Miocene Woods of Eastern Washington

Part 1
INTRODUCTION

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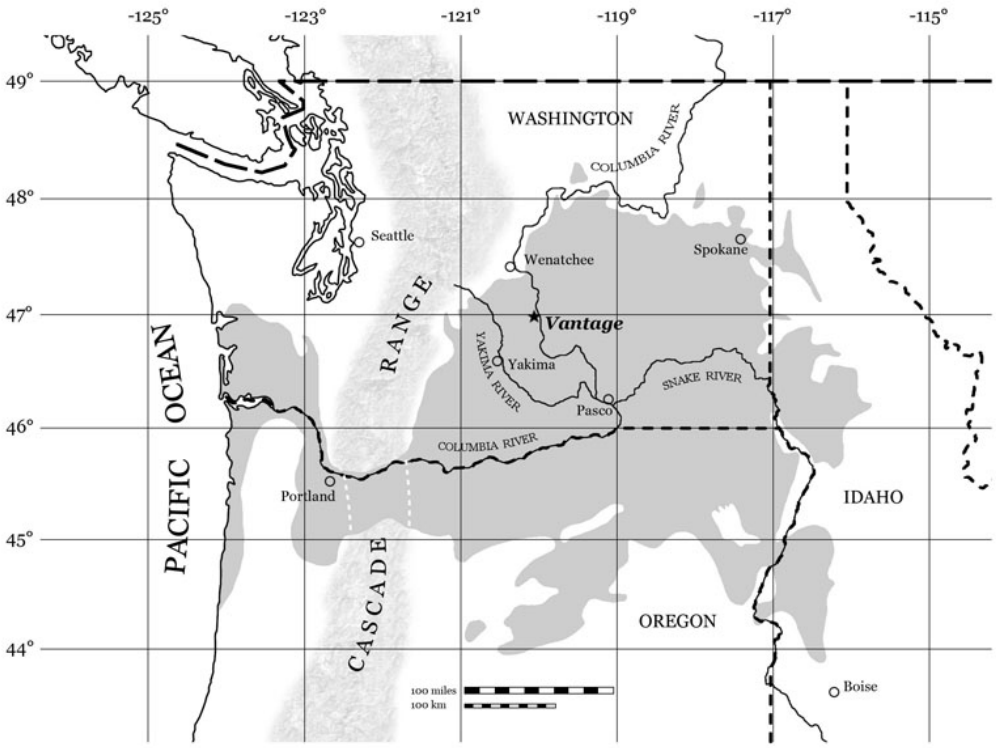
These pages are dedicated to the memory of Professor George Beck, who was on the faculty of Central Washington University during the middle of the 20th century. Professor Beck spent decades of his life advancing the knowledge of fossil woods found in the western United States and particularly in the Columbia River Basalt flows of eastern Washington. He is also substantially responsible for the establishment of the Ginkgo Petrified Forest State Park at Vantage, Washington.

Introduction

As you look out across the arid landscape near the town of Vantage in east-central Washington, it is difficult to imagine that the surrounding area was once covered in dense forest. Approximately 16 million years ago, however, that is exactly what it looked like. The Cascade mountain range had not yet risen high enough to cast a rain shadow, the global temperature was warmer than today, and abundant rainfall allowed lush temperate forests to grow in areas that currently support only dry shrub-steppe vegetation characterized by sagebrush, rabbitbrush and bunchgrasses.

