The Florissant redwood trees deposited from a Flood log mat

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There are numerous vertical, petrified trees found in sedimentary rocks around the world. The vertical, petrified redwood stumps at Florissant Fossil Beds National Monument are a famous example. They have several unusual features that are problematic for an *in situ* interpretation. In the Florissant Formation, 1,500 insect and spider species fossils and about 260 plant species and pollen have been found. They come from widely diverse environments, yet they are buried together. There is no modern analogue. Some of the fossil species are found alive in subtropical and tropical environments. Some are not native to North America but from distant parts of the globe. The hypothesis that well-preserved fossils are from preservation by biofilms has contradictions. The paleoaltitude is thought to be near the same as it is today, about 2,490 m, but with an anomalous mean annual temperature that was much warmer with very little frost. There are numerous contradictions to the uniformitarian hypothesis. The evidence supports deposition of the organisms, including the vertical redwood stumps, from floating log mats during the Genesis Flood.

Although creation scientists have reasonable answers for many earth-science challenges,[1] many still exist that need adequate answers. One of these challenges is upright petrified trees in sedimentary rocks,[2] which uniformitarian scientists almost always assume grew *in situ*.

Geological basis for the log-mat model for the Flood

From an estimate of the amount of coal in sedimentary rocks, it can be deduced that the amount of carbon in the pre-Flood terrestrial biosphere was 10 times the present-day biosphere.[3] As a result of the Flood, creation scientists have recognized that many of these trees and vegetation would end up in huge mats of logs and vegetation floating for a while on the floodwater.[4–6] These floating mats would have served as a temporary home to all kinds of creatures attempting to survive a global Flood in which the land was rapidly disappearing. The logs that floated on Spirit Lake north of Mount St Helens after the 1980 eruption provide an analogue, although imperfect because terrestrial organisms had no need to briefly inhabit those logs. Many of the floating logs on Spirit Lake have sunk vertically.

The Flood log mats provide reasonable answers to five challenges to the Flood model in sedimentary rocks: polystrate trees, including the Yellowstone fossil 'forests'; paleoflora, including high-latitude warm types; insect fossils; amber, sometimes containing insects and other organisms; and coal seams.[9] Many of these logs would have continued to float on the oceans after the Flood and may explain numerous biogeographic mysteries,[7–11] such as how New World Monkeys of Central and South America made it across the Atlantic Ocean after the Flood.[12]

Numerous locations with upright petrified trees

I have written about several of the many outcrops of vertical petrified trees in sedimentary rocks. These include those found in a coal mine about 7 km north of Sutton, Alaska, USA, which is 80 km north-east of Anchorage (figure 1).[13] Petrified trees of Ginkgo Petrified Fossil Forest State Park in central Washington, USA, are orientated at various angles to the Columbia River Basalt flows and their interbeds, which are predominantly horizontal. The tops of these trees have been sheared off. Mummified stumps of warm-climate *Metasequoia* (dawn redwood) and *Glyptostrobus* (swamp cypress) stumps, 1 m high and up to 1 m in diameter at the base of the trunk, have been found on Axel Heiberg Island at 80°N in the Queen Elizabeth Islands of north-east Canada.[14,15] Petrified stumps and trees are found at many other locations in the Queen Elizabeth Islands. These are dated Paleogene, the early Cenozoic. The so-called fossil forest of Theodore Roosevelt National Park, North Dakota, USA, has hundreds of vertical stumps about 2 m tall that flare at the base. The trunk is not only sheared off, but the trees also have no branches, roots, or soils (figure 2).[16] They are found in the early Cenozoic Fort Union Formation.

The Yellowstone 'fossil forests' are probably the best example of vertical petrified trees that are considered *in situ* and hence seen as a challenge to Flood geology.[17] Uniformitarian scientists have counted up to 75 levels of vertical trees at Specimen Creek that supposedly represent 100,000 years.[18] But there are a number of contradictions to the uniformitarian story, such as no soils, and often no roots (figure 3), which suggests deposition from log mats during the Flood.[19–21]

Figure 1. Two polystrate trees, up to 4 m (13 ft) tall, from a coal mine north of Sutton, Alaska, USA. Notice that there are no roots, branches, or soils.

