Planations of Rowena Gap Along the Oregon/Washington Border: Support for Flood Erosion of the Cascade Anticlinorium

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Abstract

The Columbia River Gorge has long been an icon of naturalistic geology. Incised through the Cascade Anticlinorium, the Columbia River supposedly exemplifies the antecedent river hypothesis. This assumes the Cascade Anticlinorium was uplifted at the same rate the Columbia River eroded. In addition to generic challenges to antecedence, it fails to explain planation surfaces along Rowena Gap near the eastern entrance to the Columbia River Gorge. As much as 700 meters above the current river, these planation surfaces truncate folded Columbia River Basalts and extend over 40 kilometers north and south of the Columbia River. Due to their planar nature and no evidence of post-erosion faulting, the planation surfaces were eroded at their current elevation. Secular and post-Flood models alike fail to explain them. That much erosion at such elevation can only be achieved during the Genesis Flood.

Key Words: Genesis Flood, denudation, transverse drainages, Columbia River Basalt, Cascade Orogeny

Introduction

River valleys have long been an icon of the naturalistic paradigm. Beginning with the gradualists of the eighteenth century, these valleys have been used to support a secular geology based on "deep time" and transmutation of organisms (Reed, 2011; Oard and Reed, 2018). Due to the rejection of the Biblical heritage, naturalistic researchers rejected the supernatural and extraordinary for the gradual operation of modern forces. Despite a renewing acceptance of catastrophes, naturalistic geology has remained steadfast to deep time and uniformitarianism (Reed, 2018). As such, river valleys have remained pivotal in the debate on the antiquity of Earth's surface.

Despite many geologists' *a priori* acceptance of naturalism, much evidence favors the Genesis Flood over their uniformitarian geohistory (Reed, 2011). Found across the globe, water gaps are one such challenge. Also called transverse drainages, these landforms are

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river valleys that transect structural barriers such as mountain ranges, defying reasonable naturalist explanation (Oard, 2008). Several secular theories of their origins have been desperately retained, the most common being the antecedent river hypothesis. In it, water gaps are the result of an antecedent stream that "was established before local uplift or diastrophic [tectonic] movement was developed across it [the stream's course] and that maintained its original course after and in spite of the deformation by incising its channel at approximately the same rate as the land was rising" (Jackson, 1997, p. 27, brackets added). This coerces the conclusion that tectonic and fluvial forces proceeded in equilibrium for extended periods of time (Oard, 2008).

There are few places where this theory has been more touted than at the Columbia River Gorge. Constituting the boundary between Washington and Oregon, the Columbia River Gorge straddles the Cascade Anticlinorium, the most prominent range in a fold belt along the western United States (Cheney, 2014; Cheney, 2016b; Isaacs, 2020) (Figure 1). So strongly has this argument been forwarded that Oard (2018) noted that the "One water gap that potentially could be explained by uniformitarian geology is the Columbia River Gorge…It is possible to claim that the river was antecedent… and the mountains uplifted slowly enough for the river to cut downward."

Despite its popularity, antecedent stream theory here ignores the extensive high elevation truncation along the Cascade Anticlinorium, such as the erosion surface visible in the region near Mount St. Helens (Isaacs, 2020). Furthermore, the Columbia River Gorge is replete with planation surfaces truncating folds high above the current river. Largely ignored in the uniformitarian literature, these planations support a massive denudation of the region during waning recessional phases of the Genesis Flood.

Structure and Stratigraphy of the Cascade Anticlinorium

The northwestern United States is dominated by a complex fold belt resulting from extensive continental foreshortening. Four "composite anticlinal structure[s] of regional extent composed of lesser [parasitic] folds" (Jackson, 1997, p. 28, brackets mine; see Figure 2) known as anticlinoria range north-south from the southern tip of British Columbia to the northern regions of California. These include the Coast Range Anticlinorium along the coastline and Eocene metamorphic core complexes in eastern Washington and Idaho, but the most spectacular is the Cascade Anticlinorium, which exceeds 3.6 km in height from the structural base of the Pasco Basin in eastern Washington to the present crest of the Cascade Anticlinorium (Cheney, 2016b). Superposed on the north-south anticlinoria are smaller east-west synclinoria ("composite synclinal structure[s] of regional extent composed of lesser [parasitic] folds." Jackson, 1997, p. 645, brackets mine), such as the Dalles-Umatilla Syncline in Northern Oregon. Though minor in comparison to the anticlinoria, the overprinted synclinoria cause structural lows across the anticlinoria, producing a characteristic "egg crate" topography of high north-south ridges marked by slightly lower east-west passes (Cheney and Sherrod, 1999; Cheney and Hayman, 2007).