Landscape view of the Ginkgo Petrified Forest State Park in central Washington State

Approximately 17.5 million years ago during the middle of the Miocene epoch, a series of large volcanic eruptions began in the eastern part of the Columbia River Plateau, near the present day borders of Washington, Oregon and Idaho. The scale of the Columbia River Basalt eruptions is immense. The lava from these eruptions was of a very fluid type that flowed across large areas of the landscape. The larger eruptions put out enough lava that some of the flows reached the Pacific Ocean, a distance of some 300 miles (480 km) from the source of the eruption. The total volume of the lava is estimated at 42,000 cubic miles (175,000 cubic kilometers), which covered an area of approximately 64,000 square miles (165,000 square kilometers) (Tolan et al, 1989). That's an area nearly as large as the state of Wisconsin. These eruptions occurred between 17.5 and 6 million years ago, with the majority of the lava erupting during the first two million years of the cycle (Tolan, et al, 1989). There were hiatuses between many of the eruptive cycles that allowed the reestablishment of forests, lakes and swamps. When conditions were right, some of these forests and swamps were buried by subsequent flows and the trees were preserved by silica dissolved from volcanic ash and the basalts. This happened several times during the 10 million years of volcanic eruptions, resulting in numerous deposits of fossilized wood across the Columbia Plateau.



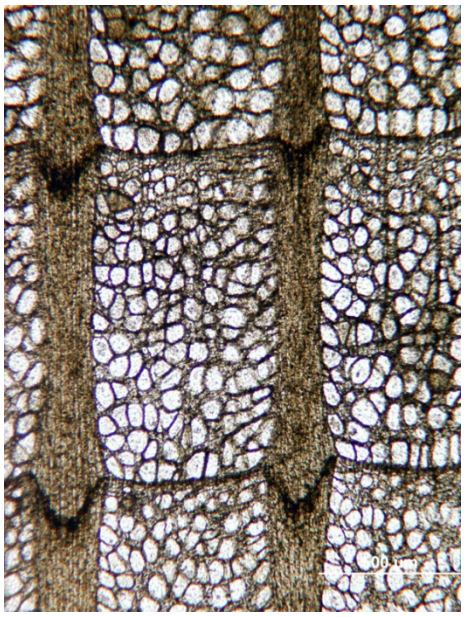
Map of the Pacific Northwest showing approximate extent of the Columbia River Basalt flows (dark shaded area)

Formation	Member	Approximate Isotopic Age
Saddle Mountains Basalt	Elephant Mountain Member	10.5 Ma
	Pomona Member	12 Ma
	Esquatzel Member	
	Asotin Member	13 Ma
Wanapum Basalt	Priest Rapids Member - Basalt of Lolo - Basalt of Rosalia	
	Roza Member	
	Frenchman Springs Member - Basalt of Sentinel Gap - Basalt of Sand Hollow - Basalt of Ginkgo	 15.3 Ma 15.5 Ma
	---- *VANTAGE HORIZON*----	
Grande Ronde Basalt	Magnetostratigraphic Unit N_2 - Sentinel Bluffs Unit - Slack Canyon Unit - Umtanum Unit - Ortley Unit - Armstrong Canyon Unit	 15.6 Ma
	Magnetostratigraphic Unit R_2 - Grouse Creek Unit - Wapshilla Ridge Unit - Mt. Horrible Unit	
	Magnetostratigraphic Unit N_1 - China Creek Unit - Downey Gulch Unit	
	Magnetostratigraphic Unit R_1 - Center Creek Unit - Rogersburg Unit - Teepee Butte Unit - Buckhorn Springs Unit	 16.5 Ma

Simplified stratigraphy of the Columbia River Basalt Group, adapted from Tolan, et al., 1989. This figure omits many of the localized basalt flows that are not associated with fossil wood deposits.