Figure 2. Portion of one layer of vertical petrified trees in the 'fossil forest' of Theodore Roosevelt National Park, south-west North Dakota, USA. Peter Klevberg pointing to the lack of roots and soil under the vertical tree stump.

Figure 3. Vertical tree with no roots in Absaroka Volcanics on Mount Hornaday, north-east Yellowstone Park, USA (David Anderson provides the scale)

All of these locations with vertical petrified trees display many contradictions to uniformitarianism. I have already pointed out problems with the idea of *in situ* vertical trees,[9] such as trees and pollen from a wide variety of environments: from cool temperate to tropical. This is more supportive of what we would expect from a log mat during the Flood.

The Florissant redwood trees

The Florissant Fossil Beds National Monument is west of Pikes Peak at about 2,490 m (8,200 ft) asl in central Colorado and about 3.5 km (2 mi) south of the town of Florissant. The site displays large vertical stumps of redwood trees (*Sequoia affinis* or ancient redwood). Collectors took many of the petrified trees away before it became a national monument in 1969, but about 30 trees still remain (figure 4). A few are not redwoods.

The redwoods are very similar to the extant redwood tree (*Sequoia sempervirons*) that grows naturally only in the coastal areas of northern California and southern Oregon, USA, in which 40% of its water comes from warm season fog. These redwoods are the tallest trees in the world, up to over 100 m (330 ft) and 7 m (23 ft) in diameter. The largest trees are about 1,500 years old. Redwood trees have been planted in many different areas of the world and grow well if watered. Interestingly, redwood trees commonly sprout from the base of a stump or decaying tree, resulting in several trees growing from it, as observed in Redwoods National Park, California, USA (figure 5). They have much the same configuration as the three contiguous petrified stumps at Florissant (figure 6).

'Big Stump' measures 4 m (13 ft) in diameter (figure 4) and was around 750 years old when it died (figure 7). The Florissant redwoods have larger growth rings (figure 7) than those in northern California and southern Oregon, indicating that in the past the redwoods grew in a healthier environment of growth than today.[22] Frost rings are considered rare. The environmental conditions indicated by the fossil tree rings contradict what would be expected at the elevation and latitude of Florissant.

The exhibits say the stumps were preserved because of a volcanic lahar from Guffey Volcano, 24 km (15 mi) to the south-west, that entombed the redwood trees in about 4.5 m (15 ft) of mud and volcanic tuff.[23] Groundwater then penetrated the tuffaceous mudstones, dissolving silica, SiO_2, which was taken up by the trees and filled the volume between the cell walls. Only the part of the tree entombed in the tuffaceous mudstones was permineralized, while the roots and the tree above the mudstone rotted away. Mustoe noted that the permineralization did not follow the typical pattern for the formation of petrified wood.[24] One problem with the lahar explanation is that the top of the lahar should have been

at the same overall height, so the tops of the stumps should also be the *same* height. However, the Big Stump is about 9 m (30 ft) higher than some of the others (figure 8). That is twice as high as the thickness of the supposed lahar.

'Lake Florissant'

The petrified redwoods are found within a small area of the deposits of 'Lake Florissant'. This lake is said to have been formed by the occasional damming of a south-flowing stream by lahars. The lake would have been about 1.5 km (1 mi) wide and about 20 km (12.5 mi) long in a valley within the 1.08-billion-year old (supposedly) Pikes Peak Granite that forms a dissected and rough erosion surface on the central Colorado Rockies at about 2,200–3,300 m (7,200–10,800 ft) (figure 9).[25,26] Secular scientists refer to this surface as the 'Tertiary pediment' found at the base of the high Colorado Mountains and it is much dissected and roughened.[27]

The sediments include a lower shale; a lower mudstone with 'stream' deposits and siltstone, where the petrified trees are found near the top; a middle shale; a conglomerate; an upper shale; and a pumice conglomerate (figure 10). These sedimentary rocks are now called the Florissant Formation and all together are 74 m (243 ft) thick. Paleozoic and Mesozoic strata are not preserved and so are claimed to have eroded away.

