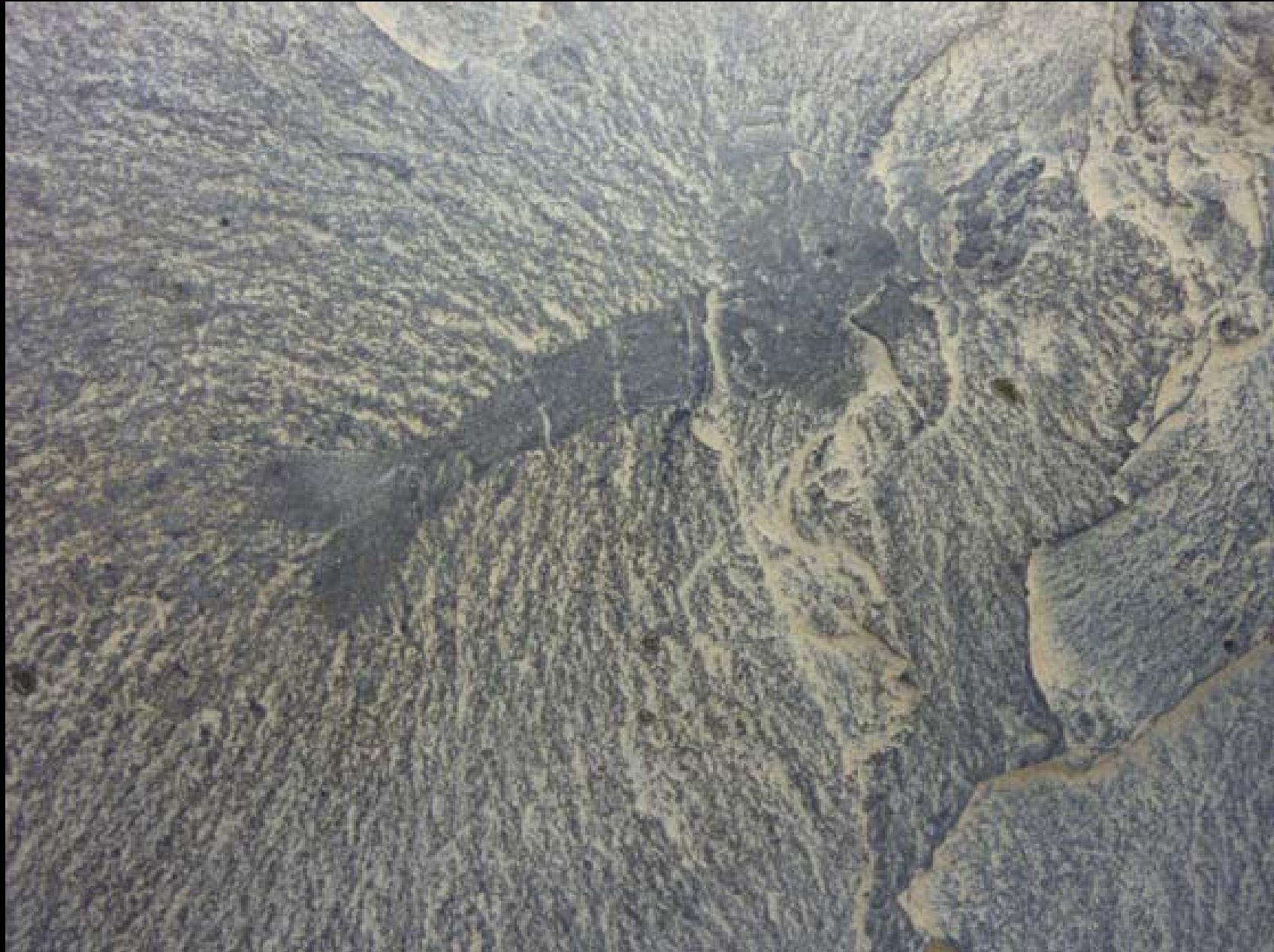
Burgess worm ... *visible gut* !



Burgess segmented worm ... *visible gut* !



Burgess “shrimp” ...



Burgess "squid" ...



Burgess segmented “bug” ...



Burgess trilobite ...



Burgess spiny trilobite ... *squished* !



Burgess *Anomalocaris* mouth appendage ...



Burgess *Anomalocaris* mouth ...



# Rocky Mountain Trench ...





# Grand Coulee ... *looking upstream*

Size ...



# Grand Coulee ... *looking downstream*

Horizontal lava flows ...



