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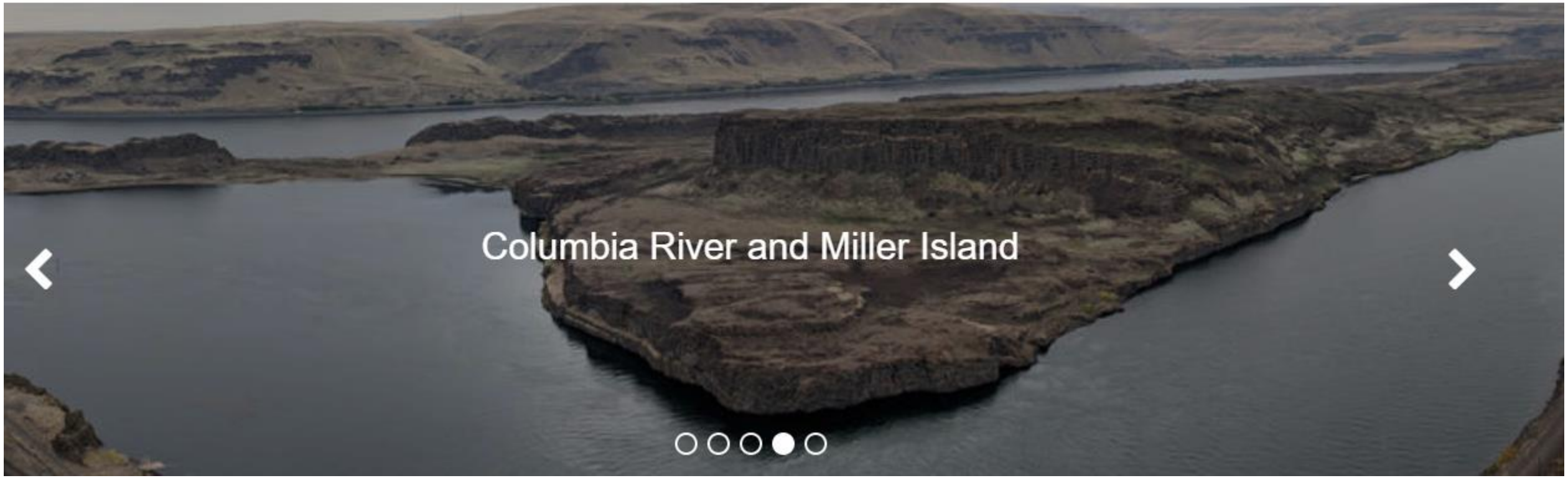
Geology, Minerals, Energy, and Geophysics Science Center

Pacific Northwest Geologic Mapping: Northern Pacific Border, Cascades and Columbia



Jim O'Connor (oconnor@usgs.gov)
https://www.usgs.gov/centers/gmeg/science/pacific-northwest-geologic-mapping-northern-pacific-border-cascades-and?qt-science_center_objects=0#qt-science_center_objects

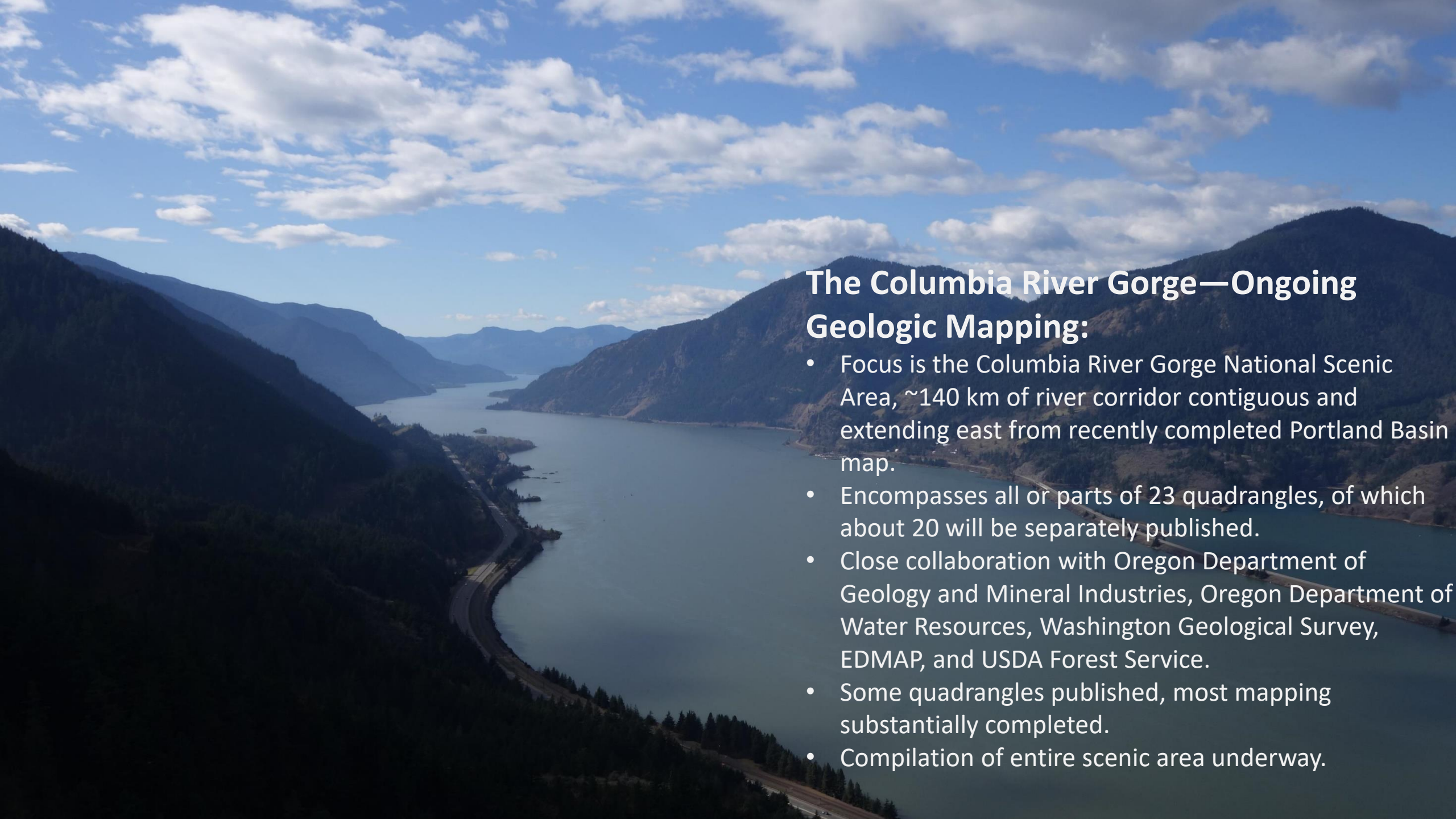
U.S.G.S. Pacific Northwest Mapping Project

Project research objectives and societal themes

Overarching objective: Framework geologic mapping and analysis in the U.S. Pacific Northwest to support assessment of hazards, resources, ecosystems, and landscape evolution in this geologically dynamic and unique setting.