The shale (figure 11) formed from repeated microlayers of diatoms (light-coloured) and ash that is mostly transformed to clay (dark-coloured).[28] Each couplet is considered to be a 'varve', a repeating sedimentation pattern deposited in one year. The varves are only 0.1 to 1 mm thick, considered 'paper shales', which seems quite thin compared to those forming today. It is mainly in the shales where the delicate leaves, pollen, and insects are found. One problem with the varve interpretation is that there are articulated fish, which should not have been preserved in such thin 'varves'. Interestingly, a compressed opossum fossil was also found in the shales.[29] Many of the fossils are well preserved, but many are not. In one area 56% of insects are disarticulated and 66% were considered of low quality.[30]

The exquisite detail of many of the fossils is claimed to have been preserved almost exclusively in a biofilm, shown by scanning electron micrographs and believed to have originated from the diatoms that grew due to the high silica content of the water.[31] This is unusual in that the vast majority of biofilms are caused by bacteria.[21] The diatoms are composed of 19 'freshwater' genera,[21] but more than 85% are from one species.[32] The most abundant types are similar to modern genera. It is unlikely that the biofilms were responsible for the fossilization since the insect remains in the mudstone and siltstone lack biofilms.[20] In one study section, 436 specimens were found in shale, 62 specimens in

Figure 4. The Big Stump from Florissant National Monument is 4 m (13 ft) in diameter.

Figure 5. Multiple redwood trees in a circle from Redwoods National Park, Northern California (my wife Beverly provides the scale)

Figure 6. Two of three petrified redwoods connected in a circle at Florissant National Monument

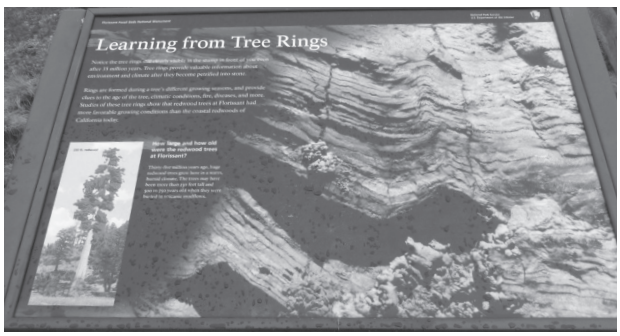

Figure 7. Kiosk at the Big Stump indicating it grew for 500 to 750 years.

Figure 8. The top of one stump in the foreground with the Big Stump in the background (arrow). The difference in the elevation of the top of these two trees is about 9 m (30 ft), which does not seem to represent the top of the ancient lahar.

Figure 9. Erosion surface (line) on front range of central Colorado Rocky Mountains, USA, at about 2,200–3,300 m (7,200–10,800 ft) taken from the top of Pikes Peak

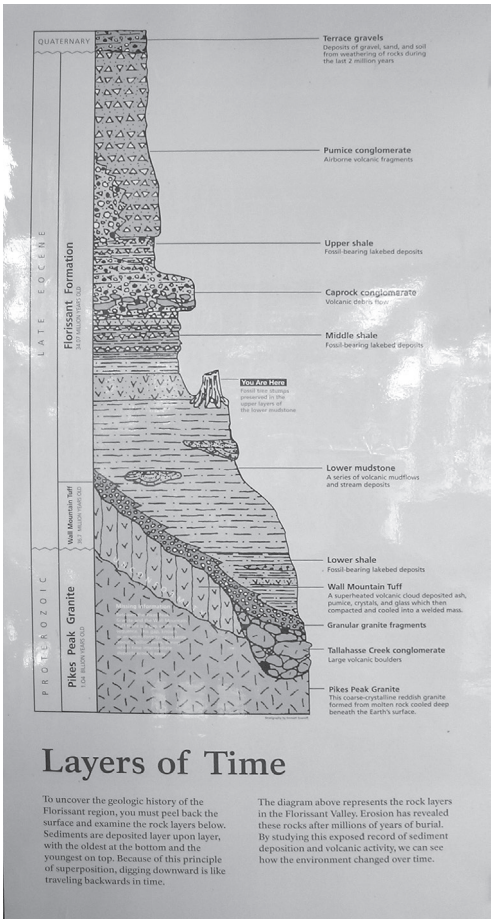

Figure 10. The stratigraphic column of the Florissant Formation from a kiosk at Florissant National Monument

mudstone, and 325 from siltstone.[20] Moreover, well-preserved fossils found at other sites, such as at Republic, north-east Washington, USA, and in the Green River Formation of Wyoming and Colorado, USA, do not have biofilms.[21] Preservation by biofilms, therefore, seems unlikely.