Moses Coulee ...

Zig-zag ...

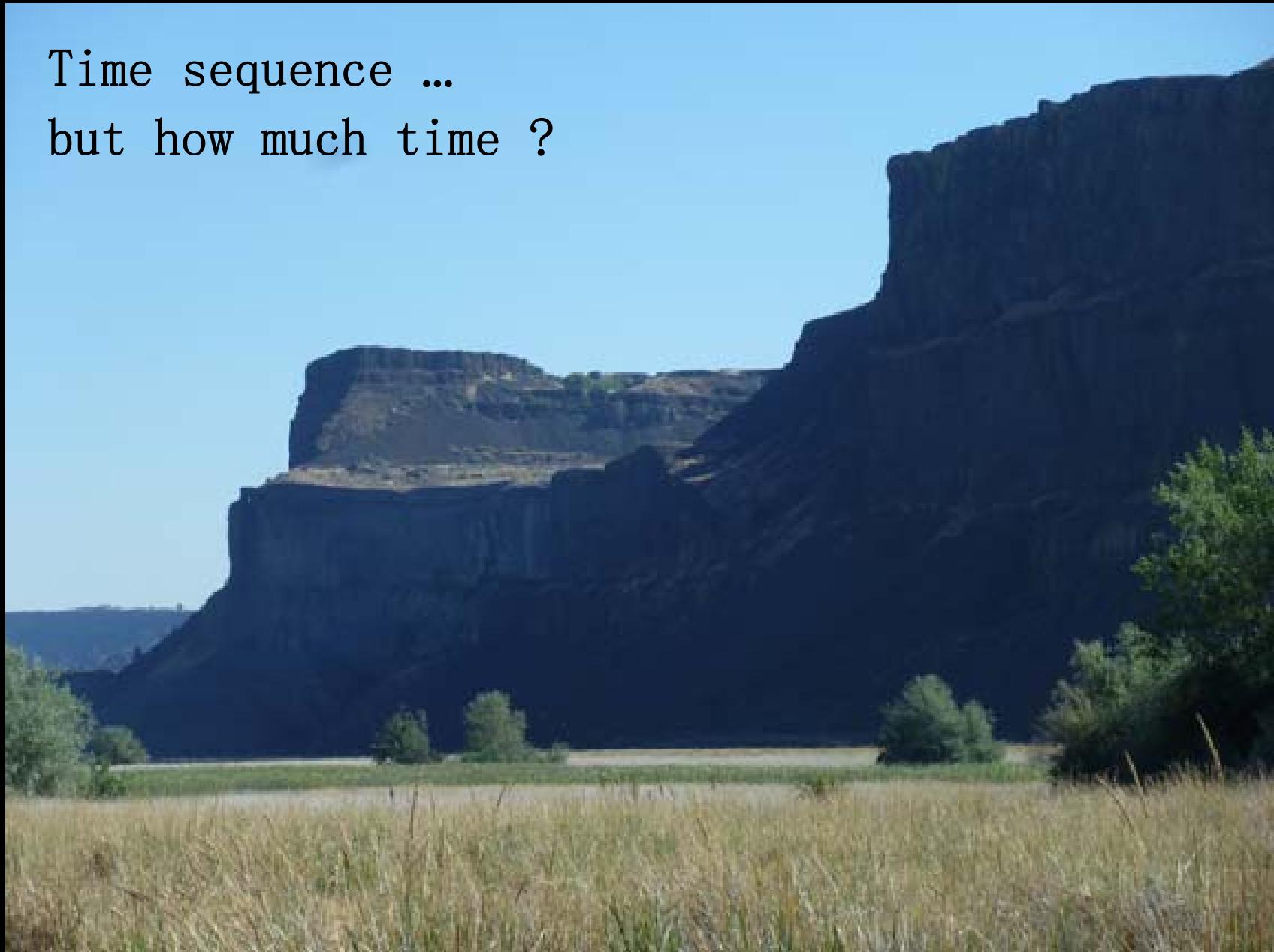


# Columbia Gorge ... *Wallula Gap*



# Grand Coulee ... *hanging valley*

Time sequence ...  
but how much time ?



Columnar-jointed basalt lava flows ...



Columnar-jointed basalt lava flows ...



# Palouse Falls ... *the role of receding cataracts*



# Palouse Falls ... *downstream*



# Nirgal Vallis ...



Few tributaries

Odd looking "meanders" = rounded corners ?

Dry Falls, Grand Coulee ... *western headwall*

Incised plain ...



