Australian marsupials: there and back again?

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To determine whether fossil fauna formed during or after the Flood, we need the location of the Flood/post-Flood boundary at each site. Correlation of local boundaries is currently imprecise because the geological column is not precise during the Cenozoic. Arment challenged the late Cenozoic boundary model based on his analysis of multiple genera of Australian marsupials that crossed three uniformitarian epoch boundaries. However, the key to determining the boundary is to encompass many kinds of rock and field evidence. Uniformitarian geologists initially dated marsupials as Pleistocene, but then pushed back their 'age' by a subjective method called 'biocorrelation', which depends on 'the stage of evolution'. The age of marsupials has thus been stretched back to the late Oligocene. The geology of Riversleigh, Australia, suggests that the animals lived in caves or fell into sinkholes early in the Ice Age. Then the caves were unroofed by acid rain. In central Australia, the marsupial fossils are associated with pluvial lakes from early in the Ice Age.

Numerous questions of biogeography are still unsolved for both uniformitarian and creation scientists.[1] Creation scientists must explain how the terrestrial animals dispersed from the Ark. However, this requires determining the Flood/post-Flood boundary at each location; to tell which fossils were buried during the Flood and which, after. Global uniformitarian boundaries may not be identical at each location,[2] so the Flood boundary has no uniformitarian equivalent.[1] That is why I suggest different locations can show a boundary in the Miocene, Pliocene, or even in the early- to mid-Pleistocene of the late Cenozoic.

Arment's fossil challenge

Arment[3] concluded that the post-Flood boundary in Australia was not in the late Cenozoic and does not contradict a boundary at the uniformitarian K/Pg boundary: "So, if the K/T boundary is postulated as recording the end of the final stage of the Flood, there is no data here that contradicts that."[4] He challenged the late Cenozoic boundary, arguing that many genera cross several uniformitarian stratigraphic boundaries, including the early to late Cenozoic. These are 61 marsupial genera that cross the Pliocene/Pleistocene boundary, 31 that cross the Miocene/Pliocene boundary, and 46 that cross the Oligocene/Miocene boundary—the line between the early and late Cenozoic. He concluded that since there are marsupials dated as early Cenozoic, then the late Cenozoic boundary model is wrong because too many lived both before and after the aforementioned boundaries.

Arment claims that one implication for a late Cenozoic boundary is that the marsupials needed to migrate to the Ark from Australia. However, this is unlikely.[2] But he is correct that the marsupials had to migrate from the Ark to Australia after the Flood. To estimate the probability of each marsupial genus migrating to Australia and not any other continent, Arment starts with the odds of arriving just in Australia as 1/6. He excludes Antarctica and makes Europe and Asia two continents.[5] He also assumes that the fossil genera are not found on other continents, which may not be true. More and more fossil surprises are found with further collecting (see below). Since the chance of one genus migrating to Australia is one in six, the odds of all the boundary-crossing marsupials making it to Australia has to be 1/6 to the power of the number of genera. Arment is assuming that the odds of each genus is 1/6, but it is possible that the each genus is not independent of other genera. Since marsupials coalesced in Australia and practically nowhere else, there may have been some reason why marsupials stayed together when migrating, making them interdependent. For all three boundaries, this becomes $(1/6)^{61}$, $(1/6)^{31}$, and $(1/6)^{46}$, respectively. These are astronomical odds, and he suggests that the post-Flood boundary cannot be in the late Cenozoic.

Arment's challenge answered

An accurate assessment of the boundary requires examining all the field evidence at each site. This can be difficult and time consuming. I have not examined the Australian sites and rely on literature descriptions. But I would argue that there is substantial evidence that marsupials from the late Oligocene to the present are post-Flood. This would place the post-Flood boundary at Arment's location just below the late Oligocene, or the very late early Cenozoic.

