

Hyaloclastite delta, CRBG



***Proposed Columbia River Basalt Province Field Trip -
2020
General Information for Participants***



Mt. St. Helens, Washington State, USA

By

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Introduction

This comprehensive five-day geological field trip will navigate through one of the youngest and best preserved Large Igneous Province (LIP) on Earth boasting spectacular mixed volcanic and sedimentary outcrops of the Columbia River Basalt Province. The trip will focus on how the exposed volcanic rocks of the Columbia River Basalt Province and associated sedimentary sequences making up the Columbia River Basalt Group (CRBG), that can be used to better understand the mixed volcano-sedimentary sequences found offshore Brazil, and similar offshore settings globally.

The trip will focus on the stratigraphy and evolution of the main CRBG basin and will visit several localities that highlight the interaction between large scale effusive basaltic volcanism and continental sedimentary drainage systems. Additional highlights on the trip will include the investigation of ash fall deposits resulting from large scale explosive felsic eruptions and a visit to Mt. St. Helens, site of the large 1980 volcanic eruption in during which a lateral blast removed the upper 396 m of the volcano.

Main Trip Leaders

Dr. John Millett (VBPR), Prof. David Jolley (University of Aberdeen), Prof. Dougal Jerram (DougalEARTH), Prof. Sverre Planke (VBPR).

General Information

- The participants will need to organize their own travel to and from Seattle, USA, where the fieldtrip will start and end. Participants to be picked up and dropped off at hotel in Seattle.
- It is recommended to arrive one or more days early to rest after a long travel and to avoid any delays or luggage problems.
- All food, travel and accommodation will be provided during the trip. Travel on the field trip will be by large comfortable people carrier (Ford Expedition or similar), and accommodation will be in hotel localities along the planned route.
- First aid equipment and a satellite phone will be available in the field. No difficult hikes or climbs will be attempted, and it is expected that good communications will be available for most parts of the trip
- The weather conditions may change rapidly and may be hot in spring/fall, please bring warm and waterproof cloths, good hiking boots, a small day pack, sun hat and sun-screen.

Proposed Trip Itinerary

Day 1: Pickup from Seattle. Drive across Cascades through Mt. Reiner National Park. Investigate multi-tiered ponded lavas of the western CRBG along Highway 12, WA. Fluvial inter-lava sediments within the Douglas Member, Yakima Canyon. Overnight in Ellensburg.