The organisms in the Green River Formation, considered a post-Flood lake by some creation scientists,[33] provide many evidences that it was deposited in the Flood,[34,35] including enough oil to supply the energy needs of the USA for 100 years. Just like with the Florissant site (see below), the fossils from the Green River Formation come from a wide range of climates and environments, such as terrestrial and marine environments.[36]

The dates of the deposits were once controversial.[37] They have been dated by various investigators from Pliocene to Eocene. Based on the paleoflora, MacGinitie "demonstrated that the lacustrine deposits belong to the early Oligocene".[38] But the dates of the Eocene/Oligocene boundary were changed, so that the Florissant Formation then automatically became very late Eocene about 34 to 35 million years in the early Cenozoic.

No modern analogue

The shales include macroflora and pollen from a wide variety of environments.[13] The Florissant site is among one of the world's richest fossil sites with over 50,000 museum specimens from fossils of over 1,800 species, of which 1,500 are insects and spiders and 260 plants.[12,39] There have been taxonomy problems, especially in regard to the older works.[29,40]

Some of the fossilized plants grow today in the southern Rocky Mountains. These include pine, fir, larch, spruce, oak, willow, hemlock, birch, poplar, rose, mountain mahogany, currant, and maple. Some of the plants found in the Florissant area indicate a cool temperate climate, such as spruce, larch, and birch. Others are found only in the eastern USA, such as hickory, redbay, elm, and linden. More are found in Mexico, such as xylonagra, *Conzattia*, and *Thouinia*. And most unusual, some genera come from eastern Asia and are not extant in North America at all, such as the golden-rain tree (figure 12), golden rubber tree, the tree of heaven, *Engelhardia*, *Dipteronia*, and *Eucominia*. The

golden-rain tree also is found today in Fiji.

The numerous insect fossils also indicate a very diverse environment. The most unusual insect fossils are those of the tsetse fly, which is found today only in central Africa. The only known fossils of this blood-sucking disease carrier are from the Florissant site (figure 13). The Florissant insects look basically similar to modern types, but because they are thought to be 34 million years old, taxonomists give them different names thinking they are extinct:

> "Many people expect that the world would have looked drastically different 34 million years ago, but in reality, some organisms such as insects looked very similar to the way they look today."[41]

Taxonomic renaming gives the impression that these 'old' organisms are significantly different, and that evolution has actually taken place. This is probably why the redwoods are given a different species name than modern redwoods.

Vertebrates are rare in the Florissant Formation.[42] These include fish with whole skeletons including the bowfin, which reached a length of 45 cm (18 in); catfish; sucker; and perch.[13] Rare fossils of birds including cuckoo, shorebirds, and ground rollers have been found. Ground rollers live today only in Africa.[13] Only one fossil mammal was found in the shales—a mouse opossum, a marsupial whose closest living relative is from Mexico and South America.

With detailed collecting, other fossil mammals have been found, mostly in the mudstone, siltstone, and stream deposits. Most of these fossils are jaws and teeth. These include the brontothere, an extinct rhinoceros-like animal; an oreodont, an extinct animal somewhat resembling a pig; a small three-toed horse jaw attributed to *Mesohippus*; rabbits; various rodents; a shrew; a mole; and other unidentified bone fragments. There are also clams

Table 1. Seventeen criteria listed by Johns to interpret *in situ* trees

1	Monospecific trees
2	Non-random spacing
3	Non-overlapping roots
4	Roots that cross-cut bedding planes
5	Rapid burial and excellent preservation
6	Paucity of underlying sedimentary rocks
7	Little or no distortion of bedding layers below trunk
8	Mixture of vegetation
9	Lack of root truncation
10	Roots penetrate downward like a spider
11	Trees found in tidal laminations
12	Delicate roots penetrating laminated sediments
13	A more or less complete ecosystem
14	Widely spaced trees resembling modern tree spacing
15	Finding conifers and angiosperms on two or more levels of peat or coal
16	Boulders and cobbles in rooted zone with fine-grained sediments below
17	High height/stump width

Figure 11. Paper-thin shale from Florissant National Monument that contains abundant insect and plant fossils (arrow)

