Student Field Experiences in the Pacific Northwest and Beyond

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ABSTRACT

A rewarding aspect of teaching at Eastern Washington University (Cheney, WA) is to offer a field component to the spring quarter upper level geology classes as well as longer summer session field experiences. During the spring quarter, my students are required to take detailed field notes and digital photographs of localities to produce a field photo journal of the one or two day trip. The one-week to ten-day summer field course (co-taught by Buchanan, GEOL and O'Quinn, BIOL) requirements include keeping a field notebook and journal, answering a series of pre-trip and post-trip questions, and writing a research paper on a topic of interest related to the field trip. I have recently produced and published resources for a number of field trips in the Pacific Northwest for the Field Trip Collection compiled by the NAGT including the North Cascades, Columbia River Gorge and Oregon Coast, Mt. Rainier and Mt. St. Helens, the Olympic Peninsula, the Snake River Plain and Yellowstone, and Crater Lake and Newberry Volcanoes. I have also led a field trip to the Big Island of Hawaii (2008) as part of GSA Geoventures and will do so again immediately following the VEPP workshop. This poster will share volcano-related trips.

IGNEOUS AND METAMORPHIC PETROLOGY FIELD TRIP

This two day field trip introduces students to igneous, sedimentary and metamorphic rocks as seen in the field in the southern part of the Washington Cascades between Ellensburg and Leavenworth and in the vicinity of Lake Wenatchee.

VOLCANOLOGY FIELD TRIP

This field trip introduces students to the Columbia River Flood Basalt Province in eastern Washington, including the general characteristics of the flood basalt flows, their dike and vent systems, and the tectonic evolution of the province.

Trip Assignment

Students in each class prepare a field trip report (a photo-journal) which is graded on the quality and detail of field observations, geological "correctness" and writing style. Examples of submissions from my Spring 2010 Petrology course are shown below.

SUMMER FIELD COURSES WITH A VOLCANIC THEME

LIVING WITH VOLCANOES - MT. RAINIER AND MT. ST. HELENS

A seven-day field trip to Mt. Rainier National Park and Mt. St. Helens National Volcanic Monument for the purpose of examining the geology and biology of the largest and most active volcanoes, respectively, in Washington State. We will observe the short- and long-term effects of the interplay among volcanic activity, glaciation and recent human activity on the vegetation and wildlife of these two prominent mountains in the Cascade landscape.

BATTLE OF LAVA AND LIFE: CRATER LAKE NATIONAL PARK AND NEWBERRY VOLCANO NATIONAL MONUMENT

The goal of this class is to explore the natural history of the southern part of the Cascade Range in Oregon. We will discuss the complex geologic setting of the range and will focus primarily on volcanic features, geologic history and landscape evolution. Adaptation of organisms to desert, alpine and forest habitats will be investigated, as well as the spatial and temporal factors that influence plant species distribution. We will spend most of our time exploring Crater Lake National Park and Newberry Volcano National Monument during this immersive field experience.

ON THE TRAIL OF THE YELLOWSTONE HOTSPOT – SNAKE RIVER PLAIN, CRATERS OF THE MOON, AND YELLOWSTONE

An eight-day field trip to Hagerman Fossil Beds and Craters of the Moon National Monuments, and Yellowstone National Park, for the purpose of examining the geology and biology of the Snake River Plain in southern Idaho. In this field class we will examine the volcanic geology in the wake of the Yellowstone hot spot as the North American plate moved westward during the last 20 million years. In addition, we will examine the vegetation of this geologically young landscape and discuss how limited soil development, and the long fire intervals, coupled with a semi-arid climate, shape plant communities. The biology of organisms that occupy extreme environments – extremophiles – will also be emphasized in relation to the geothermal features at Yellowstone National Park.

Materials for these and other summer courses are now available in the NAGT Teaching in the Field collection

http://www.nagt.org

Teanaway Formation (Tv) Eocene 47-39 Ma

The Teanaway formation is denoted by the Tv symbol in figure 1. Red lines in figure one present in Tc are Teanaway feeder dikes. In the specific outcrop studied the limb of a syncline shows basalt overlain by pyroclastic material (Fig. 4.1). The pyroclastic material is outlined in figure 4.1 by yellow, where it is evident that the package was tilted (it is the limb of a syncline.) This layer is probably lapilli ejected onto the top of a lava flow (basalt under pyroclastic layer in Fig 4.1). This is reasonable because lapilli sized material is typical for basaltic eruptions. The bottom right of the outcrop in the photo illustrates how loosely consolidated the material is by the weathered material which has created a slope.