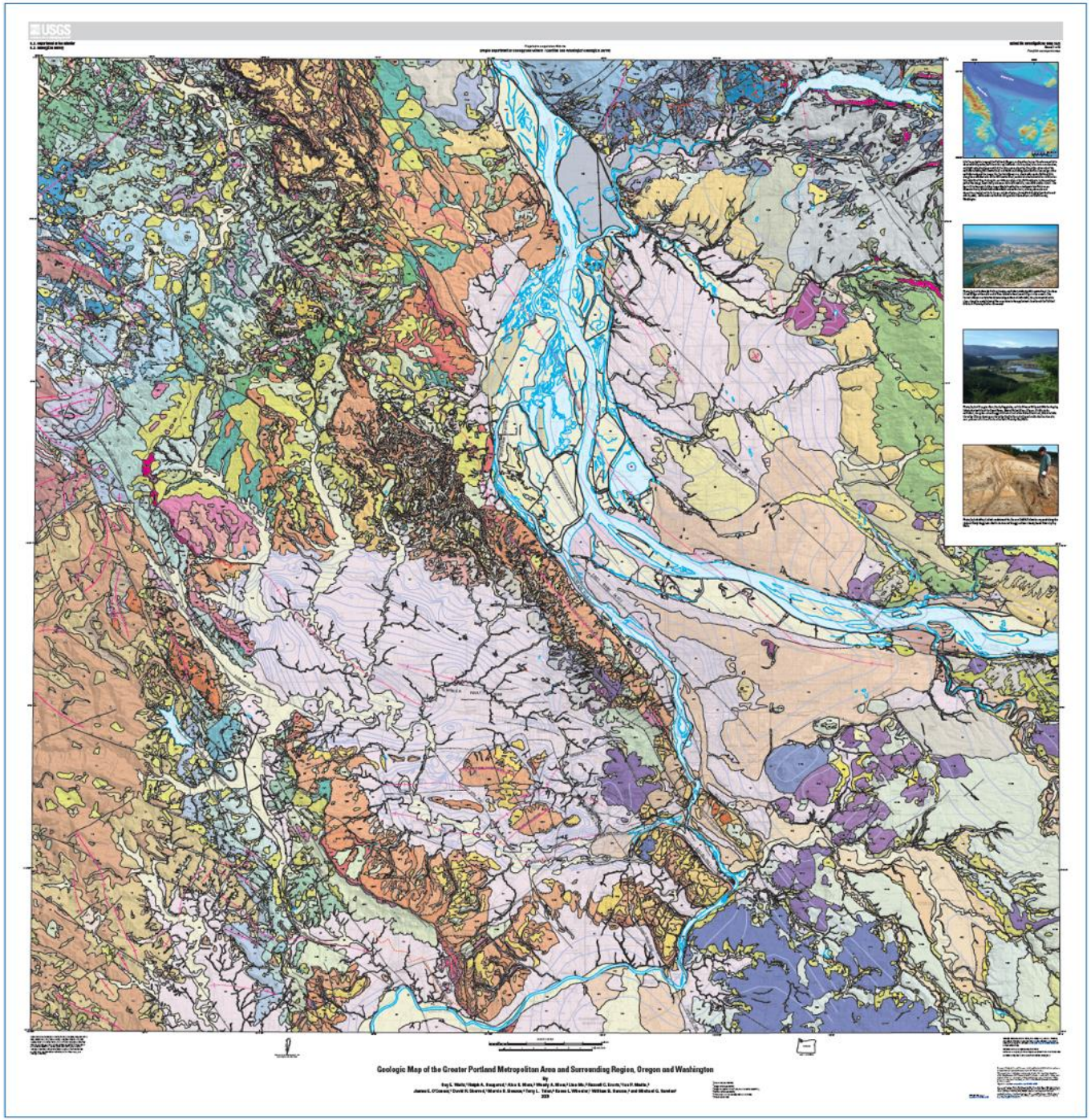
Main activities:

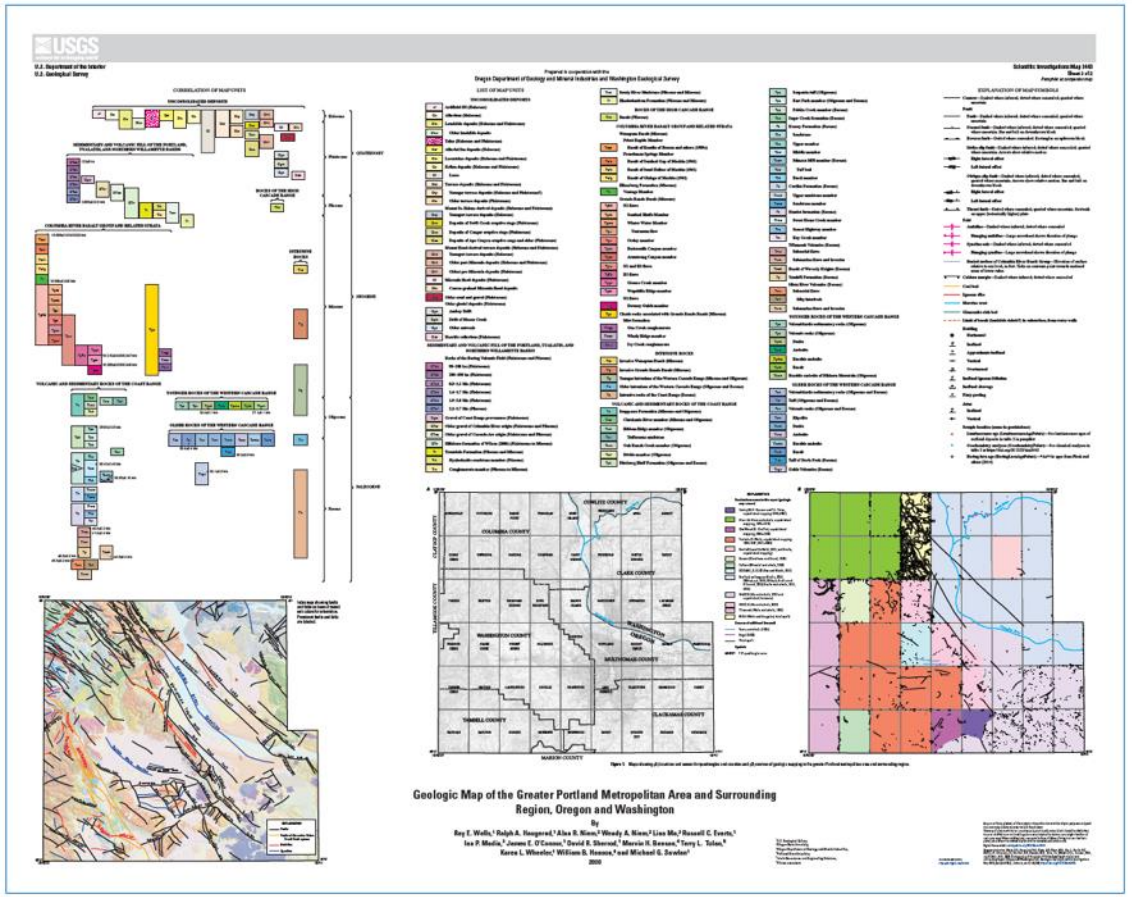
- Geologic and geophysical mapping at a wide range of scales.
- Stratigraphy, geochemistry, geochronology, and deformation of the Columbia River Basalt Group.
- Tectonic history of the Pacific Northwest, focused on faulting and seismic hazards.
- History of the Columbia River and its tributaries, focused on 1) late Cenozoic drainage development and landscape evolution; 2) Quaternary flooding, landslides, and volcanism; and 3) Geomorphic processes and ecosystems.