# Dry Falls ... *twin headwalls and "blade"*

Incised plain ...



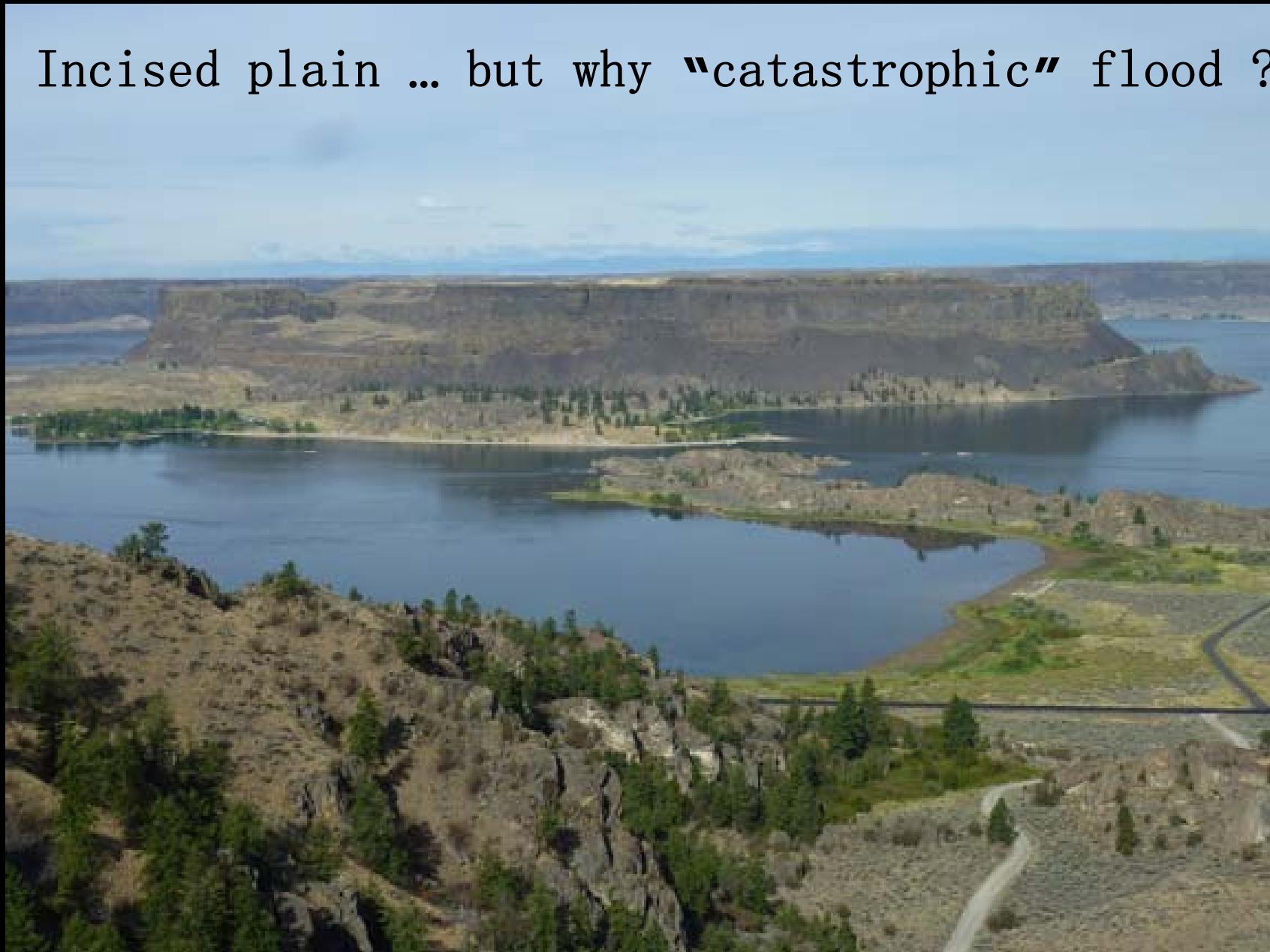
# Dry Falls, Grand Coulee ... *rocky "blade"*

Incised plain ...



# Steamboat Rock ... *isolated rocky "blade"*

Incised plain ... but why "catastrophic" flood ?



Ephrata Fan ... *covered with 1m+ basalt "shot"*



# Deep Lake Coulee ... *mega-potholes* in basalt



+ elevations ...

Streamlined island of sediment ... *flow to right* !

Why water ... ?