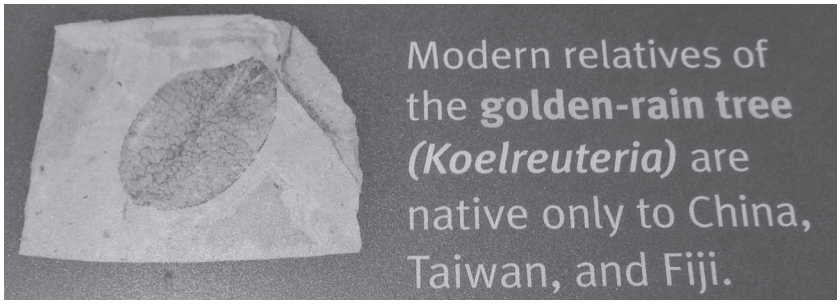

Figure 12. Kiosk of a golden-rain tree leaf fossil found at Florissant Fossil Beds National Monument

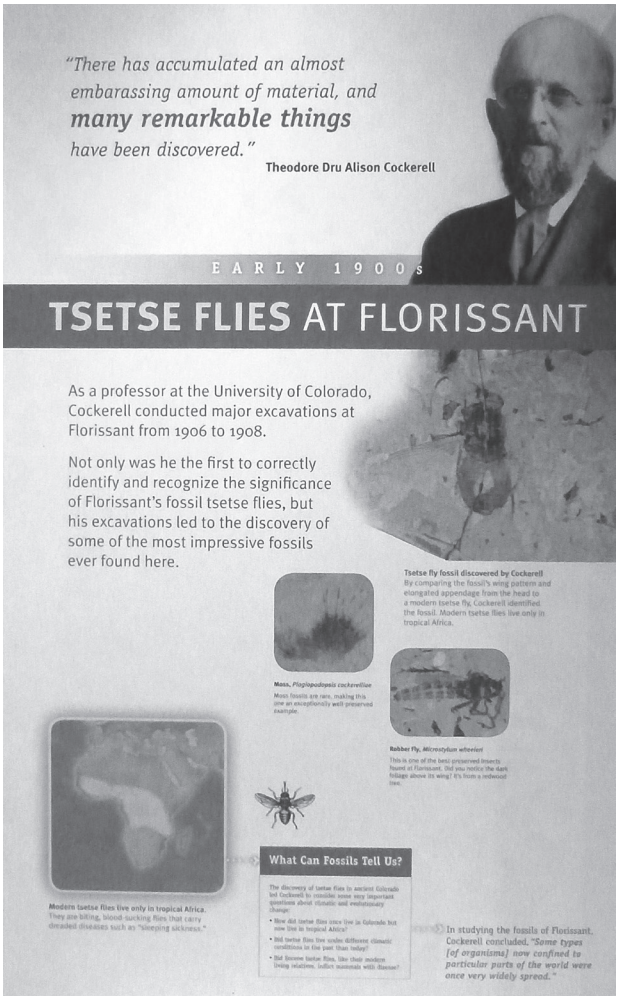

Figure 13. Kiosk about the tsetse fly fossil found at Florissant Fossil Beds National Monument and its modern distribution in equatorial Africa

and snails, but most mysteriously, reptiles or amphibians are missing.[13] This is one more indication that these fossils beds were not from a natural environment.

High elevations and warm temperatures

Researchers have argued over the paleoelevation of the Florissant fossil site.[43] The paleoelevation estimates vary from 455–4,133 m (1,490–13,560 ft).[44] One problem is that the character of the fossils may reflect either altitude or climate change.[45] Zaborac-Reed and Leopold believe the altitude was 1–1.5 km (3,300–4,900 ft), while Meyer believes several methods converge on about the same altitude as today, 2,490 m (8,200 ft) asl,[34] which seems to be the current consensus.