The Columbia River Gorge—Ongoing Geologic Mapping:

- Focus is the Columbia River Gorge National Scenic Area, ~140 km of river corridor contiguous and extending east from recently completed Portland Basin map.
- Encompasses all or parts of 23 quadrangles, of which about 20 will be separately published.
- Close collaboration with Oregon Department of Geology and Mineral Industries, Oregon Department of Water Resources, Washington Geological Survey, EDMAP, and USDA Forest Service.
- Some quadrangles published, most mapping substantially completed.
- Compilation of entire scenic area underway.

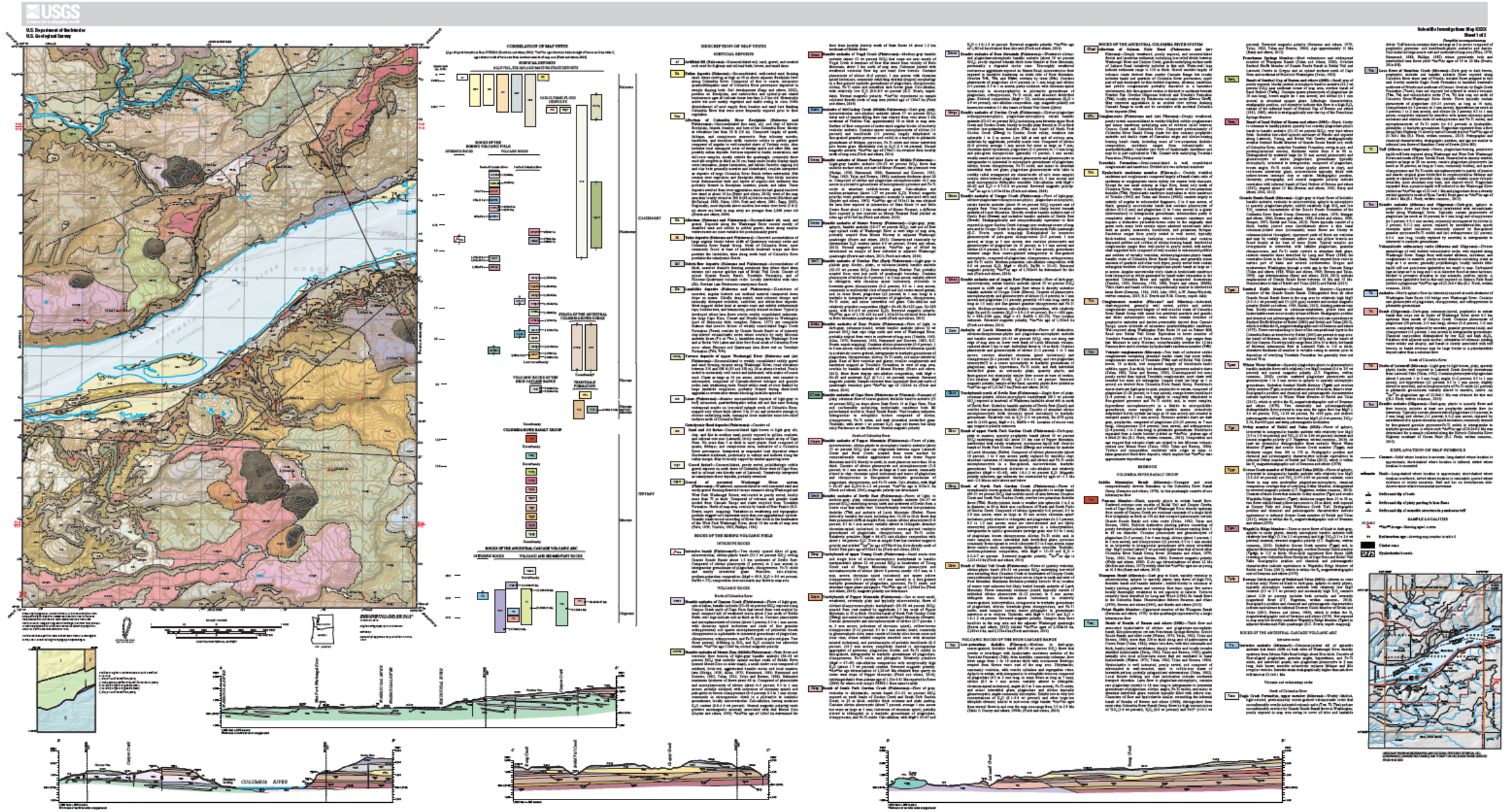




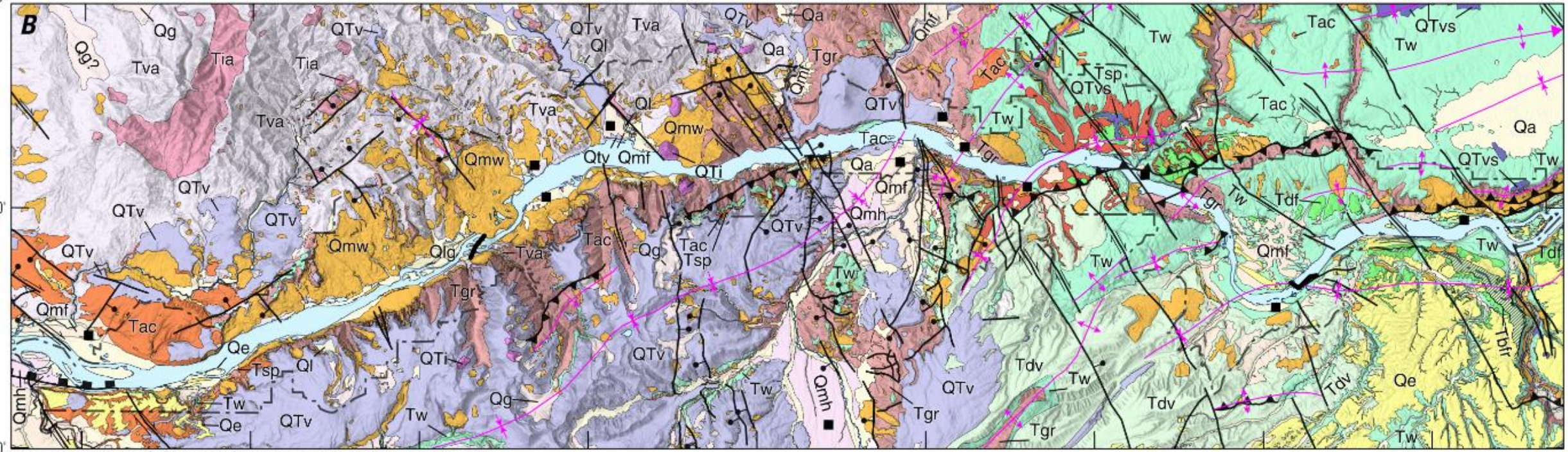
Portland metro area geologic map

SIM 3443, 2020, Wells, Haugerud, and 13 coauthors. 24K geodatabase covering 2500 mi^2

TASK 2: Columbia Corridor Mapping



Bridal Veil, in press



Base modified from U.S. Geological Survey The National Map digital data, 2021
100-meter contours and shaded relief calculated from lidar acquired 2002 to 2019

SURFICIAL DEPOSITS

- Qa — Alluvial deposits (Quaternary)
- Qlg — Lake-of-the-Gods outburst (Holocene)