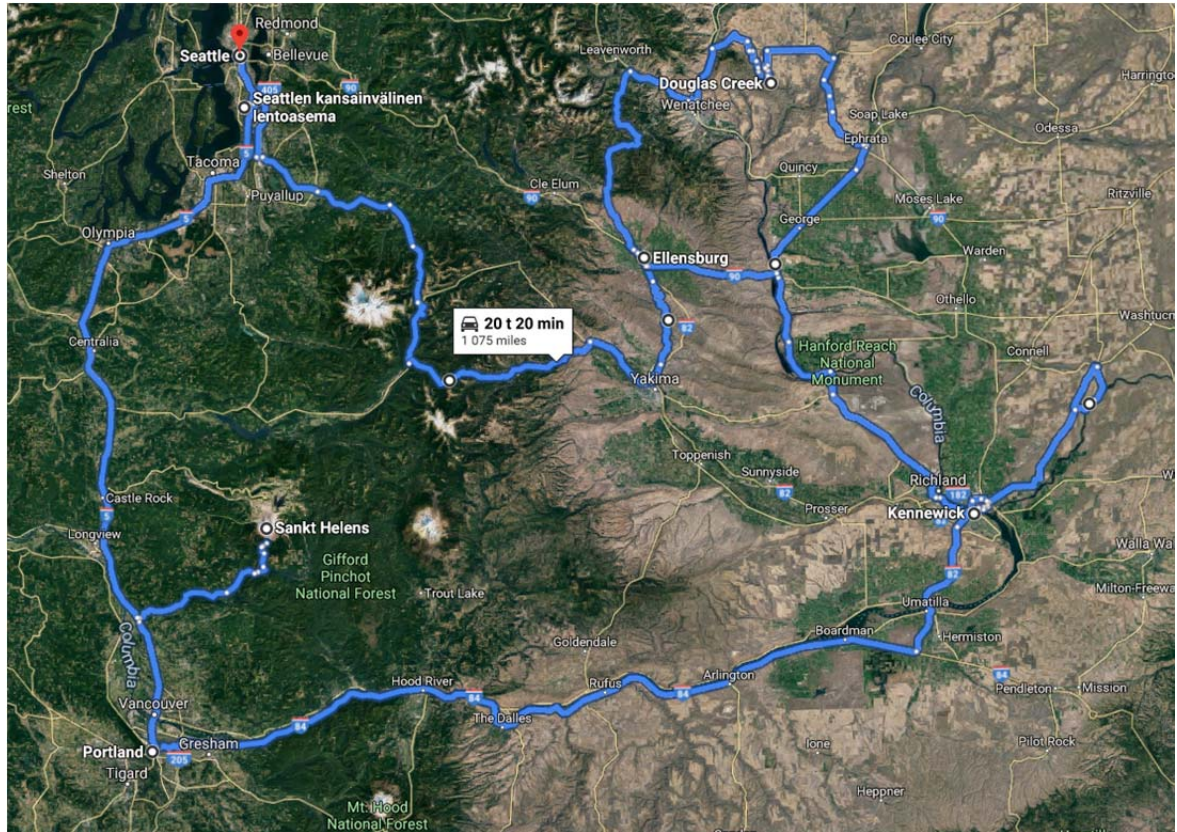
Day 2: Grande Ronde, lava flows, pillow complexes and inter-lava drainage systems of Vantage and Frenchman Springs Members. Vantage, Ginko petrified forest national park, flood lava flow morphologies on the Columbia River. Ash fall deposits of the Selah Member, Saddle Mountains. Overnight at Ellensburg.

Day 3: Douglas Creek, Pillow lava complexes, hyaloclastite deltas, rapid base level changes. Caliche Lakes, spatter ramparts and diatomite lacustrine systems, Squaw Creek and Quincy Members. Overnight Kennewick, Tri-Cities.

Day 4: Fluvial sedimentary interbeds in the Clearwater embayment, eastern CRBG. Grande Ronde lava flows and dike swarm. Intra-canyon lava flows of the Elephant Mountain and Pamona Members, Windust. Overnight in Kennewick, Tri-Cities.

Day 5: Invasive lava flows, Pleasant Valley and Columbia River outcrops. Overnight in Portland.

Day 6: Mount St. Helens, explosive volcanism, lahar deposits. Trip ends in Seattle.