I believe the boundary is usually in the late Cenozoic, but, as described above, it can vary with place. If these locations show a boundary that extends *locally* into the Oligocene, arguing for a global, uniform correlation to the uniformitarian column is an unwarranted leap.

Arment is correct that the boundary at the sites he examined is below the Late Oligocene, according to uniformitarian

dating. His conclusions apply to the marsupial fossil sites, but *not* to other sites in Australia or on other continents. Why these marsupial sites are an exception to the column is found in the unique dating method used by uniformitarian scientists.

There is a biostratigraphic break in Australia

If we expect a clear stratigraphic break or discontinuity to show the post-Flood boundary below the late Oligocene at the fossil sites, we will not be surprised that there is a gap of 25 Ma in the uniformitarian timescale until the marsupial fossils found in the Tingamarra Local Fauna at Murgon, southeast Queensland.[6] The dates for this site have been variously estimated, ranging from late Oligocene to late Paleocene,[6,7] suggesting that the uniformitarian dating of these sites is a rough estimate. The site is now dated as early Eocene.[8] Besides marsupials, there are many other types of animals, such as turtles, crocodiles, frogs, snakes, bats, birds, and a condylarth-like placental mammal,[9] if the descriptions are accurate. A condylarth is considered an extinct type of herbivorous placental mammal from the early Cenozoic.[10] This appears to be the earliest Cenozoic fossil site in Australia.

The Murgon site in Australia is not unique; marsupials, as well as placental mammals, are found on *all* the continents in the Cretaceous and early Cenozoic,[8] and were likely laid down by the Flood. The duck-billed platypus monotreme, once thought unique to Australia, has been found in the Paleocene of South America and Antarctica.[11] For the following discussion, all references to marsupials of Australia include only those found in and after the late Oligocene.

Why are marsupials dated to the late Oligocene?

The Australian sites assigned to the late Oligocene, Miocene, and Pliocene have been dated in a subjective manner called biocorrelation, which is based on an assumed 'stage of evolution'. They rarely can be radiometrically dated, since the local faunas are isolated, and there are few, if any, igneous intrusions or volcanic ash layers. Until 2016, there were only a little more than a half dozen widely dispersed radiometric dates associated with Tertiary marsupial fossils in Australia, including Tasmania:

> "Australia is one of the last continents to have a securely dated framework for the evolution of its Cenozoic terrestrial biotas. Until now, the vast majority of Australia's mammal-bearing deposits have been dated by biocorrelation, anchored by little more than half a dozen radiometric dates for the entire continent."[12]

One of these is a Rb-Sr date of 25 Ma on illite clay reported in 1983 from the Etadunna Formation, but the details of the dating had not been published as of 1993,[13] and the date is tentative as of 2016.[12]