- Qe — Eolian deposits (Quaternary)
- Ql — Lacustrine deposits (Quaternary)
- Qmw — Mass wasting deposits (Quaternary)
- Qmh — Mt. Hood alluvium and lahars (Quaternary)
- Qmf — Cataclysmic-flood deposits (Pleistocene)
- Qg — Glacial till and outwash (Pleistocene)

BEDROCK

- QTv — High Cascades and Boring volcanic field (Late Miocene to Quaternary)
- QTi — Intrusive (Late Miocene to Quaternary)
- QTvs — Simcoe volcanic field (Pliocene to Quaternary)
- Tbfr — Basalt of Fulton Ridge (Late Miocene)—Hatched where eolian-concealed
- Tdf — Non-Columbia River fluvial, mostly in Dalles Fm. (Miocene to Pliocene)
- Tdv — Volcaniclastic rocks, mostly in Dalles Fm. (Miocene to Pliocene)
- Tac — Ancestral Columbia River system (Miocene to Pliocene)

Columbia River Basalt Group

- Tsp — Saddle Mtns. Basalt, Pomona Member (Miocene)
- Tw — Wanapum Basalt (Miocene)
- Tgr — Grande Ronde Basalt (Miocene)

Ancestral Cascade volcanic arc

- Tva — Volcanic and sedimentary (Oligocene to Miocene)
- Tia — Intrusive (Oligocene to Miocene)

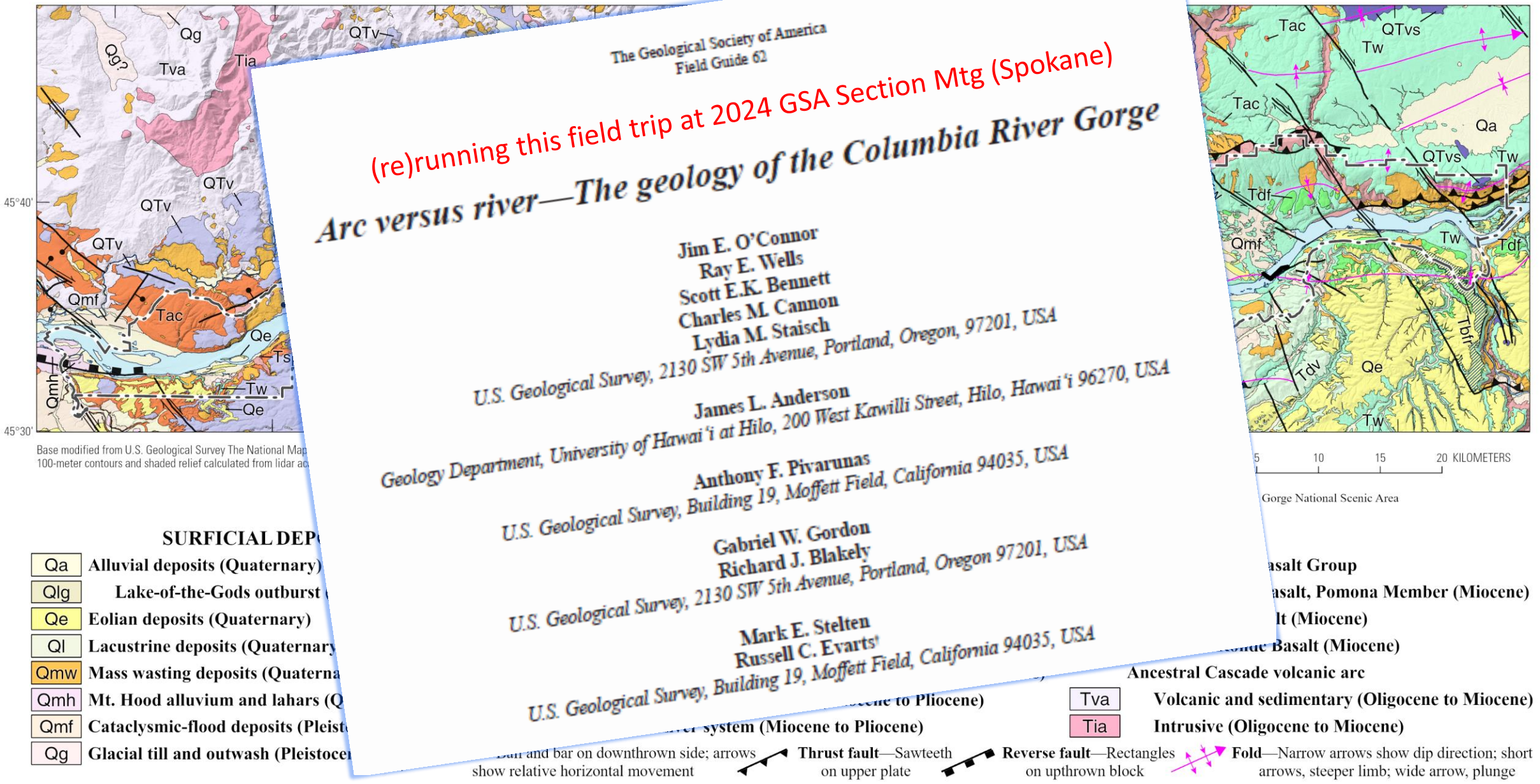
Fault—Ball and bar on downthrown side; arrows show relative horizontal movement