Fig. 4.1 Teanaway Outcrop

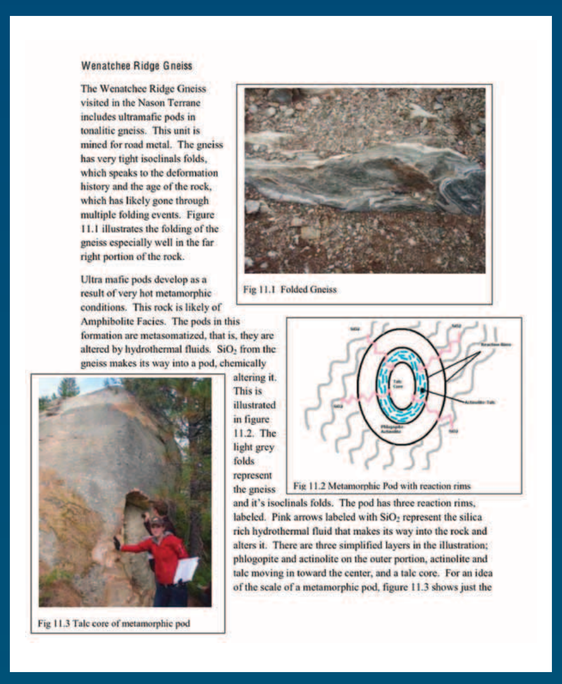
Fig 4.2 Calcite Nodule

This unit is pervasively altered and contains evidence of Quartz and Calcite, though mainly the latter, as products of hydrothermal alteration. Figure 4.2 shows a calcite nodule in the lower basalt flow.

In other outcrops of the Teanaway there is evidence of rhyolitic ash flow as well as minor arkosic sedimentary rocks (>25% Feldspar.) This said, the formation is mainly basalt fed by dikes which cut through much of the older rock.

This area (Liberty, Wa/Blewett Pass) was extensively Placer mined for gold in the late 1800's through 1957. In 50 operative years, the Blewett Pass mines accounted for 850 thousand ounces of gold, and the Holden mine recovered 514 thousand ounces of gold in the Chelan district in 1938 alone. Placer mining has undesirable effects on the natural environment; the Blewett Pass District is now a historic mining district. Fig 4.3 shows tailings piles from placer mining on the edges of a River.

Fig 4.3 Tailings piles



Wenatchee Ridge Gneiss

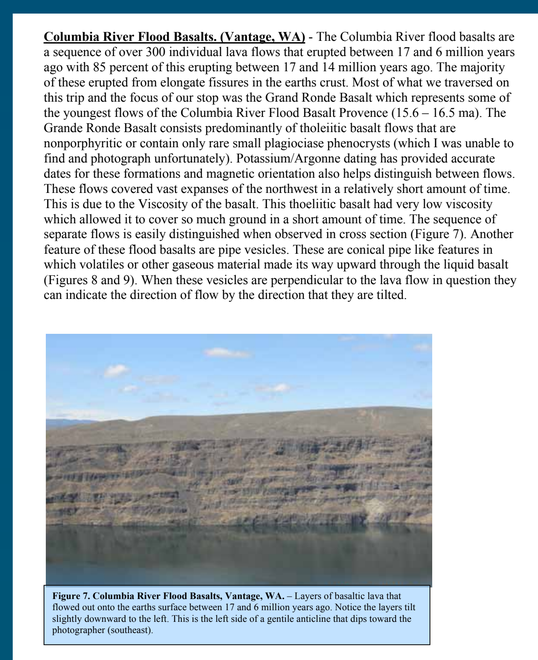
The Wenatchee Ridge Gneiss visited in the Nason Terrane includes ultramafic pods in tonalitic gneiss. This unit is mined for road metal. The gneiss has very tight isoclinals folds, which speaks to the deformation history and the age of the rock, which has likely gone through multiple folding events. Figure 11.1 illustrates the folding of the gneiss especially well in the far right portion of the rock.