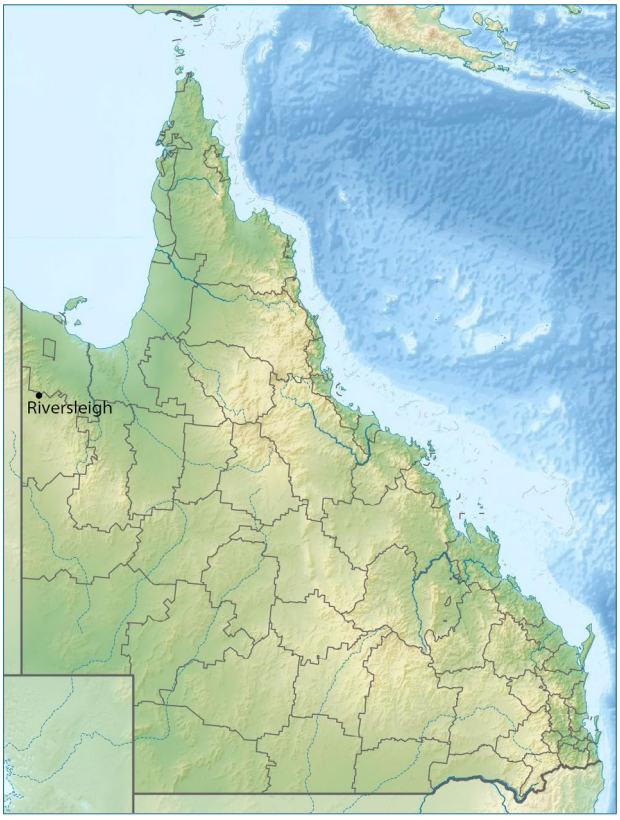

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Figure 1. Colour-coded elevation map of Queensland, Australia, showing the location of Riversleigh

Riversleigh initially dated as Pleistocene

An example of the dating uncertainty is Riversleigh—the main fossil marsupial site in Australia. It is a World Heritage Area, located near the Gregory River in northwest Queensland (figure 1).

The fossils are found in a 100 km^2 (39 mi^2) area with over 200 sites described as of 2006, with more sites added year after year.[14] Most of the fossils are unique to Riversleigh, but some are found elsewhere, and are used to help date those sites. Besides marsupials, a platypus, numerous bat species, various rats and mice, crocodiles, fish, frogs, turtles, lizards, snakes, various types of birds, lungfish, insects, arthropods, gastropods, and other invertebrates have been found,[14,15] including the unique marsupial mole.[16] The fossils occur in the soft Carl Creek Limestone, overlying Proterozoic siliciclastic rocks and Cambrian marine limestone and chert.[17]

When the Riversleigh fossils were first discovered, about 1900, they were dated as Pleistocene:

> "First, Cameron [in 1900] was convinced that the rocks that produced these fossils were no older than Pleistocene in age, i.e. less than 2 million years old, and many deposits of this age, even then, were known from Australia."[18]

The Riversleigh fossils were not considered 'old' until about 1950: "Before the 1950s, the marsupial record of the continent was generally believed to have no great antiquity."[19] They are now pushed back to the late Oligocene.

It is interesting that the Pleistocene date fits well with biblical expectations. The Pleistocene is the uniformitarian ice age period, and largely corresponds to the post-Flood Ice Age. Most terrestrial areas show a single glaciation event; it is data from deep ocean sediments and the hypothetical Milankovitch mechanism that have pushed the number of supposed ice ages to 50.[20,21] In areas not affected directly by the Ice Age, Pleistocene sediments are usually post-Flood. As an example of Pleistocene sediments likely from the Flood, hundreds- to thousands-of-metres thick strata is found in some basins.[22] For instance, the South Caspian Basin, northeast of Iran, is about 450 km (280 mi) in diameter and has a total thickness of about 27,000 m (88,500 ft) of sedimentary rock, most of it Cenozoic.[23] The top 10,000 m (32,800 ft) is regarded as Pliocene and Pleistocene.[24] Knapp *et al*. believe that the sedimentation rate was 2,000 m per million years for the past 5 Ma,[23] and if the Pleistocene was 2 million years long, that would mean 4,000 m of sediment accumulated during the Pleistocene.

Marsupial dates pushed back older than the Pleistocene by 'biocorrelation'

Numerous Pleistocene marsupial sites occur in Australia[25] with many of these marsupial families alive today. The number of pre-Pleistocene sites is small, around a dozen. I believe these sites are also post-Flood and have been misdated. The basis for misdating is an assumption of evolution as a valid correlation mechanism.