Many of these synclinoria have since facilitated drainage towards the Pacific Ocean, the most prominent case being the Columbia River Gorge. Flowing through the Cascade Anticlinorium, the Columbia River follows the northern limb of the east-west Dalles-Umatilla Synclinorium towards the Pacific Ocean, exposing the Cascade Anticlinorium's southerly plunge in southern Washington and northerly plunge in northern Oregon due to the Dalles-Umatilla Synclinorium (D-U on Figure 1) (Cheney, 2014). Both the anticlinoria and synclinoria are truncated by an extensive erosion surface. In the region contiguous to Mount St. Helens, folds have been truncated by over 7,850 m, suggesting that a greater volume of rock was eroded from the Cascade Anticlinorium in Washington alone than the water of all the Great Lakes (Isaacs, 2020).

In British Columbia and northern Washington, the Cascade Anticlinorium is dominated by a crystalline core. Farther south, this core is mantled by four major unconformity-bounded sequences (synthems) defining the structural features of the region (Cheney, 2016a) (Table 1). Dated to the Early to Late Eocene, the lowermost sequence is the predominately arkosic Challis Synthem containing interbeds of basaltic to rhyolitic flows and volcaniclastics. The second is the volcaniclastic Kittitas Synthem representing the Late Eocene to Early Miocene. The Walpapi Synthem (Early Miocene to Pliocene) is the final extensive synthem and is represented primarily by the Columbia River Basalts, a series of tholeiitic basalt flows erupted from fissures in eastern Washington and Oregon totaling over 230,000 km^2 (Reidel et al., 2013). This is sparsely capped by the Pliocene to recent High Cascades Synthem comprised of eruptive and mass-wasting products associated with the Pleistocene cones.

Geology of Rowena Gap

As a gateway to the Pacific Ocean, Rowena Gap is an important physiographic boundary along the course of the Columbia River (Figure 3). After leaving its source in the Rocky Mountains of British Columbia, the Columbia River flows south across the Columbia Plateau in Eastern Washington until it turns west through the Columbia River Gorge, a narrow 130 km-long canyon up to 1,200 m deep, cut through the Cascade Anticlinorium. Approximately ten kilometers downstream the confluence