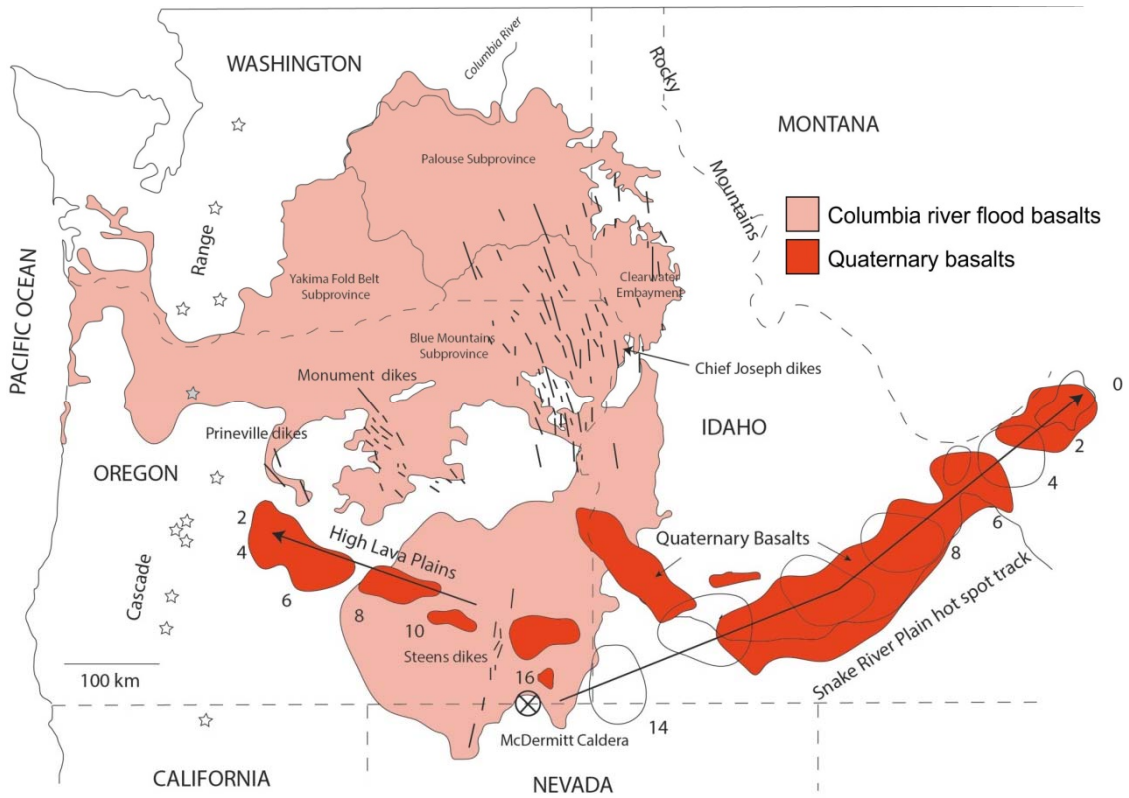
Generalized trip route map.

