Rhiana Elizabeth Henry
Tectonic History
Hildebrand Project 2A
December 9th, 2016

Rubia has Triassic through early Cretaceous plutonism that is absent from the truly North American continental margin.

Are there any magmatic products on Hildebrand's North American margin?

Robert S. Hildebrand argues in his Geological Society of America Special Papers "Did Westward Subduction Cause Cretaceous–Tertiary Orogeny in the North American Cordillera?" and "Mesozoic Assembly of the North American Cordillera" that a hypothetical "ribbon continent" called Rubia collided with the North American continent around ~124 Ma. He claims that this hypothetical ribbon continent experienced magmatism during the Triassic through early-Cretaceous, as it assembled from what he calls Sierrita and Proto-Rubia, while the edge of North America was a passive margin and experienced no magmatism. To test this theory, I used NAVDAT: Western North American Volcanic and Intrusive Rock Database. I searched for volcanic samples during 250-150 Ma on either side of the North American continental margin, as he has defined it. Additionally, I used NAVDAT to search for magmatism between 150-100 Ma, as this includes the time of Rubia's collision with North America.

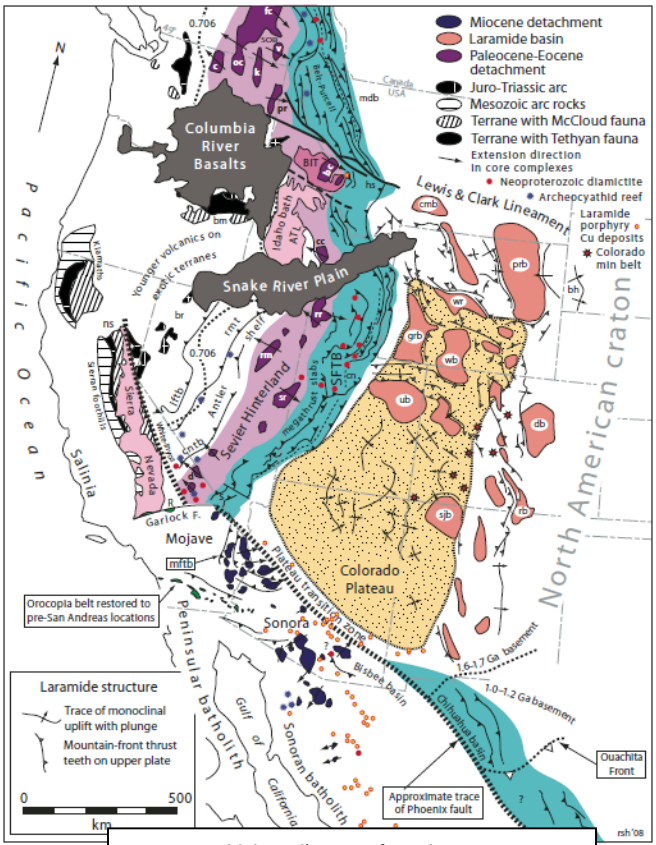

Figure 1: Hildebrand's map of North American versus exotic terranes. From Hildebrand, 2009.

The first task I was to decide what to use as the continental margin of North America, as defined by Hildebrand. In Figure 1, everything east of the blue band is distinctly North American, according to Hildebrand's model. Therefore, this approximate region was chosen as my search location. To the east, including parts of Colorado, Montana, Wyoming, New Mexico, eastern Utah, and Arizona were my North American target locations. To the west, including parts of western Utah, eastern Nevada, Idaho, Montana, Arizona, and Oregon, and southern British

Columbia were my target locations for Rubia. Due to the boundary settings in NAVDAT, my search regions are not perfectly precise to line up with Hildebrand's margin, however, they seem sufficient for a search of this type.

The first search was the most crucial to determine if Hildebrand had found a good argument for North America as a passive margin during the Triassic through early-Cretaceous. The goal was to find evidence of magmatism within Hildebrand's North America. The search criteria for igneous samples in NAVDAT were as follows: 50% < SiO_2 < 75%, 250-150 Ma in age, in the search window seen in Figure 2. This range of silica content was chosen to aim for roughly andesitic composition, but with enough range to find grano-diorites and nearly basaltic events. That should have been a wide enough net to catch any significant magmatic events in this time period. The search found precisely zero igneous samples fitting my criteria; Hildebrand seems to be correct. His version of the North American margin seemed to be a passive margin during the Triassic through early-Cretaceous.

Figure 2: 250-150 Ma search window in NAVDAT for magmatism; North American side of the margin.

The next task was to determine if the region Hildebrand claims was part of Rubia experienced magmatism during this same time period. The search criteria were narrowed slightly to 55 < SiO_2 < 70%, for the sake of getting closer to andesitic compositions, which would occur in a magmatic arc such as Rubia. Figure 3 shows the search window chosen. Unlike the initial search, this returned 116 samples, clustered in northeastern Nevada (Figure 4). Two major sets of ages were found in this data; spikes at 150-160 Ma, and another spike at 170-175 Ma. The magmatism is slightly more felsic than a standard

Figure 3: 250-150 Ma search window in NAVDAT for magmatism; Rubian side of the margin.