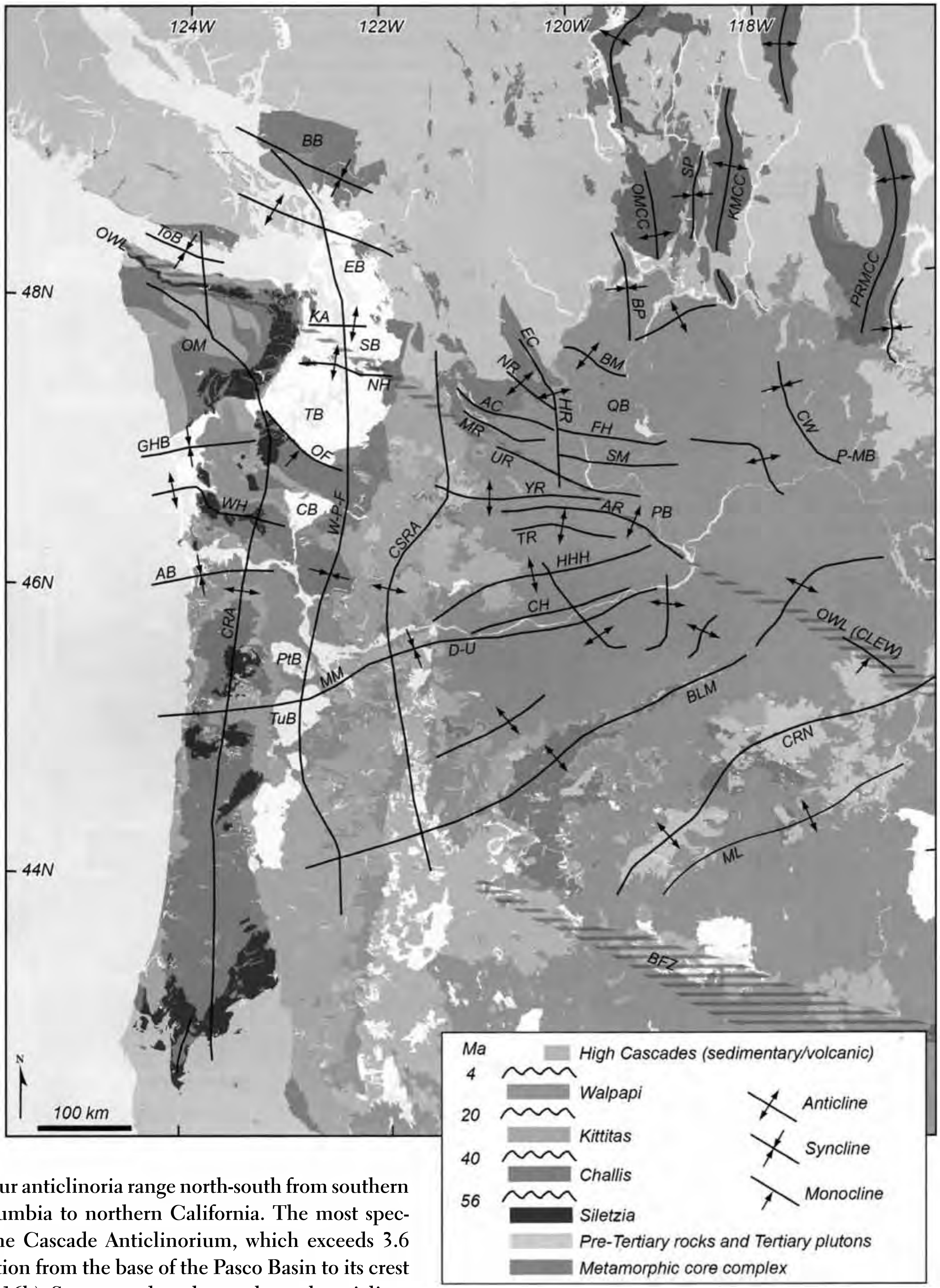

Figure 1. Four anticlinoria range north-south from southern British Columbia to northern California. The most spectacular is the Cascade Anticlinorium, which exceeds 3.6 km in elevation from the base of the Pasco Basin to its crest (Cheney, 2016b). Superposed on the north-south anticlinoria are smaller east-west synclinoria such as the Dalles-Umatilla (D-U) in Northern Oregon. This network of north-south/east-west structures produces the characteristic "egg crate" topography of north-south ridges and slightly lower east-west passes, which facilitates transverse drainages like the Columbia River Gorge. After Cheney, 2016b.

of the Deschutes River, Rowena Gap is the first major constriction along the Columbia River Gorge, which is flanked by rock walls towering over 700 m above the current river.

Incised on the northern flank of the Dalles-Umatilla Synclinorium, the Columbia River Gorge cuts through a complex network of folds. Some north-south parasitic anticlines of the Cascade Anticlinorium only plunge along the east-west Dalles-Umatilla Synclinorium, while others have been rerouted due to later folding overprinted onto the Cascade Anticlinorium. As seen in Figure 4, two anticlines run north-south across the Columbia River between Hood River and The Dalles in northern Oregon. Trending south past White Salmon, Bingen Anticline crosses the Columbia River to west of Hood River where it is displaced eastward. East towards The Dalles, the Ortley Anticline trends from the Columbia Hills across the Columbia River towards Ortley Plateau, which lies over 700 m above the river. These two anticlines are separated by the Mosier Syncline, while to the east the Dalles Syncline (a segment of the Dalles-Umatilla Synclinorium) parallels the Ortley Anticline until it turns west, cutting off the Bingen and Ortley anticlines.

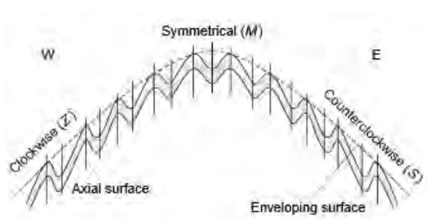

Figure 2. The general structure of a symmetrical anticlinorium, a "composite anticlinal structure of regional extent composed of lesser folds" (Jackson, 1997, p. 28); the inverse of an anticlinorium is termed a synclinorium. Figure after van der Pluijm and Marshak (2004). For further information, see their Chapter 10.

Table 1. The Cascade Anticlinorium is comprised of four unconformity-bounded sequences, termed synthems, composed of a variety of lithologies dated from Early Eocene to recent.

Synthem	Age	Primary lithologies
High Cascade	Pliocene to Present	Alluvial, laharic, volcaniclastic, glaciogenic, and mass wasting deposits
Walpapi	Early Miocene to Pliocene	Flood basalts with interbeds of volcaniclastics, siliciclastics, and lithics
Kittitas	Late Eocene to Early Miocene	Andesitic and felsic volcaniclastics
Challis	Early to Late Eocene	Primarily arkosic with interbeds of basaltic to rhyolitic flows and volcaniclastics

Figure 3. Starting in the foothills of the Rocky Mountains of British Columbia, the Columbia River flows south across the Columbian Plateau in Eastern Washington until it turns west into the Columbia River Gorge, a narrow 130 km-long canyon up to 1,200 m deep. Approximately 10 km downstream the confluence of the Deschutes River, Rowena Gap is the first major constriction along the gorge with rock walls rising over 700 m above the river. Image from "Kmusser" under license CC-BY-SA-3.0 based on United States Geological Survey data.