Streamlined island of sediment ... *flow to right!*

Why water ... ?



Streamlined island of sediment ... *flow to right* !

Why water ... ?



# Mega-sandbar ... *Columbia River*

Why water ... ?



# Mega-sandbar ... *mega current ripples*

Why water ... ?



# Mega current ripples ... *Snake River*

Why water ... ?



Streamlined island of sediment ...

*submerged !*

How deep ... ?



# Mega-island ... *submerged* - and fertile !



# Mega-island ... *submerged* – and fertile !

How deep ... ?



# Staircase Rapids ...



Staircase Rapids ... *and streamlined*

*is*

How fast ... ?



# Staircase Rapids ... *looking downstream*

How fast ... ?

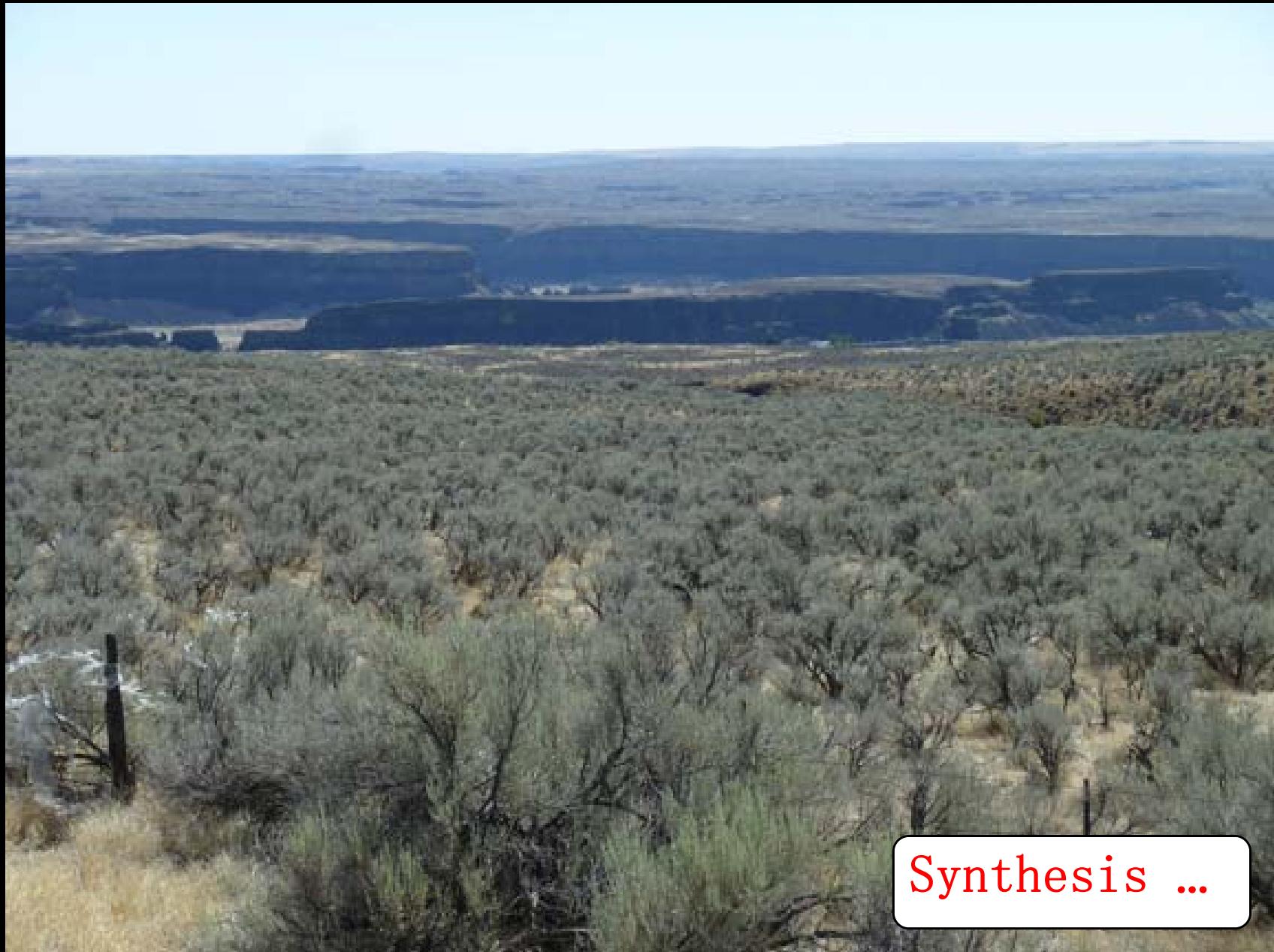


# Parting of the waters ... *Saddle Mountains*

Why deep, fast water ... ?