Estimating the temperature and precipitation from the fossils is also fraught with problems. All methods have large errors with leaf physiognomy (mostly the shape of the margin) producing cool temperatures while the nearest living relative method gives warm temperatures. Both paleoenvironmental deductions are likely true since the fossils represent a mixture of environments.[46] Many of the fossils indicate a subtropical climate. Some are even from the tropics.[12] A search was made for a modern analogue from 241 modern forest plots in North America, Central America, and South America.[47] No analogue was found, but three environments came close, which had moderately high mean annual temperature with seasonal precipitation. Meyer and Weber conclude:

> "Nowhere in the modern world is the same association of plants and insects found living together. Among the fossils at Florissant, plants and insects that today are subtropical are juxtaposed beside others that are typically cool-temperate in modern distribution."[48]

Generally, mean annual temperatures are estimated between 13 to 18°C (55–65°F) with very little if any frost. This compares to the mean annual temperature today of 4°C (39°F), but temperatures can drop as low as -37°C (-35°F) in winter.[13]

Criteria for determining *in situ* trees

Johns has presented 17 criteria that can be used to decide whether vertical petrified trees are *in situ* or have been transported.[2] These represent an amalgamation of lists developed by Clarey and Tomkins[49] and Wise[50] with several additions. Johns also challenges some of the criteria produced by Clarey and Tomkins and Wise, and Wise challenges several of the criteria listed by Clarey and Tompkins. John's criteria are presented in table 1. Many of these criteria cannot be evaluated at fossil 'forest' sites, mostly because of lack of exposure for inspection. Some can be challenged, such as monospecific trees, criterion 1. The Florissant trees are mostly monospecific. The numerous trees, probably on one bedding plane, in the Theodore Roosevelt National Park are monospecific, but they lack roots and soil and so are obviously from the Flood. So, criterion 1 is equivocal. Number 15 also seems equivocal and would need detailed analysis of outcrops. It also would depend upon peat and coal being *in situ*, which contradicts the Flood model. Number 5 is the dodge used by uniformitarians to explain the lack of rotting of polystrate trees, but this is as expected within a Flood model with rapid deposition. The finding of long roots, criterion 9, does not necessarily mean the trees are *in situ*. The Yellowstone fossil 'forests' trees sometimes have long roots (figure 14). There are numerous laminates in the sedimentary rocks but proving that any of them are truly tidal, criterion 11, would be very difficult. Number 6 is a necessary but not sufficient criterion for *in situ* trees in a Flood model, since even vertical trees on upper continental

crust does not necessarily mean they are from pre-Flood growth.

The Florissant redwood stumps would be interpreted as *in situ* based on criterion 1, 8, 13, 14, and possibly 17. However, criterion 9 would indicate transported trees, and the huge variety of fossils found from such different environments would indicate that these trees are not *in situ*. Moreover, the stumps are not consistent with an *in situ* interpretation according to criterion 6, as there are fossiliferous sedimentary rocks below the level of the upright petrified trees (figure 10). Nonetheless, I would suggest that many of the criteria in table 1 are equivocal, but instead a mix of organisms from so many different environments should be a very strong criterion for transport.

Figure 14. Broken long root from a stump at Specimen Creek, Yellowstone National Park, USA. (Perry Fishbaugh pointing to the end of the root). The root of a growing tree lies perpendicular over the petrified root.

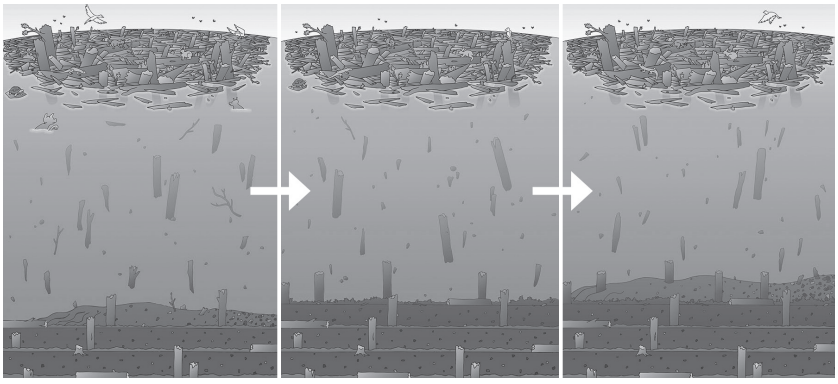

Figure 15. A log mat with trees and other organisms sinking vertically to bottom, while bottom is collecting deposits horizontally from volcanic debris flows forming the Absaroka Volcanics with numerous vertical, petrified trees. (Drawn by Keaton Halley.)