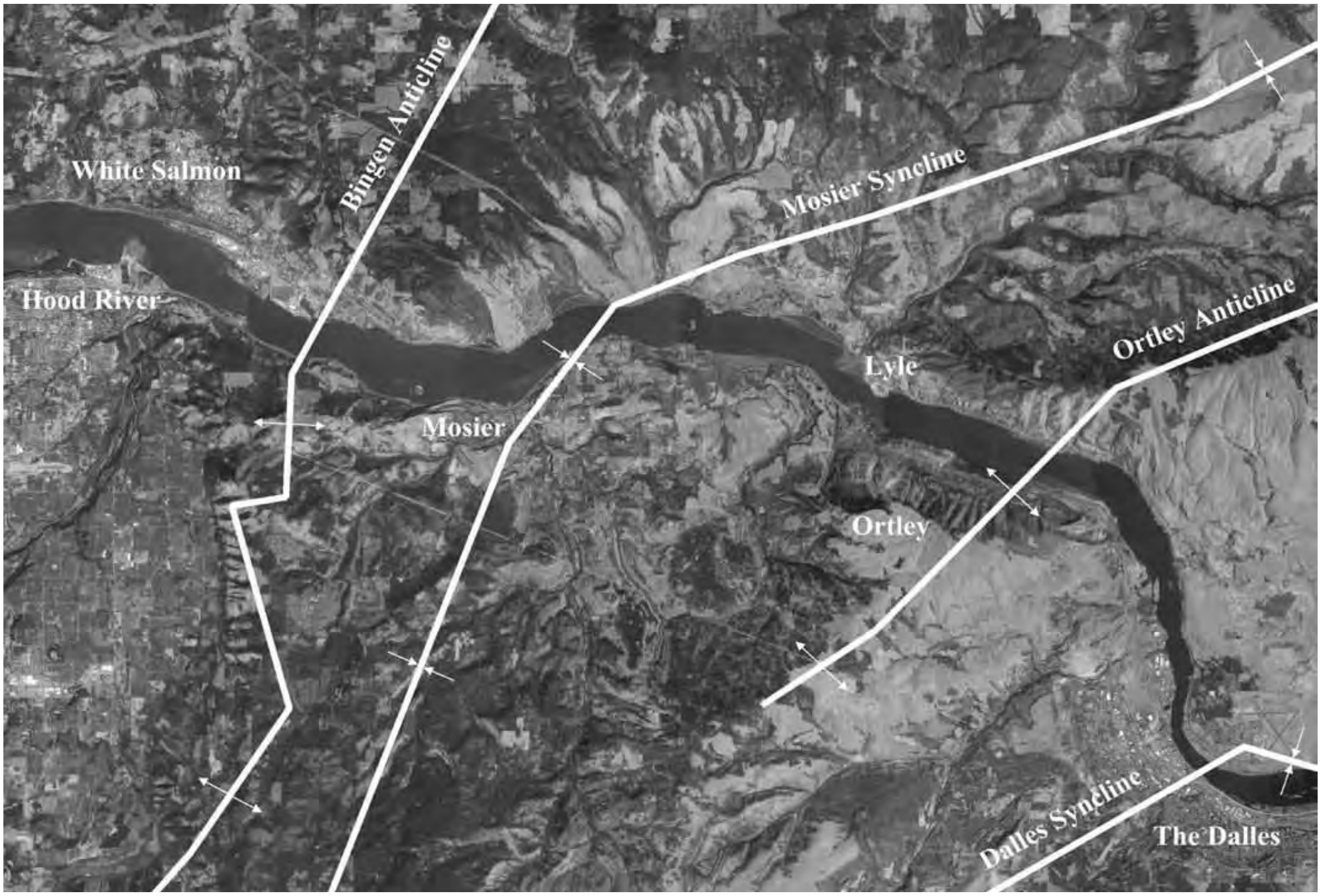

Figure 4. The Rowena Gap is dominated by a complex belt of parasitic folds (Bela, 1982). Bingen Anticline trends south across the Columbia River where it is faulted eastward south of the river, while to the east the Mosier Syncline parallels the adjacent Ortley Anticline southwest from the Columbia Hills to Ortley Plateau with an elevation over 700 m above the river. Similarly, the Dalles Syncline (a segment of the Dalles-Umatilla Synclinorium) parallels the Ortley Anticline until it turns west (south of image), cutting off the Bingen and Ortley anticlines.

Table 2. Stratigraphy of rocks exposed along the Rowena Gap. The Simcoe Volcanics are tentatively assigned as postdating the production and unroofing of the folds. Dates from Bela (1982) and Reidel et al. (2013).