Thrust fault—Sawteeth on upper plate

Reverse fault—Rectangles on upthrown block

Fold—Narrow arrows show dip direction; short arrows, steeper limb; wide arrow, plunge

TASK 2: Columbia Corridor Mapping



The Geological Society of America
Field Guide 62

(re)running this field trip at 2024 GSA Section Mtg (Spokane)

Arc versus river—The geology of the Columbia River Gorge

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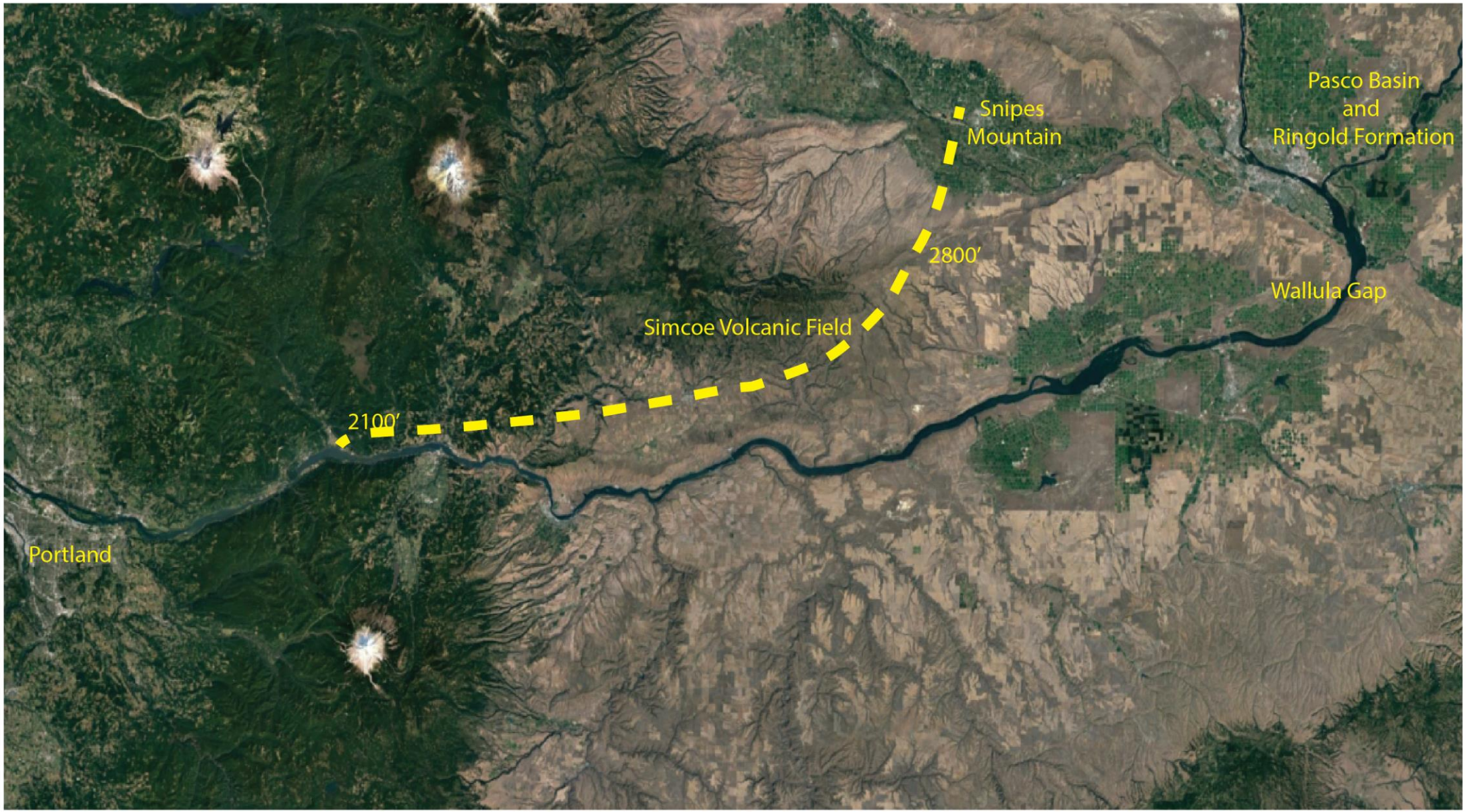
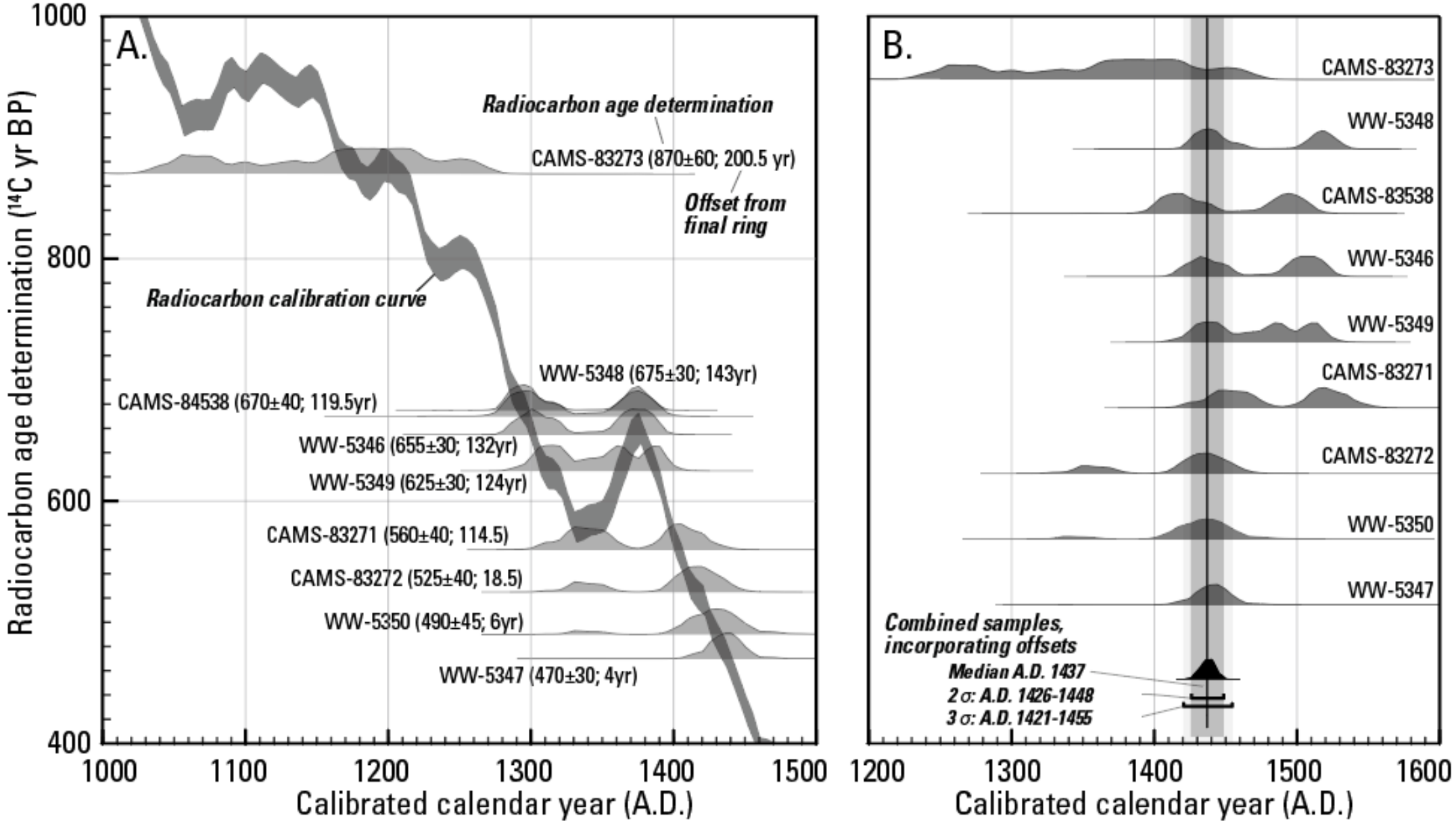
Compilation by Charles Cannon and team (in O'Connor et al., 2021 GSA Fieldtrip Guide)