Uniformitarian challenges to *in situ* interpretation

Not surprisingly, many aspects of the Florissant fossils are problematic for the uniformitarian principle. The vertical petrified stumps have no roots and the top has been sheared off. Would not the roots also absorb silica from the lahar and be preserved? Why would redwoods grow at high elevation and far from the coast, even in the 'warm' Eocene? The so-called varves have polystrate fossils, such as the opossum and various fish fossils. Many of the fossils are well preserved, and a diatom biofilm does not seem adequate. The fossils indicate a wide variety of environments, from cool temperate, such as spruce, larch, and birch, to numerous subtropical and a few tropical varieties. Tropical and subtropical species growing at a similar altitude as today along with cool, temperate varieties is a climatic contradiction, even in the warm Eocene. A climate like this is very difficult to model.[51] The main problem is that the radiational cooling in the winter of a continental climate at about 2,490 m (8,200 ft) asl would be intense, since winter cooling depends mainly on the angle of the sun and the continentality of the site. It all adds up to the necessity of another explanation. I propose the fossil beds are deposits from log mats floating on top of the Flood water.[9]

Floating log mats during the Flood explain the fossils

The size of the trees gives the impression that they are very old, perhaps older than the pre-Flood period of about 1,600 years.[52] But, measurements of the tree rings indicate they are no more than 750 years old (figure 7). Moreover, the trees grew from an environment that was even more healthy than the one where redwoods grow today. This supports the deduction that the pre-Flood environment would have been warm and well-watered.[53]

Since the Flood/post-Flood boundary is in the late Cenozoic,[54–60] the Florissant fossil site would be a result of Noah's Flood. The 32 criteria that I developed to determine

the location of this boundary supports this conclusion. These include subtropical and tropical fossils at mid and high latitudes and at high altitudes in continental areas, and the fact that the sediments are consolidated. Furthermore, the early post-Flood period would be cold due to at least volcanic and impact winter and not allow for the growth of subtropical and tropical plants at this latitude. So, the Flood explanation is the most likely explanation of disharmonic plant, insect, and animal associations, which also supports placing the Flood/post-Flood boundary in the late Cenozoic.

It is most likely the Florissant organisms were deposited after the erosion surface was cut in Pikes Peak granite during the Flood. This surface is a large erosion surface on the high granitic mountains of central Colorado which was likely carved during the early Retreating Stage of the Flood.[61] Most large erosion surfaces likely developed during the Sheet Flow Phase of the Retreating Stage of the Flood.[62]

Log mats that had been gathering flotsam on their journey floated over the top of the erosion surface.[9] Trees, mostly redwood, sank vertically to the bottom where they were pinned by volcanic debris. Before they were incorporated into the sediments, they had been sheared off at about 4.5 m (15 ft) in their area of origin during the early Flood. Mount St Helens during the May 18, 1980, eruption demonstrated how quickly wind blast and volcanism can shear trees from their stumps.[63] In the Flood, the stumps temporarily left in the ground would eventually be eroded, float, and be incorporated into log mats. Due to air blast, water turbulence, and violent collision, the trees and stumps would be mostly stripped of branches, roots, and bark. The trees eventually became waterlogged and sunk vertically from the log mat.

Figure 15 is a schematic for the deposition of Yellowstone fossil 'forests' within the Absaroka Volcanics during the Flood, which would also apply for the Florissant redwoods. Various log mats from different pre-Flood environments floated on the Floodwaters and would often mix, which explains the paleoflora from widely different environments.[9]

At the same time as the trees sank, plant parts also sank. The log mats also carried insects that fell off the mat and sank to the bottom. It is likely that the log mats were vast. What is found in the Florissant 'lake' beds is only what became trapped in a little, north-south valley on the erosion surface. Thick sediments must have accumulated over the erosion surface for the sediments to lithify in the valley because it takes a fair amount of overburden to compress and cement sediments. Then later in the Retreating Stage of the Flood, the overburden was eroded away, which means the 'Tertiary pediment' is really an exhumed erosion surface. The area continued to uplift, emerged from the Floodwaters, and rose relative to the ocean bottom[64] to the high elevations observed today in the Colorado Rocky Mountains.

Conclusions

Numerous contradictions to uniformitarianism are found at the Florissant Fossil Beds National Monument, especially the mix of fossils from widely divergent environments. These can be explained by the Retreating Stage of the Flood as the product of log mats, where many trees sank vertically together with plant parts. Numerous insects clinging to the log mat fell off the mat, sank to the bottom, and accumulated within a small valley on an erosion surface.

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