Fig 11.1 Folded Gneiss

Ultra mafic pods develop as a result of very hot metamorphic conditions. This rock is likely of Amphibolite Facies. The pods in this formation are metasomatized, that is, they are altered by hydrothermal fluids. SiO_2 from the gneiss makes its way into a pod, chemically altering it. This is illustrated in figure 11.2. The light grey folds represent the gneiss and it's isoclinals folds. The pod has three reaction rims, labeled. Pink arrows labeled with SiO_2 represent the silica rich hydrothermal fluid that makes its way into the rock and alters it. There are three simplified layers in the illustration; phlogopite and actinolite on the outer portion, actinolite and talc moving in toward the center, and a talc core. For an idea of the scale of a metamorphic pod, figure 11.3 shows just the

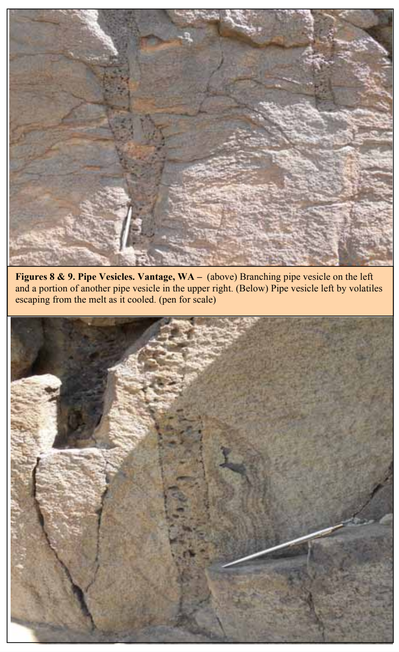
Fig 11.2 Metamorphic Pod with reaction rims

Fig 11.3 Talc core of metamorphic pod



Columbia River Flood Basalts. (Vantage, WA) - The Columbia River flood basalts are a sequence of over 300 individual lava flows that erupted between 17 and 6 million years ago with 85 percent of this erupting between 17 and 14 million years ago. The majority of these erupted from elongate fissures in the earths crust. Most of what we traversed on this trip and the focus of our stop was the Grand Ronde Basalt which represents some of the youngest flows of the Columbia River Flood Basalt Provence (15.6 – 16.5 ma). The Grande Ronde Basalt consists predominantly of tholeiitic basalt flows that are nonporphyritic or contain only rare small plagiociase phenocrysts (which I was unable to find and photograph unfortunately). Potassium/Argonne dating has provided accurate dates for these formations and magnetic orientation also helps distinguish between flows. These flows covered vast expanses of the northwest in a relatively short amount of time. This is due to the Viscosity of the basalt. This thoeliitic basalt had very low viscosity which allowed it to cover so much ground in a short amount of time. The sequence of separate flows is easily distinguished when observed in cross section (Figure 7). Another feature of these flood basalts are pipe vesicles. These are conical pipe like features in which volatiles or other gaseous material made its way upward through the liquid basalt (Figures 8 and 9). When these vesicles are perpendicular to the lava flow in question they can indicate the direction of flow by the direction that they are tilted.

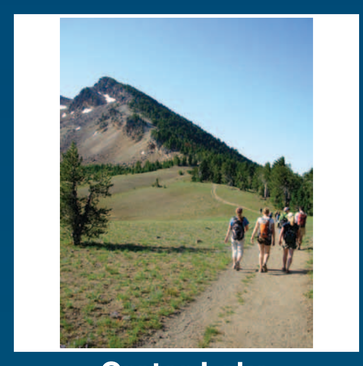
Figure 7. Columbia River Flood Basalts, Vantage, WA. – Layers of basaltic lava that flowed out onto the earths surface between 17 and 6 million years ago. Notice the layers tilt slightly downward to the left. This is the left side of a gentile anticline that dips toward the photographer (southeast).



Figures 8 & 9. Pipe Vesicles. Vantage, WA – (above) Branching pipe vesicle on the left and a portion of another pipe vesicle in the upper right. (Below) Pipe vesicle left by volatiles escaping from the melt as it cooled. (pen for scale)

Mt. St. Helens
Harmony Falls Trail

Mt. Rainier
Emmon's Glacier



Crater Lake
Mt. Scott Trail

Newberry Volcano
Lava Butte Trail

Yellowstone
National Park

Craters of the Moon
North Crater Trail

GEOVENTURES HAWAII 2010

This eight-day field course on the Big Island of Hawaii introduces participants to plate tectonics, hot spot volcanism, and the geologic features and hazards associated with living on an active volcano. On the Big Island of Hawaii, primarily within Hawaii Volcanoes National Park.

July 30 – August 8, 2010

Hawaii Geoventures 2008

REFERENCES

Thomson, J.A., Buchanan, J.P. and Schwab, S. (2006) An integrative summer field course in geology and biology for K-12 instructors and college and continuing education students at Eastern Washington University and beyond. Journal of Geoscience Education, v. 54, n. 5, 588-595.