Geological setting and outlook

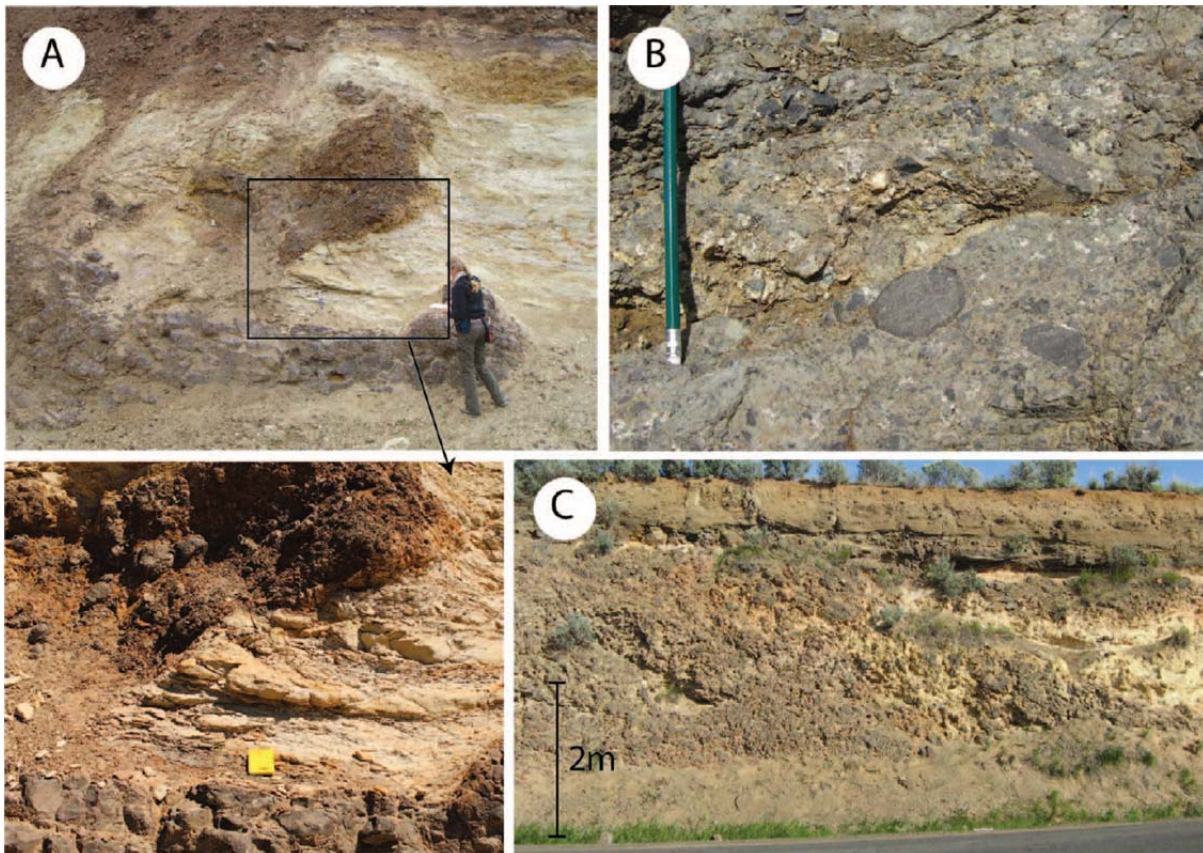
The CRBG is located in the back-arc basin of the Cascade Range, which prior to CRBG volcanism was subject to early Paleogene to early Miocene alluvial and lacustrine deposition and the emplacement of andesitic to rhyolitic lava flows. From late early Miocene times, flood basalt and rhyolitic to andesitic volcanism occurred west of the Cascade Range, including the Oregon Plateau, CRBP, and the Snake River Plain (see map). The CRBG includes a highly detailed stratigraphy for both the effusive volcanic sequences which comprise lava flows, pillow complexes, hyaloclastite and explosive volcanic successions, but also for the exceptionally well exposed sedimentary interbed sequences which comprise a diverse range of fluvial, lacustrine and soil systems.

The stratigraphy of the CRBG records a complex interaction between competing volcanic and sedimentary systems alongside evidence for significant time gaps within the deposition systems where erosion and incision of the basin took place. The CRBG comprises one of the best exposed and accessible field analogue areas in the world for understanding the interaction between effusive volcanism and mixed sedimentary drainage systems. In addition, an estimated annual \$6 billion worth of agriculture within the Columbia River basin is irrigated largely by water pumped from aquifers located within lava flow and inter-lava reservoirs. The CRBG therefore offers the unique setting where working igneous reservoirs can be inspected at outcrop only a few hundred meters above equivalent facies which form highly productive reservoir units.

This fieldtrip provides a powerful training basis for understanding mixed volcano-sedimentary systems and how they may be interpreted within the sub-surface petroleum exploration context. The field workshop will comprise group visits and interaction at key outcrops as well as evening outline and discussion sessions, depending on the groups specific goals and needs.



Summary map of the Columbia River Basalt Province, Washington State, USA (after Ebinghaus et al., 2014, modified from Camp and Ross 2004, and Reidel et al., 2013).



Examples of (A) invasive units, (B) hyaloclastite and (C) spatter ramparts, CRBG (from Ebinghaus et al., 2014).