After 1950, paleontologists began calling features of the fossils, mainly teeth and jaws, 'primitive', 'derived', or 'advanced'. These terms were used in an evolutionary sense, and so implied younger or older dates. Kangaroo fossils, mostly teeth, from the Namba Formation in central Australia were judged to be 'extremely primitive'. Thus, the fossils were judged 'old' based on their 'stage of evolution'.[26] Uniformitarian scientists called this method *biocorrelation*.[27] Jones *et al*. inform us:

> "Unfortunately, the deposits that contain most Australian mammals are not readily dated in this way [by radioactive dating], and so other techniques and processes must be used.
>
> "One of these is called biocorrelation. Because of the large number of dated horizons in other areas of the world and in some places within Australia, it is sometimes possible to relate otherwise undated horizons containing fossils to a dated horizon somewhere else on the basis of shared fossils. Palaeontologists have used biocorrelation to date many Australian fossil mammal deposits."[28]

Since there are hardly any marsupial sites on other continents, paleontologists typically compare the sites only from Australia. These other sites have been also dated by biocorrelation: "Approximately 99% of the 360 fossil assemblages analyzed are classified using this method [biocorrelation]."[29] The procedure is subjective:

> "The principles and practices of stage-of-evolution biochronology are not formally encoded, but have developed through an evolving 'consensus of usage'."[30]

Biochronology is the method of correlating the fossils in time, while biocorrelation is the process of correlating fossils only. Recently, paleontologists have obtained several radiometric dates, but it is likely these radiometric dates were selected to fit previous biocorrelation 'dates'. U-Pb ages were determined on speleothems from unroofed caves at Riversleigh.[25] A hint that radiometric dates are fitted to previous beliefs was shown by Ayliffe *et al*.:

> "Despite the current widespread enthusiasm for sophisticated new numerical techniques used in analyzing existing data sets, major advances are likely to be slow and incremental, because they are reliant on field-based studies involving detailed analysis of sites conducive to multiple dating techniques."[31]

Radiometric dating has changed a few of the stages of evolution dates, such as that of the Riversleigh site of Rackham's Roost. It was previously dated as early- to mid-Pliocene based on the stage of evolution,[32] but now it is dated early Pleistocene, based on the U-Pb method on speleothems.[25]

Marsupials in the Etadunna Formation and/or its stratigraphic equivalent, the Namba Formation, of central Australia have also been dated by biocorrelation.[33] Stirton and others dated the Etadunna Formation as late Oligocene back in 1961, based on biocorrelation.[13,34] All the marsupial sites seem to use this method: "Another method in common use, at least until a more precise method can be found, is the assessment of the relative stage of evolution."[28] The Kangaroo Well Local Fauna of central Australia was also dated by biochronology.[35] A new site in the Northern Territory even used assumed evolutionary connections between different assemblages to extract a date in this manner:

> "The age of the assemblage can therefore only be assessed in terms of the relative stage-of-evolution of its members compared to their mostly closely related forms in other Local Faunas … ."[36]

Thus, ages of Australian marsupials are largely based on circular reasoning and evolution. The geological context may have helped persuade paleontologists that these sites are pre-Pleistocene. Riversleigh fossils were found in unroofed caves (see below), and those from central Australia are associated with pluvial lakes. The unroofing of caves and the drying of pluvial Lake Eyre would appear to take much time but can be explained by processes during the Ice Age.

Australia is probably the last continent with solid radiometric dates for its Cenozoic terrestrial biotas. Until now,