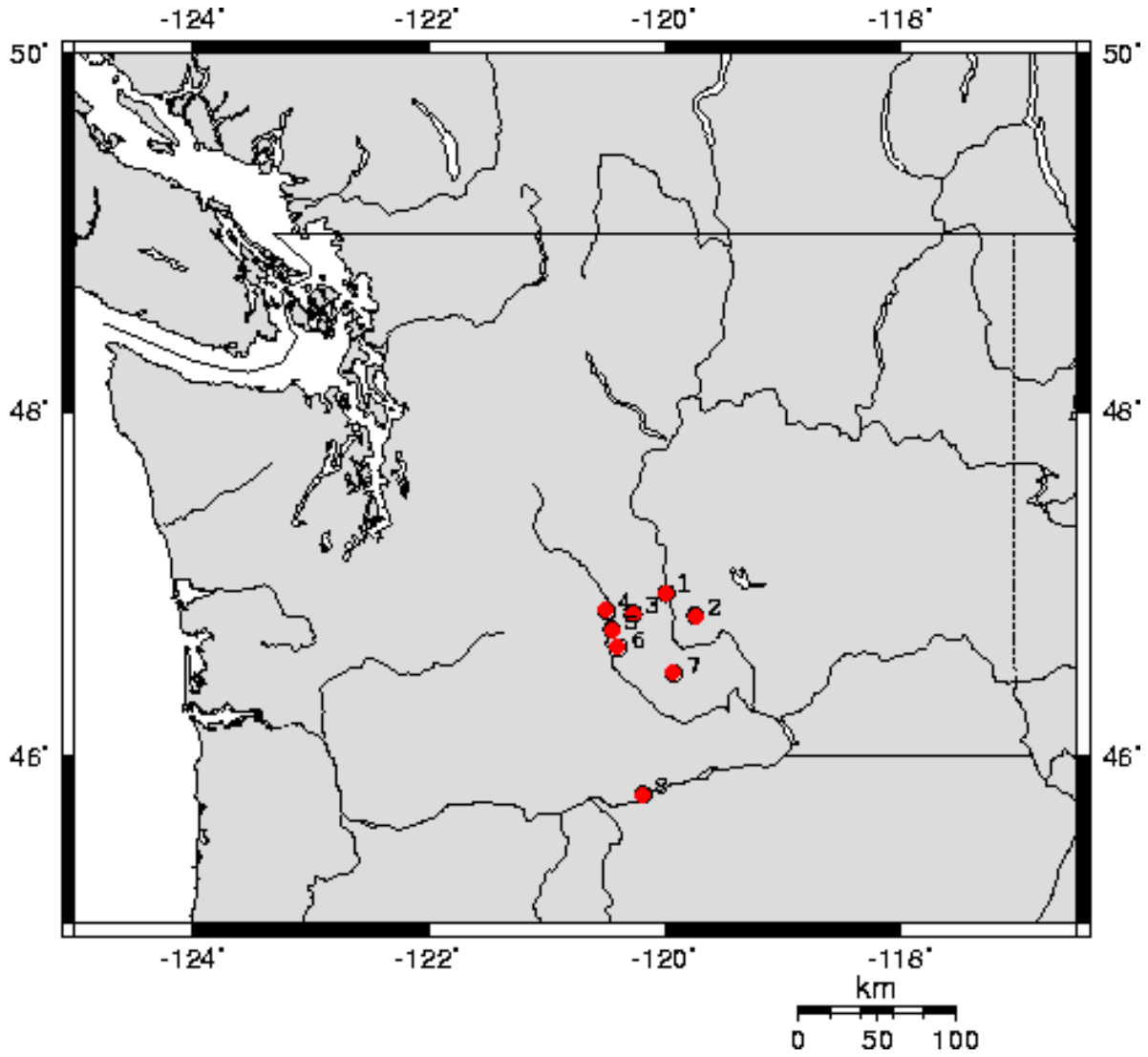
Later geologic uplift and erosion has exposed some of these trees, which have been collected by amateurs and scientists for nearly a century. When cut and polished, the specimens of petrified wood can be quite beautiful to behold. In addition, some of the wood has been preserved in minute detail even down to the microscopic level, allowing scientists to determine the types of trees that grew in the Pacific Northwest during this time period. The scientific information that is gained from the study of the fossil wood and other preserved remains has provided valuable scientific insights into the forests and climate of the region during the Miocene.