Formation	Alleged Age	Occurrence
Grande Ronde Basalt	15.6–16.0Ma	Exposed along anticlinal crests
Frenchman Springs Member (Wanapum)	15.0 Ma	Exposed along anticlinal crests
Roza Member (Wanapum)	14.98 Ma	Limbs of anticlines
Priest Rapids (Wanapum)	>14.98 Ma	Limbs of anticlines
Pomona (Yakima)	10.85–12 Ma	Limbs of anticlines
Post-Folding/Post-Unroofing		
Simcoe Volcanics	4.5 Ma	Limbs of anticlines
Missoula Flood gravels	>15 ka	Local river drainages/terraces

Exposed along Rowena Gap are rocks dated Miocene to recent, the Columbia River Basalts (CRB) featuring most prominently. Because erosion of the folds has incrementally unroofed the strata, anticlines are generally crested by the Frenchman Springs Member of the Wanapum Basalt followed by the Roza Member, Priest Rapids Member, and the Pomona Member of the CRB (Bela, 1982; Reidel et al., 2013). Particularly common south of Hood River and the Ortley Plateau, the volcaniclastic Chenoweth Formation is occasionally overlain by the Simcoe Volcanics, which are here tentatively assigned as post-dating the production and erosion of the folds (Table 2). Local alluvium and Missoula Flood gravels fill the surrounding river drainages incised into the Grande Ronde Basalt (Bela, 1982).

Secular Paleoenvironmental Reconstructions at the Columbia River Gorge

The Columbia River Gorge has been well studied for over a century, revealing new insights and competing interpretations on the genesis of the CRB, the path of the "ancestral" Columbia River, and the Cascade Orogeny. The work of Tolan and Beeson in the 1980s has formed the basis of modern interpretation. In the introduction to one of their classic studies, they state:

> "Flows of the Miocene Columbia River Basalt Group that are found in western Oregon and Washington (Fig. 3) are thought to have entered this area through a broad low that existed astride the site of the present-day northern Oregon Cascade Range…. The area to be discussed in this paper [Tolan and Beeson, 1984] (Fig. 1) is on the northwestern margin of the low, where pre-existing topography, regional deformation, and channel and canyon cutting by the ancestral Columbia River led to the presence of major intracanyon flows within the Columbia River Basalt Group." (Tolan and Beeson, 1984, brackets mine)

In that paper, they concluded:

> "The Priest Rapids Member (Wanapum Basalt) and the Pomona Member (Saddle Mountains Basalt) of the Columbia River Basalt Group both crossed the Miocene Cascade Range into western Oregon and Washington via ancestral Columbia River channels. … Our work tentatively suggests that the onset of Cascadian uplift in northern Oregon and southern Washington and the incision of the [modern] Columbia River Gorge may have begun as late as 2 m.y. ago." (brackets mine)

Summarizing this conceptual history, Tolan et al. (2002) state:

> "One constant factor during this 17 million-year history was the presence of a drainage system through this region that was the forerunner of today's Columbia River system. Results from geologic studies … have found that the ancestral Columbia River has not always followed its present-day course. The path of the ancestral Columbia River across this region (as well as its major tributaries) has been repeatedly changed due to the effects of flood basalt volcanism, Cascade Arc volcanism, and regional-scale deformation. The present-day path and Gorge of the Columbia River are the end result of this dynamic geologic history."

Later work identified this alleged paleocanyon beneath the present Mount Hood in northern Oregon, after which the Columbia River Gorge is suggested to have migrated northward following subsequent regional diastrophism. Due to this Columbia Trans-Arc Lowland, Riedel et al. (2013) suggested that the CRB flows were funneled through the ancestral Cascade Range and thus limited the flows to their western transect to the Pacific Ocean. However, this ignores the extensive unconformity at the base of the Walapi Synthem, which indicates that the pre-CRB topography was relatively planar (Cheney, 1997). Furthermore, the CRB flows along the Columbia Trans-Arc Lowland dip towards the axis of the paleocanyon of Tolan and Beeson (1984), indicating that it is not a prior river gorge but instead an east-west syncline (Newcomb, 1967). The slight non-horizontality of flows along the alleged paleocanyon has been understandably overlooked in early geologic mapping, but even the existence of flat-lying CRB stratigraphy is a "structural accident" that "defines a westerly striking syncline between anticlinal uplifts of the CRBG in the Washington Cascades to the north and the Oregon Cascades to the south" (Cheney, 1997).