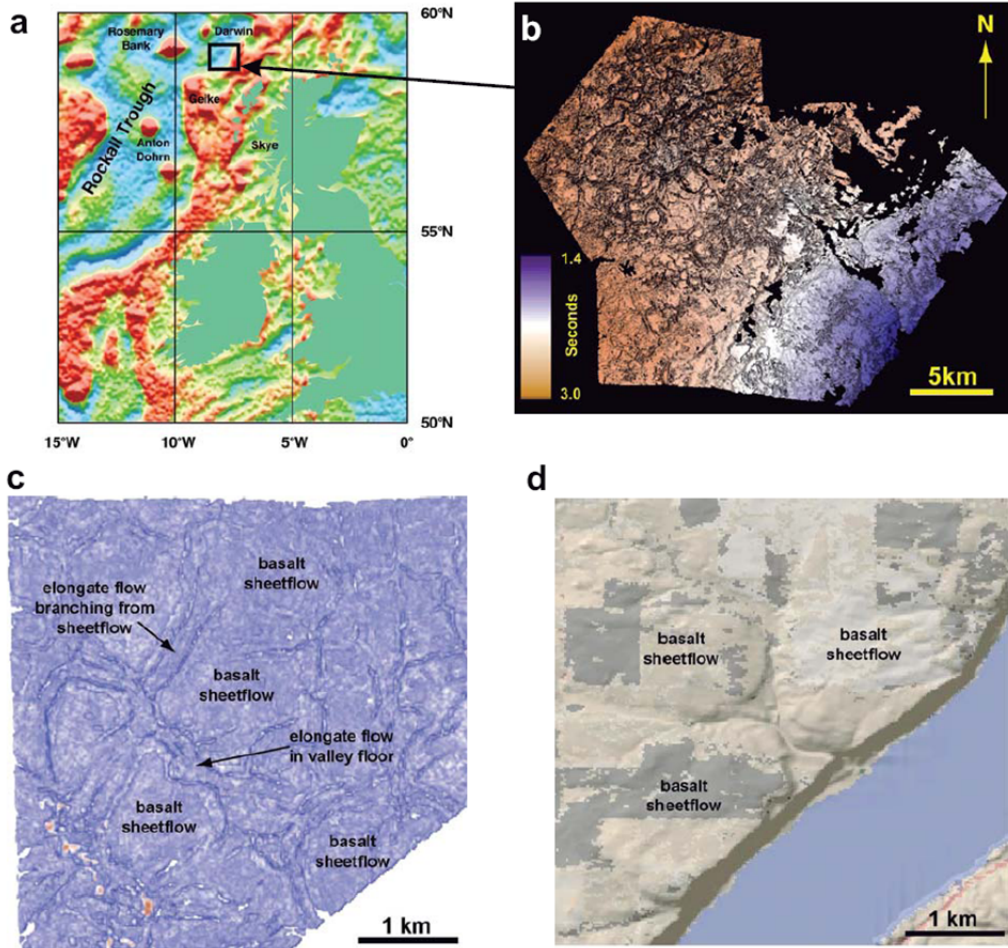
Multi-tiered columnar lava flows, western CRBG.



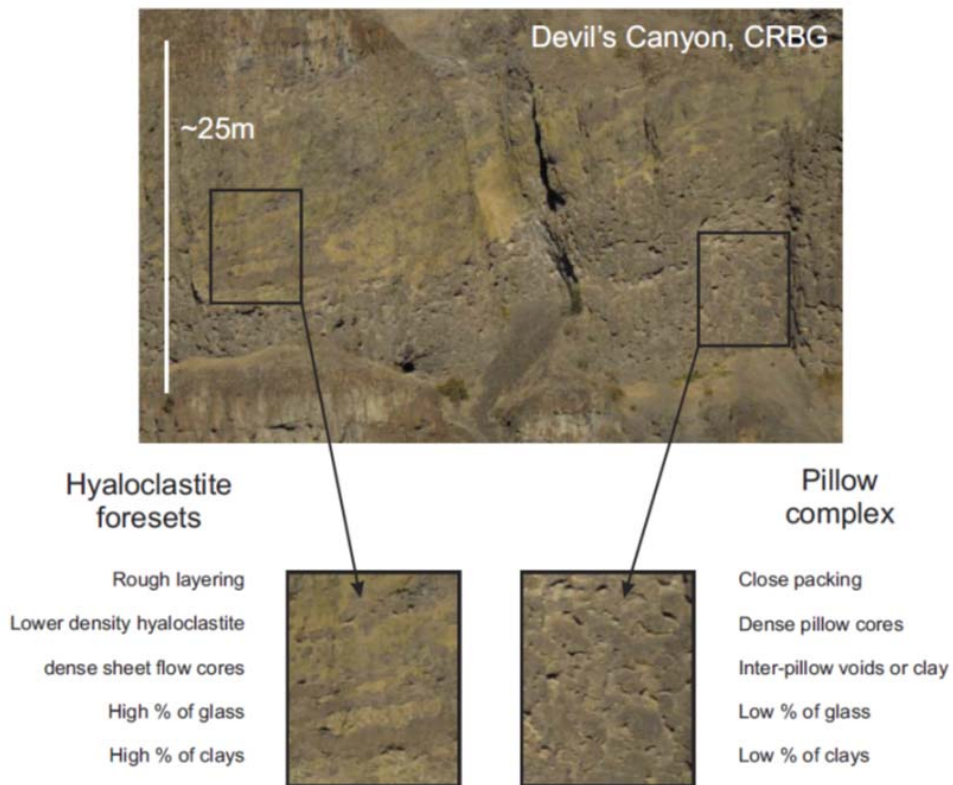
Pillow rampart, Ellensburg.