Section of a fossil log on display at the Ginkgo Petrified Forest State Park visitor center



Cross section of fossil *Platanus* (Sycamore) wood

Major fossil wood localities in the Columbia River Basalts of Washington



1) Vantage
2) Saddle Mountain
3) Squaw Creek
4) Yakima Canyon (Umptanum)
5) Yakima Canyon (County Line)
6) Yakima Ridge
7) Sunnyside
8) Roosevelt

Site 1: The Wood Assemblage at Vantage

The fossil wood assemblage at Vantage is the best known site in the Columbia River Basalts. Professor George Beck of Central Washington University studied this area intensively in the 1930s and 1940s, and he was largely responsible for having the site preserved as Ginkgo Petrified Forest State Park. The major wood areas are now all within the state park boundary, and visitors are welcome, although collecting is strictly prohibited. There is a visitor center at the site with displays of the fossil wood. There are also interpretive trails that allow visitors to see some of the logs still in place in the basalt. For more information, visit the state park website at:
http://www.parks.wa.gov/parks/?selectedpark=Ginkgo+Petrified+Forest%2FWanapum+Recreational+Area

Vantage is the only fossil wood site in the Columbia River Basalts which has received significant scientific study. Professor Beck wrote several formal and informal publications describing the area and its wood (see bibliography), and in the 1960s, a series of publications (Prakash and Barghoorn 1961a, 1961b; Scott, Barghoorn & Prakash, 1962; Prakash, 1968) came out which were the first to formally describe some of the Vantage wood types in the scientific literature. More recently, Wheeler and Dillhoff (2009) published a comprehensive treatment of the Vantage woods. This work updated and expanded the earlier publications, and included a number of wood types which had not previously been described. Currently, the assemblage at Vantage is regarded as the single most diverse fossil wood locality from the Miocene of North America. There are 40 different woods recognized, including 6 different gymnosperm wood types and 34 angiosperm wood types.

Vantage wood is preserved in prostrate log rafts entombed directly within a basalt flow. The flow is part of the Wanapum Basalt Formation within the Columbia River Basalts, and has been dated at approximately 15.5 million years old. In his field notes and in later publications, Beck surmised that the deposit represented a watershed drainage where trees from various habitats fell into rivers and were transported to a large lake at Vantage. Once there, the tree trunks drifted in the lake and became waterlogged, and thus were preserved when the lava flow swept through the region and buried the logs (Beck, 1935). More recently, scientists have postulated that the logs were transported into the Vantage area by a lahar from an early Cascade volcano. The logs would have formed a floating raft on top of a lake resulting from a dammed section of the ancestral Columbia River, which was later inundated by the Ginkgo Flow of the Wanapum Basalts (Tolan, et al., 1991).

Polished round of Douglas fir (*Pseudotsuga pseudotsugae*) from Vantage

Site 2: Saddle Mountains

The Saddle Mountains are an east-west trending anticline in Grant County, Washington, approximately 13 miles (20 km) southeast of the Ginkgo Petrified Forest. Several exposures of petrified wood are found at various locations on the Saddle Mountains. Orsen and Reidel (2003) considered this to be a distinct fossil forest assemblage which they named the Saddle Mountains Petrified Forest. It occurs between the top of the Roza Member and the base of the Priest Rapids Member in the Wanapum Basalt Formation (making it somewhat younger than the Ginkgo forest), although geologic maps and geochemical analysis of the basalts indicate that some of the localities on the west end of Saddle Mountain also occur within the older Frenchman Springs Member basalts. Portions of the Saddle Mountains are administered by the Bureau of Land Management which has maintained some areas open for public collecting.

There has been no rigorous scientific study of wood from the Saddle Mountains. Much of the wood seen by the author is *Taxodioxylon* type conifer wood, although there are areas that show more diversity and contain hardwoods. Saddle Mountain is famous for its 'picture wood' which shows beautiful colors and dendritic patterns due to mineral inclusions. Beck made some collections from this area which show interesting diversity and warrant further study.