The folds along the CRB challenge not only the paleocanyon interpretation of Tolan and Beeson (1984) but also the very existence of the Cascade Range prior to the CRB outpourings. With CRB flows ranging as deep as 4 km beneath the surface in eastern Washington, the Pasco Basin has been interpreted as resulting from ponding of the CRB east of the Cascade axis, yet structural analysis of the basin indicates that the flows dip east from the Cascade Range towards the basin, indicating uplift of the Cascades and/or sinking of the Pasco Basin after the emplacement of most of the CRB flows. Swanson (1997) found that some flows were as much as several km *uphill* of their source fissures, indicating that the Pasco Basin is a *structural* rather than depositional feature. The existence of CRB flows in structural lows and their paucity along structural highs suggest that the current extent of the CRB is a function of structure: the CRB had been preserved in structural lows (such as the Dalles-Umatilla Synclinorium) but removed from structural highs during the truncation of the Cascade Anticlinorium. Thus, the CRB was once more extensive prior to the formation of the ubiquitous erosion surface of the Cascade Anticlinorium.

Planations of Rowena Gap

Flanking the Columbia River, the ridges of Rowena Gap are eroded remnants of several anticlines that currently rise over 700 m above the current river, yet many ridges are planed despite the folds. One such ridge is the Ortley Plateau northwest of The Dalles lying nearly 700 m above the Columbia River. Though a horizontal surface truncating the Ortley Segment of the Columbia Hills Anticline (Figure 5a), the Ortley Plateau correlates to planations on other folds

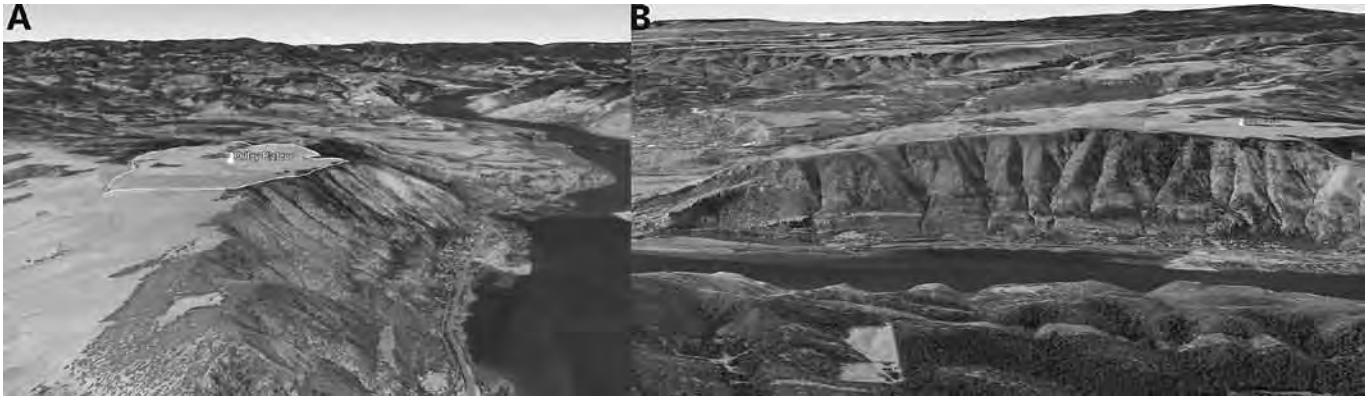

Figure 5. A. Lying nearly 700 meters above the Columbia River, the Ortley Plateau (as seen from the east looking west) is the remnant of a truncated Ortley Anticline. The planar structure and lack of upfaulting implies that the erosional surface was produced at its current elevation. B. The Ortley Plateau correlates to planations on other folds to the south, which produces a plane with slight dips east (left) from Mount Hood, as can be seen from this view looking south. Courtesy of Google Earth.

to the south, which produces a regional surface which dips slightly east from Mount Hood (Figure 5b). To the north, a planation at a similar elevation extends from Coyote Wall on the western limb of the Bingen Anticline northward over 40 km. This planation has been extensively incised, leaving several segments north of the Columbia River. Taken together, the planations correlate to nearly the same elevation across 80 km and produce a triangular shape centering around Rowena Gap.

Antecedence Fails to Explain Planations

The presence of these planation surfaces challenges the antecedent stream theory of the Columbia River. Antecedence is predicated on the assumption that uplift and erosion continue in equilibrium in order to allow the river to incise the mountain, but the erosion that formed these planations truncate folds. If a river eroded an active fold that continued to be uplifted after the river's erosion ceased, the resulting planation surface would be an arc because of the continued uplift, but these surfaces are planar, indicating that the planations were created at their present elevation *after* folding had largely ceased. Furthermore, these planations correlate to others, tens of km north and south of Rowena Gap, which would force the antecedent river to be eroding at the planations' current elevation across an expanse of over 80 km *at the same time!*