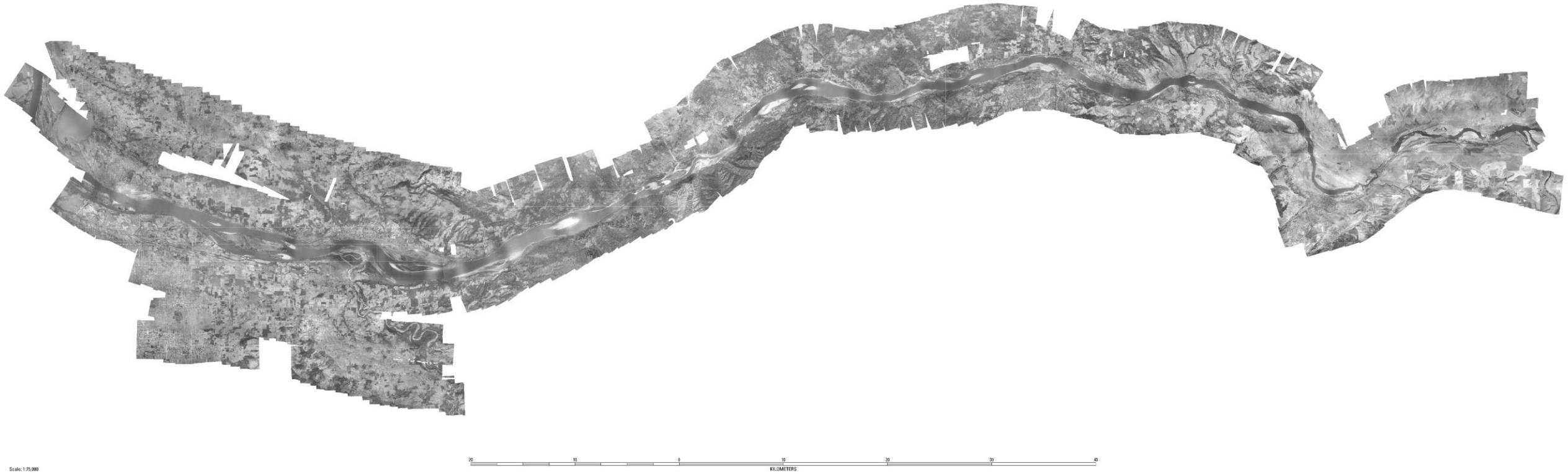
Post 5.2 Ma shift of the Columbia River to present Wallula Gap route
Causes and implications?


BONNEVILLE LANDSLIDE
BRIDGE OF THE GODS
WASHINGTON STATE DEPT OF NATURAL RESOURCES
WASHINGTON GEOLOGICAL SURVEY
Hundreds of years ago, an entire hillside along the Columbia River collapsed in a massive landslide covering an area of about six square miles. The Bonneville landslide was so huge that it created a natural dam in the Columbia River, forming a temporary lake stretching all the way to Wallula Gap, 150 miles upriver. The deposit is known as the "Bridge of the Gods", because it temporarily connected the land on both sides of the Columbia River. The modern-day bridge at Cascade Locks is named after this prehistoric land bridge.
The Bonneville landslide's headscarp is exposed on Table Mountain, which has an almost vertical 800-foot-tall open face close to its peak. Table Mountain is composed of Columbia River Basalt (CRB) lava flows, that sit on top of the sedimentary Eagle Creek Formation. The sedimentary rock weathers into clay as water trickles down through cracks in the CRB lavas. The Bonneville landslide, like many of the large landslides in the Cascade landslide complex, was activated when CRBs slid along this weak clay layer.
WASHINGTON
location
Greenleaf Peak
CASCADE LANDSLIDE COMPLEX
The Bonneville landslide is just one of several overlapping landslides within the much larger Cascade landslide complex.
Table Mountain
Greenleaf Basin
Red Bluffs
headscarp
Red Bluffs landslide
Crescent Lake landslide
Greenleaf Basin rock avalanche
Bonneville landslide
Sacajawea and Papoose Rocks
Carpenters Lake landslide
Hot Springs landslide
The Piper Road landslide activated in 2007 after heavy rainfall. The slide affected two homes and threatened nearby infrastructure. More than 1.5 million dollars was spent to mitigate the hazard.
Rock Creek
Landslides often have hummocky topography—uneven terrain made up of large blocks of land deposited during the landslide.
Many of the lakes on the Bonneville landslide are large sag ponds—bodies of water that occupy depressions in the landslide deposit.
Before construction of the Bonneville Dam, this was the site of the Cascades Rapids
present-day Bridge of the Gods
SR 14 EVERGREEN HIGHWAY
PACIFIC CREST NATIONAL SCENIC TRAIL (PCT)
After crossing into Washington, thru-hikers on the Pacific Crest National Scenic Trail (PCT) traverse several miles of the Bonneville landslide on their way north to Canada.
APPROXIMATE LOCATION OF THE ORIGINAL "BRIDGE OF THE GODS"
APPROXIMATE ORIGINAL EXTENT OF BONNEVILLE LANDSLIDE
Cascades Island
Bradford Island
BONNEVILLE DAM
Robins Island
NORTH BONNEVILLE
WASHINGTON
Columbia River
US INTERSTATE 84
OREGON
Greenleaf Slough
Greenleaf Creek