Magnified section of 'picture wood' from Saddle Mountain (UWBM 56575)

Site 3: Badger Pocket/Squaw Creek

These names refer to an area containing petrified wood that is located southeast of Ellensburg on what is now the Yakima Training Center, a military training site that is closed to wood collecting. Orsen and Reidel (2003) postulate that these localities are the same age as the Ginkgo Petrified Forest, representing either an extension of the Ginkgo assemblage or a transported component of a nearby forest. Professor Beck did a fair amount of work in this area in the 1930s and 1940s, comparing the wood assemblage to the similarly aged Mascall fossil leaf deposit in northeastern Oregon (Beck, 1942/1943). In this informal study, he estimated dominance of the various wood types as follow:
Sycamore (*Platanus*) – 15%
Douglas fir (*Piceoxylon*) – 15%
Redwood (*Taxodioxylon*) – 15%
Red gum (*Liquidambar*) – 15%
Oak (*Quercus*) – 15%
Minor constituents include hickory (*Carya*), elm (*Ulmus*), *Ginkgo*, horse chestnut (*Aesculus*), walnut (*Juglans*), alder (*Alnus*), and pine (*Pinus*).

In the middle part of the 20th century, these localities were heavily collected by local amateurs, who found a number of high quality fossilized logs. Polished rounds from these logs are often seen in old collections. There are several specimens that are highly sought after from this area. First and foremost is the Squaw Creek *Ginkgo* log discovered by George Schreiner in 1941. This log was reported to be up to 18 inches in diameter, approximately 25 feet long, and was forked. The best polished sections from this log display a very nice bluish tone and command a high price in the marketplace.

Section of Squaw Creek *Ginkgo* in the collection at the University of Washington Burke Museum (UWBM 96265)

Another famous discovery from this area was the large, hollow sycamore log described by J. Melvin Smith (2000). There are no rounds from this log since it was largely hollow, but polished sections of the fossil wood display a distinctive and lovely wood grain, and are thus sought after by lapidarists.

Section of Squaw Creek sycamore cut on radial axis to show the grain pattern

A less well known discovery was that made in the 1940s by an amateur collector named Carl Clinesmith. This specimen was a silicified cache of hickory nuts found inside of a sycamore log. The nuts were formally described as *Carya washingtonensis* by Manchester (1987).

Portion of silicified hickory nut cache found inside a fossil sycamore log (UWBM38700)

Sites 4 & 5: Yakima Canyon

The Yakima River has carved a deep canyon through flows of the Columbia River Basalts between the cities of Ellensburg and Yakima. In the process, some important fossil wood deposits have been exposed, including those of Umtanum Canyon and other areas further south. Orsen and Reidel (2003) place this assemblage in the interface between the Sentinel Bluffs Member and Umtanum Member of the Grande Ronde Basalts, which makes it slightly older than the Ginkgo Petrified Forest. Observations by George Beck and this author indicate the Yakima Canyon assemblage is somewhat different than the Vantage assemblage. Swamp habitat species such as *Nyssa* (Tupelo gum) and *Taxodium* (swamp cypress) are more abundant, as well as *Pterocarya* (Chinese walnut) and occasional pines. Little study has been done on the wood from this area.

Fossilized oak wood from Yakima Canyon

The Sentinel Bluffs Member in Yakima Canyon also hosts deposits of silicified forest floor material, known as 'bog' sites by the local collectors. These deposits have preserved cones, fruits, seeds and other plant organs. Dr. Kathleen Pigg of Arizona State University and her collaborators have published several studies of plant remains from the bog sites (Borgardt & Pigg, 1999; Pigg & Rothwell, 2001; Pigg, et al., 2004; Pigg & DeVore, 2005), expanding our knowledge of the Yakima Canyon flora. Dr. Charles Miller (1992) also described silicified pine foliage and cones from these deposits.

Silicified *Nyssa* (Tupelo gum) fruit from Yakima Canyon.