With no evidence that these planation surfaces have been uplifted by faulting, what can the secular paradigm do? Extensively truncated anticlines near Mount St. Helens (Isaacs, 2020) are best explained by flowing water because, "wind lacks the necessary power, while there is no evidence of glaciers forming such an extensive erosion surface." This is also true of the planations of Rowena Gap because glaciers receive their erosive potential due to the force of gravity along a slope, which the planations generally lack. Mass wasting also fails to explain these surfaces because there is no evidence of the colluvium, neither could mass wasting produce 80-km wide surfaces. Even the Lake Missoula Flood could not produce these surfaces, because the flow was restricted to existing basins and valleys and reached a depth of only 300 m through the Rowena Gap (Allen and Burns, 1986). This leaves the secular model with only the superimposed (superposed) stream hypothesis, which supposes that water gaps were produced by burying the obstruction (e.g., mountain range) under sediment. This would negate the problem of elevation by bringing the river to the planations' elevation, but such a solution would raise more mysteries than answers. Indeed, this model would require that the entire Pasco Basin be buried beneath sufficient sediment in order to raise the elevation of the Columbia River to the height of the planations, a preposterous proposition (Isaacs, 2020). The secular paradigm is further complicated by the Columbia River Gorge incising at an oblique angle through the north limb of the east-west Dalles-Umatilla Synclinorium rather than along its axis. Not only did the river not follow the original valley floor of the Dalles-Umatilla Synclinorium, but it eventually flows towards the axis of the associated anticline paralleling the Dalles-Umatilla Synclinorium instead of following the path of least resistance.

Regardless of which model it relies upon, the secular paradigm is challenged by time. Though generally considered an ally of naturalism, time