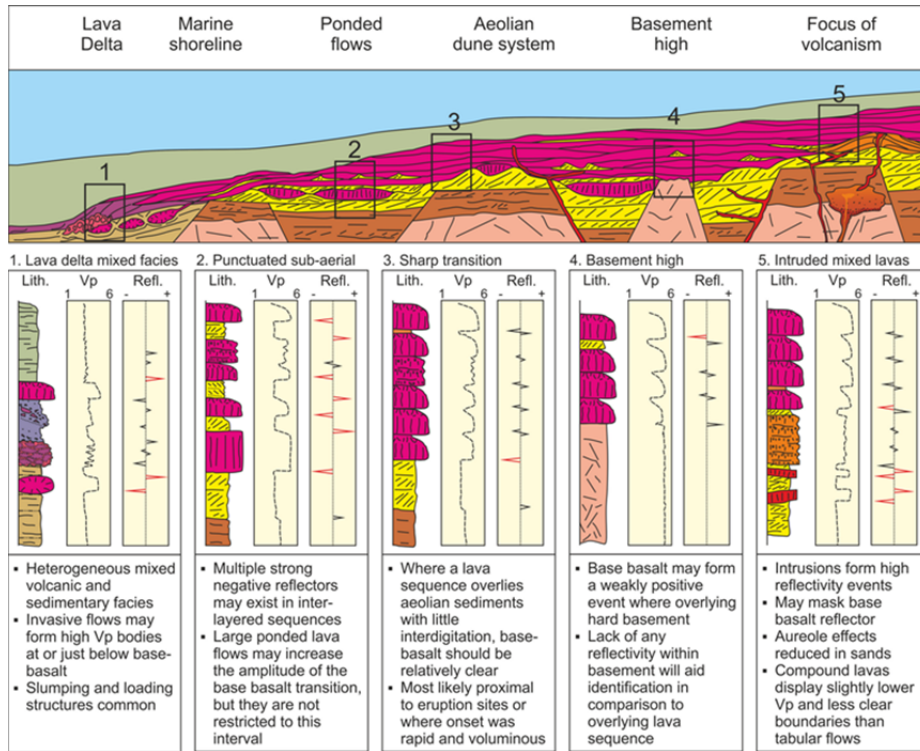
Stacked lava sequences along the Columbia river (photo, Ebinghaus EGUblogs).



CRBG flows as analogues for offshore lava flow sequences (Thompson, 2005).



Using CRBG facies to help understand volcanic heterogeneities. Field image of mixed pillow and hyaloclastite hydro-volcanic facies from the Columbia River Basalt Group (Millett 2014). (VMAPP CM2)



CRBG to help in Understanding of sediment lava systems and the base basalt transition (VMAPP, Millett et al., in review).