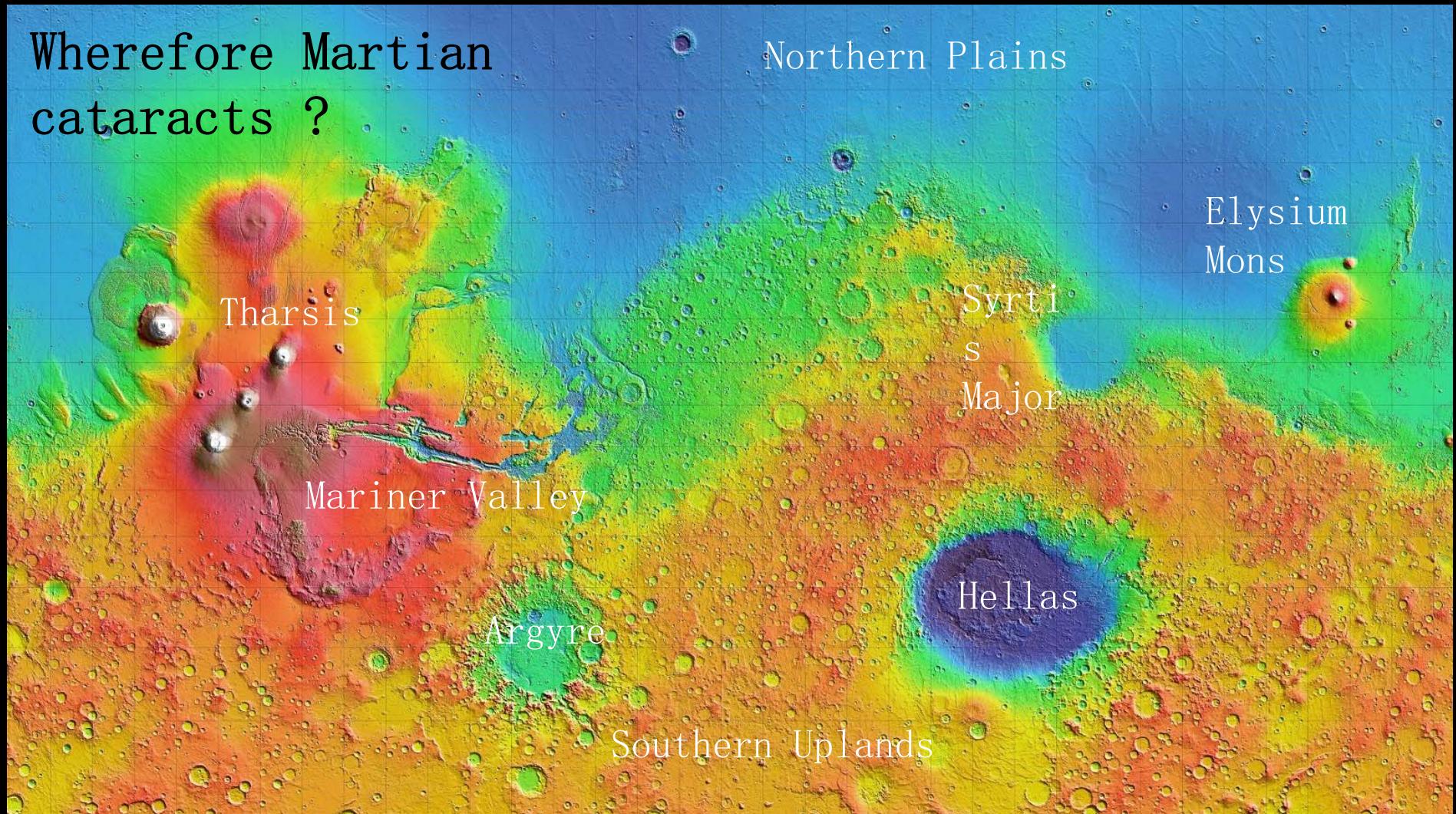


# Dry Falls, Grand Coulee ... *rocky "blade"*



Synthesis ...

# Martian geography ...



Summary ...

Badlands ... *Dinosaur Provincial Park,*

*Alb*

The return trip ...