Photo courtesy of Dr. Kathleen Pigg

Site 6: Yakima Ridge

In recent years, some high quality specimens of fossilized wood have been collected from private property on the west end of Yakima Ridge. Preliminary studies indicate that the wood is from the Ginkgo flow of the Frenchman Springs Member, Wanapum Basalt Formation. This is the same flow that hosts the Ginkgo Petrified Forest at Vantage. An informal study was performed (link here) on one site which has been the source of over 200 standing logs. Diversity is low with elm and hickory as the dominant types, with minor amounts of maple, sweet gum, and honey locust types. Conifer and oak wood have been found at other sites in the area.

Hickory type wood from Yakima Ridge

Site 7: Sunnyside/Rattlesnake Hills

The area north of the town of Sunnyside was a favorite amateur collecting site for many years, although these deposits are on private property and now closed. Sunnyside is best known for the frequent occurrence of *Taxodioxylon* type wood, especially *Taxodium* 'knees' which show the characteristic internal voids when sliced. Orsen and Reidel (2003) consider this deposit to be in the same flows as the Saddle Mountains Petrified Forest. Besides *Taxodioxylon*, some other sites in the area show a good diversity of hardwoods. It is not known whether the hardwood deposits are located in the same strata as the *Taxodium* occurrences. No scientific study has been done on this area to date. Some of the hardwoods are currently being examined to determine whether they represent types not previously identified from the Columbia River Basalts.

Slice of fossil *Taxodium* 'knee' showing internal voids

Site 8: Roosevelt

A number of nice specimens have been collected from this area, but little scientific investigation has been done to date. Orsen and Reidel (2003) consider this assemblage to be equivalent in age to the Saddle Mountain Petrified Forest. Beck (1945) identified four wood types from this area, including redwood (*Sequoia*), hickory (*Carya*), katsura (*Cercidiphyllum*), and Chinese walnut (*Pterocarya*). Several nice logs of elm (*Ulmus*) were collected from the area in the early 2000s, but the exact location was kept secret so the stratigraphic relationship of this find with other Roosevelt sites cannot be established.

Fossil elm wood from near Roosevelt, Washington

Additional localities

The preceding site descriptions only address the better known wood localities in the Columbia River Basalts of eastern Washington. There are a number of localities that have yielded quality fossil wood specimens, including Asotin Creek in southeastern Washington, Petrified Canyon east of Wenatchee, Lookout Point near Yakima, and others. These sites are less well known and have received very little scientific investigation, and will not be addressed here. There are also some significant fossilized wood localities in eastern Oregon that are associated with Miocene basalt eruptions, but they are beyond the scope of this report.

Fossilized oak from Stinking Water, Oregon

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Vol. I, No. 1 (Apr 1, 1941): White and red oaks
Vol. I, No. 2 (May 1, 1941): Elm and sycamore
Vol. I, No. 3 (Jun 1, 1941): Pitchy and cedar-like conifers (*Pityoxylon* vs. *Cupressinoxylon*)
Vol. I, No. 4 (Jul 1, 1941): Fir-like conifers (*Cedroxylon*) and *Ginkgo*
Vol. I, No. 5 (Aug 1, 1941): The Chehalis petrified woods
Vol. I, No. 6 (Sep 1, 1941): *Keteleeria*
Vol. I, No. 7 (Oct.1, 1941): *Cedrus*
Vol. I, No. 8 (Nov 1, 1941): *Sequoia*
Vol. I, No. 9 (Dec 1, 1941): *Abies*(?)
Vol. I, No. 10 (Jan 1, 1942): *Liquidambar*
Vol. I, No. 11 (Feb 1, 1942): *Trochodendron*(?)
Vol. I, No. 12 (Mar 1, 1942): Palm and *Schilderia*
Vol. II, Nos. 1-6 (Apr-Sep 1942): Seven Gray Ranch woods (of the Bridge Creek flora)
Vol. II, Nos. 7-12 (Oct – Mar 1942/3): Squaw Creek forest

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