FIG. 8—Partly excavated Douglas fir stump of the Wyeth group, showing well preserved bark below the level of the silt surface. Looking northwestward. (Aug. 27, 1934)



By radiocarbon: A.D. 1426-1448; By (tentative) tree-ring correlation, A.D. 1446-1447



718 scanned 1935 pre-dam U.S. Army Corps of Engineer Photos
I-5 to Deschutes River
Orthomosaicked and georeferenced
Agisoft Photoscan in conjunction with lidar to create digital elevation models
https://doi.org/10.5066/P1ELGYBG

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http://pubs.usgs.gov/of/2011/1228/

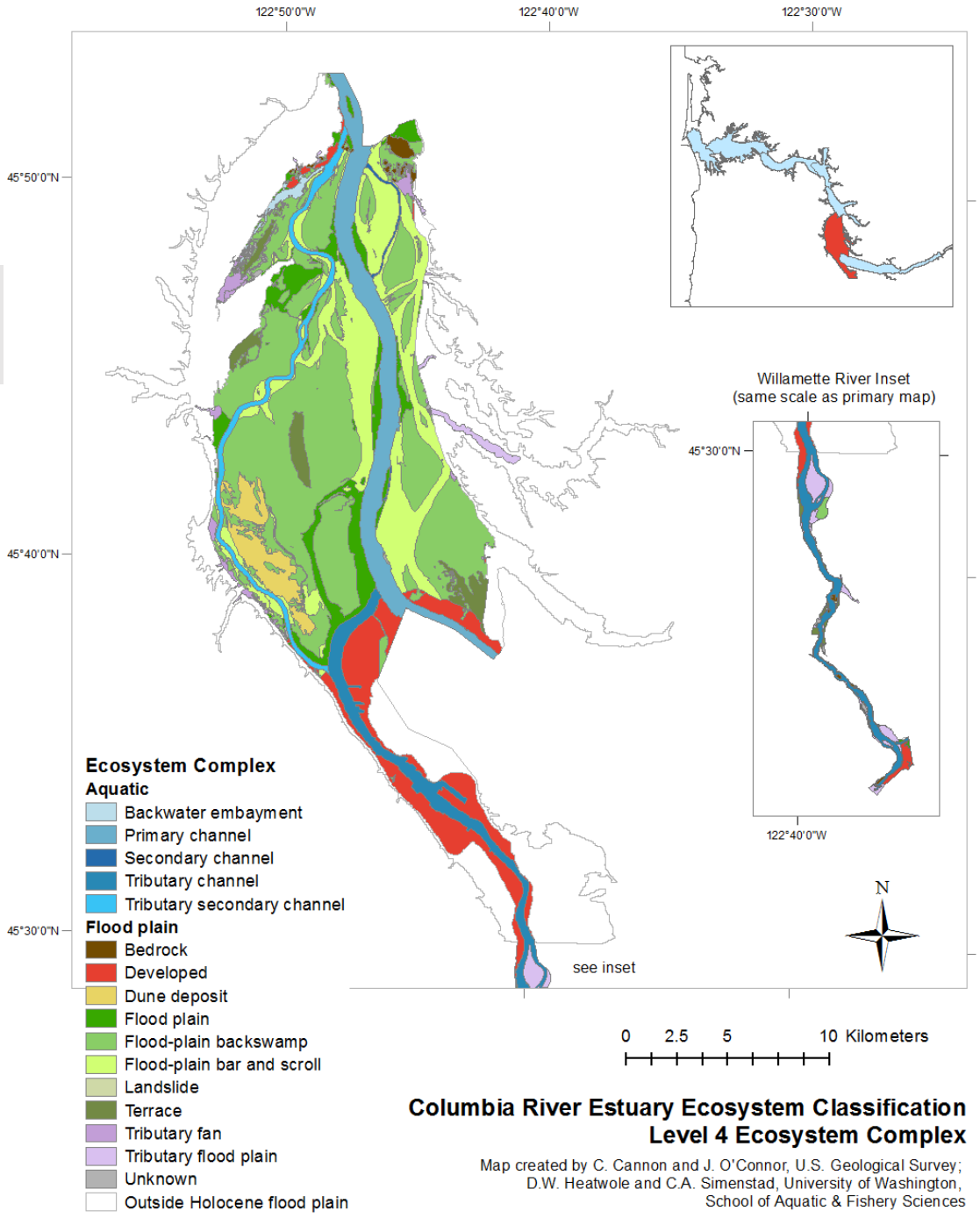
Prepared in cooperation with the University of Washington and the Lower Columbia River Estuary Partnership

Columbia River Estuary Ecosystem Classification—Concept and Application

https://www.estuarypartnership.org/columbia-river-estuary-ecosystem-classification

Open-File Report 2011–1228

U.S. Department of the Interior
U.S. Geological Survey



Columbia River Estuary Ecosystem Classification
Level 4 Ecosystem Complex

Map created by C. Cannon and J. O'Connor, U.S. Geological Survey;
D.W. Heatwole and C.A. Simenstad, University of Washington,
School of Aquatic & Fishery Sciences