# Badlands ... *Red Deer Valley*



# Badlands sediments ... *dinosaurs and coal*



# Tyrrell Museum ... *Drumheller*



# Tyrrell Museum ...



# Tyrrell Museum ...



# Tyrrell Museum ...



# Tyrrell Museum ...



# Tyrrell Museum ...



Tyrrell Museum ...



# Tyrrell Museum ...



Tyrrell Museum ...



# Tyrrell Museum ...



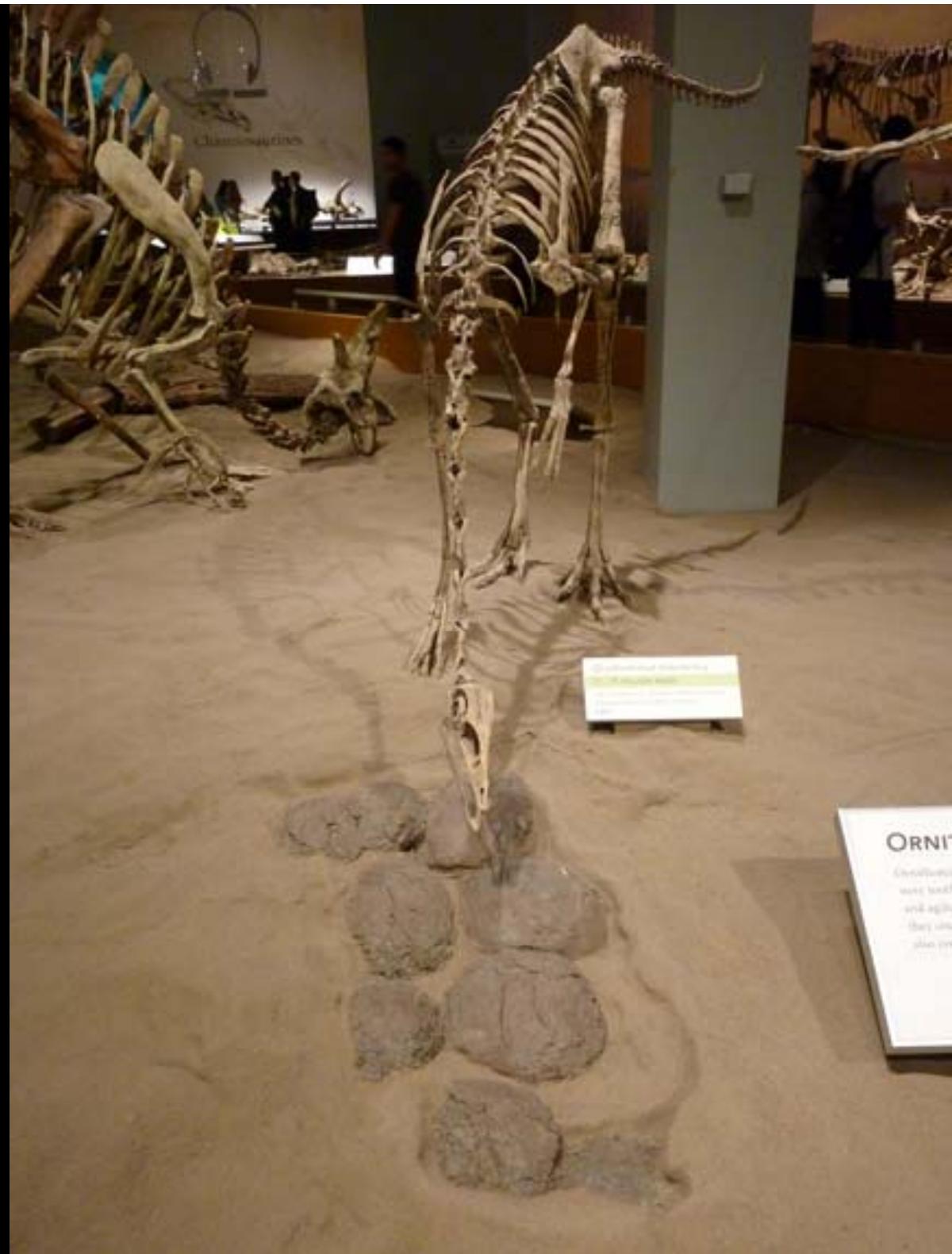
Tyrrell Museum ...



# Tyrrell Museum ...



# Tyrrell Museum ...



# Tyrrell Museum ...



Tyrrell Museum ...



Tyrrell Museum ...



# Tyrrell Museum ... *a criticism!*