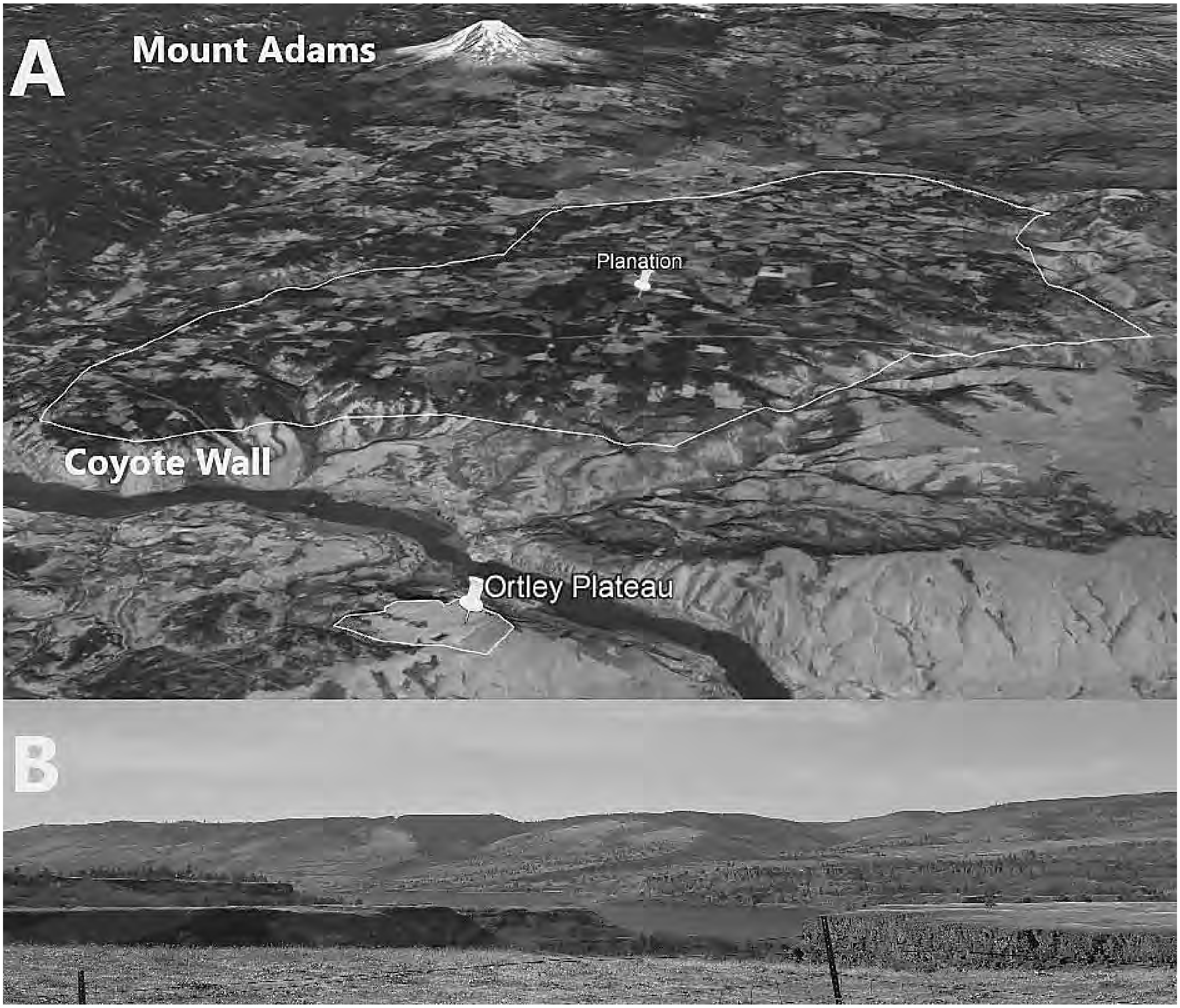

Figure 6. A. North of the Columbia River, a planation of slightly higher elevation than Ortley Plateau extends from Coyote Wall on the western limb of the Bingen Anticline northward over forty kilometers. This planation has been extensively incised, leaving several segments of a single planation north of the Columbia River. B. Portion of the planation surface visible east of Mosier, Oregon, across the Columbia River to the north.

is too short for the Columbia River to produce the planations and carve the Columbia River Gorge. Indeed, Tolan et al. (2002) claimed that the Columbia River's course was set over the past 17 million years, but the uplift of the Cascade Anticlinorium after the CRB flows reduces the time to no more than 4 Ma if not less. This may give the secular model too little time for gradual processes to produce the Columbia River Gorge and associated planations at Rowena Gap.

Planations Support Flood Erosion

Uniformitarian explanations of the planations of Rowena Gap are clearly inadequate, and these large-scale planation surfaces require a mechanism that could: (1) erode powerfully enough over a broad area to plane folded rocks of various lithologies, (2) erode at an elevation of 700 m above the current river surface. These conditions apparently preclude local catastrophes (uniformitarian or diluvial) such as Ice Age floods. Field data show that those catastrophes are limited to extant basins. Even the Lake Missoula Flood failed to reach half the required elevation of 700 m.

Therefore, the best apparent explanation is strong runoff currents of the Genesis Flood (Oard, 2001a, 2001b). Based on erosion in the region contiguous to Mount St. Helens, Isaacs (2020) proposed that sheet flow from the uplifting Rocky Mountains truncated the Cascade Anticlinorium, which also would have planed the regional-scale north-south anticlinoria. As sheet flows across the region weakened into channelized flow, the waters began to focus on the present-day Columbia River Gorge. Based on the elevation of the planations and their correlation across the region, these planation surfaces were likely produced while the Floodwater channelized through the nascent gorge, sweeping across the eastern limb of the Cascade Anticlinorium and producing the triangular shape centered at Rowena Gap. How this sheet flow relates to the uplift of the Ochoco and Strawberry Mountains in Central Oregon is yet to be ascertained, but further study of water gaps and planation surfaces should help to further define the relative chronology of tectonic and erosional regimes active through the Genesis Flood in this region.

Conclusions

Though used by eighteenth-century geologists as evidence of deep time, river valleys remain stubbornly inexplicable to secular scientists. The very presence of rivers transecting mountain ranges along water gaps remains anomalous despite the host of explanations set forth by researchers. Of all the water gaps found across the world, Oard (2018) has suggested that the Columbia River Gorge may be the only one conducive to secular models, yet this paper has demonstrated that not even Columbia River Gorge is explained by naturalistic models. Planation surfaces that truncate anticlines as much as 700 m above the current river and correlate across 80 km of the eastern limb of the Cascade Anticlinorium defies secular explanation. The lack of upfaulting or arching of the horizontal surface indicates the planations were produced at their current elevation, yet no secular model can explain erosion on such a vast scale.

The inability of wind, glacial, and mass wasting processes to explain these features leaves moving water as the only reasonable explanation of the planations, but river antecedence fails to explain why the planations were produced so high above the current river *after* regional folding. Though elevating the river, a superimposed river only compounds the challenge by a preposterous quantity of sediment requiring removal by gradual river erosion. Because the Columbia River Basalts predate the folding of the Cascade Anticlinorium, this leaves less than four million years within the uniformitarian timescale for all of this erosion to occur. If even the simplest of all water gaps cannot be explained by uniformitarian conditions, then how inept naturalistic geology must be! Indeed, it is evident that only the Genesis Flood provides the needed mechanism to produce the observed field data. Receding currents flowing from the uplifting Rocky Mountains near the climax of the Genesis Flood likely funneled through the nascent Columbia River Gorge being incised through the Cascade Anticlinorium, which served to partially impound the receding currents. If this is the case, Floodwaters may have also been diverted south through the drainages along the eastern foothills of the Cascade Anticlinorium in central and southern Oregon, potentially causing similarly extensive erosion. This should leave regionally correlative erosion surfaces and associated deposits, providing clues to better understand the tectonic and erosive forces active across the western United States during the Genesis Flood.

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