Rhiana Elizabeth Henry
Tectonic History
Hildebrand Project 2A
December 9th, 2016

Figure 4: 250-150 Ma search results in NAVDAT for magmatism; Rubian side of the margin.

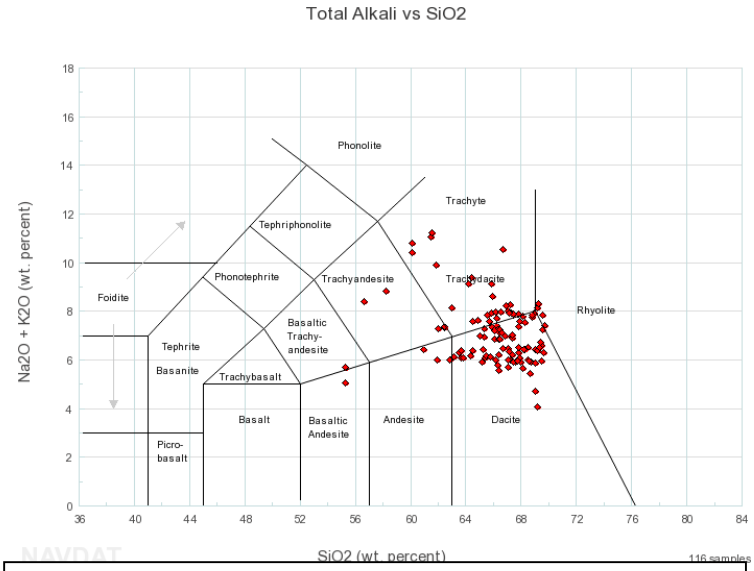

Figure 5: 250-150 Ma search results in NAVDAT for magmatism; Rubian side of the margin. Total alkali content versus silica content.

andesite, tending towards a dacitic composition (Figure 5) on a plot of alkali versus silica content. This suggests the influence of some continental type material in the melt creating these samples. If this region was part of a ribbon continent, the crust of Rubia would have been fairly felsic. Since the North American side of the margin contained zero samples, but the Rubian side does have igneous material, it would appear that Hildebrand is correct in identifying the eastern side as passive, while the western side of the margin had activity.

The goal of the following search was to determine if the North American side of the margin remained magmatically quiescent during the collision with Rubia. The search criteria were approximately the same as previously, however, the region windows were slightly changed due to the inability to save a search that comes up with zero results. I had to replicate the window by hand, introducing some inaccuracy. Between 150-100 Ma, along the North American side of the margin, with $50\% < SiO_2 < 75\%$, zero igneous samples were found once again. However, on the Rubian side of the margin during this same time period, with $55\% < SiO_2 < 70\%$, 183 samples were

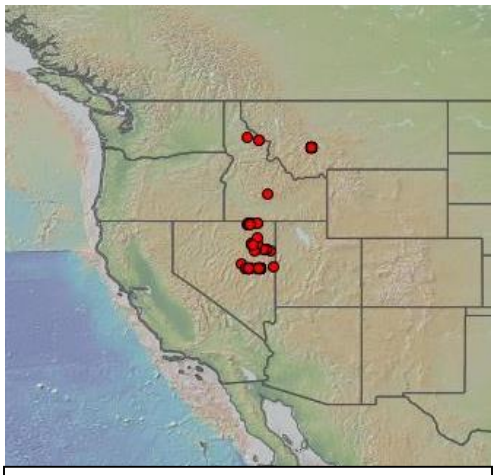

Figure 6: 150-100 Ma search results in NAVDAT for magmatism; Rubian side of the margin.

uncovered. The majority are also in northeastern Nevada, however, some are within Idaho and Montana (Figure 6). The ages are clustered at 110-104 Ma in Nevada, but the few in Idaho are ~120 Ma.

Based on this search, it appears that Hildebrand is correct in identifying a magmatic discrepancy along this margin during the Triassic through early-Cretaceous, and through the collision of Rubia and North America. During assembly of Rubia at ~124 Ma, the Rubian side of the margin experienced magmatism while the North American side did not; this could potentially be evidence for Hildebrand's idea of westward subduction of North America as opposed to conventional models of purely eastward subduction starting with the Antler orogeny. However, this NAVDAT search can only be used as a starting point for such an investigation.

References

Hildebrand, Robert S. "Did Westward Subduction Cause Cretaceous–Tertiary Orogeny in the North American Cordillera?" Geological Society of America Special Papers (2009): 1-71.

Hildebrand, Robert S. "Mesozoic Assembly of the North American Cordillera." Geological Society of America Special Papers (2013): 1-169.

The Western North American Volcanic and Intrusive Rock Database. www.navdat.org