River Corridor Geomorphic Mapping

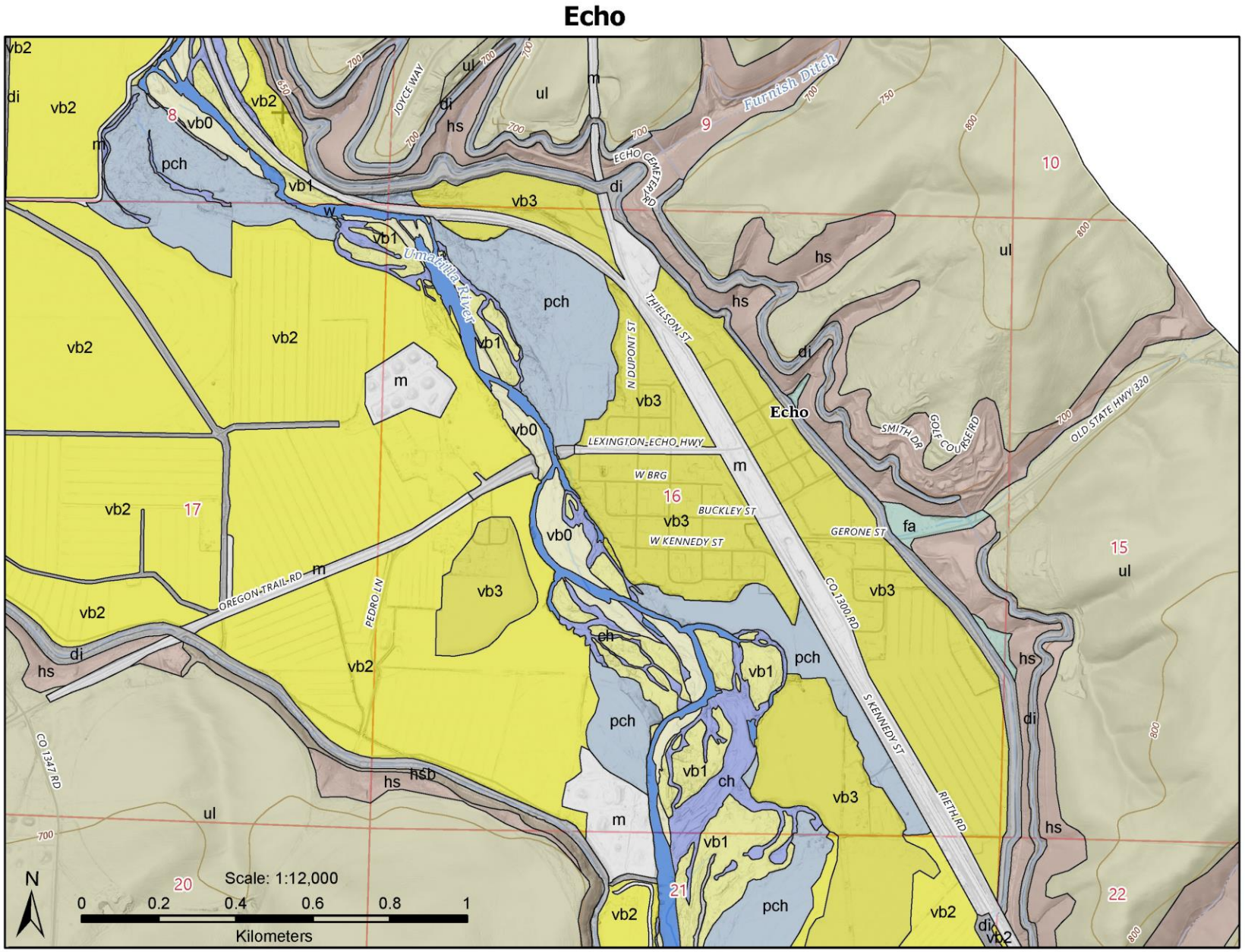
by Yuh, Haugerud, O'Connor, and O'Daniel

In collaboration with Confederated Tribes of the Umatilla Indian Reservation

Scientific review completed, in technical review now, soon to go SPN. Should be published within 6 months.

We've begun work on a similar geomorphic map of the Walla Walla valley

TASK 7: River Corridor Geomorphic Mapping



Part of completed Umatilla map

m—Modified land
af—Artificial fill
di--Ditch
w—Water
ch—Channel
pch—Paleochannel
vb0—Active bar
vb1—Low valley bottom
vb2—Lower valley bottom
vb3—Higher valley bottom
vbt—Tributary valley bottom
fa—Fan
t—Terrace
hs—Hillslope
hsb—Hillslope bedrock
ul—Uplands

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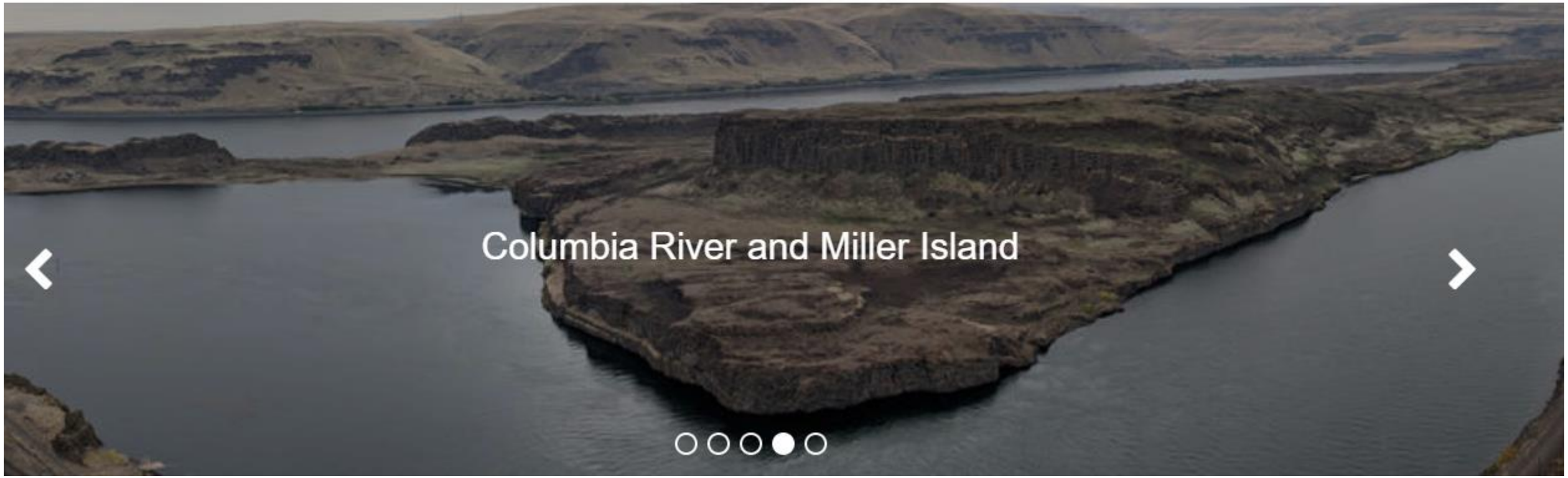

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