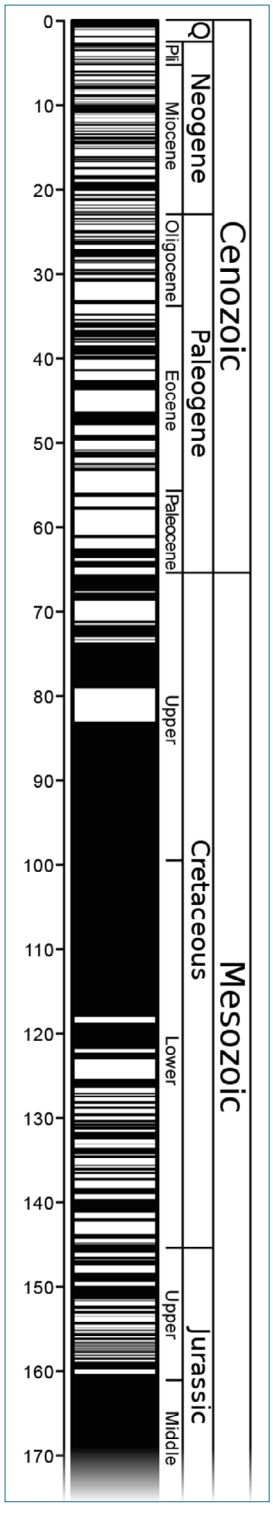

Figure 2. The standard magnetic timescale from the mid-Jurassic to the present. Dark areas are normal and light areas, reversals. The long black band is the Cretaceous normal superchron.

they have been dated by biocorrelation, anchored by a few scattered radiometric dates for the entire continent.[37] So the migration of dates from the Pleistocene to the Pliocene, Miocene, and even the late Oligocene, was accomplished by the subjective, non-standardized biochronology method that assumes evolution.

Biochronology is input to other areas of the world

The idea for biochronology in Australia actually got its start in North America by Stirton and others:[38]

> "The lack of formality [of biochronology] has an historic irony, for the development of codes governing other branches of stratigraphy owes much to studies of the thick, mammal-rich, non-marine sediment of the North American interior where stage-of-evolution biochronology originated … ."[39]

It is also used to date fossils in South America:

> "Most biostratigraphic sequences in Patagonia and elsewhere in South America have been based on the evolutionary stage and taxonomic representation of 'ungulates' (archaic endemic herbivores or southern ungulates) and/or marsupials."[40]

Paleomagnetism reinforces biocorrelation

Long *et al*. also have used paleomagnetism as a dating tool.[28] But a hiatus or a period of rapid sedimentation can affect a local paleomagnetic profile, making it easy to be off a reversal cycle. Because time is an unknown, any section can be made to fit the secular polarity chart (figure 2). Thus, paleomagnetism must be 'anchored' to other dating methods; it is not an independent dating method and hence is subjective:

> "Magnetic polarity zones, however, are not in themselves uniquely diagnostic, and without the aid of additional stratigraphy indicators, correlation of magnetic zones in terrestrial sequences is problematic. For example, differences in depositional rates, and/or diagenetic histories between two areas, or the presence of subtle unconformities, can result in an unrecognizable mismatch of polarity zones."[41]

Moreover, even in a particular normal interval, numerous 'excursions' occur. A paleomagnetic excursion is defined as a brief period of less than 10,000 ka during which the geomagnetic pole almost reverses. For instance, 10 polarity reversals and 27 excursions supposedly occurred in the past 2.6 Ma, the Quaternary, with seven excursions in the Bruhnes normal polarity chron.[42] With so many reversals, as shown on figure 2, combined with even more excursions, even small hiatuses or slight increases in sedimentation would throw off the dating. Worse, an unexpected paleomagnetic sequence can be explained by 'previously undetected' changes in sedimentation.

In the case of Australian marsupials, the subjectivity of using evolutionary changes to assign dates; reworking; and using nomenclature to obscure similarities between organisms from different countries, regions, and assumed ages are some of the reasons for skepticism of biostratigraphic correlations over long distances. It is also why I do not take the uniformitarian Cenozoic fossil ages as globally synchronous. The Upper Cenozoic seems to be highly diachronous within biblical earth history.[2]

Another boundary fluctuation

Uniformitarians want the public to consider the timescale as absolute, but they adjust dates and even stages at will. Simply noting the differences between the 2004 and 2016 scales shows that.[43,44] This 'insider' flexibility is seen in pushing the Antarctic Ice Sheet into the early Cenozoic. It had once been assigned to the late Pliocene/Pleistocene.[45] Then scientists found what they considered ice-rafted debris (IRD) in early Cenozoic deep-sea cores off Antarctica.[46,47] Those dates were likely from marine microorganism biocorrelation. Since IRD implies icebergs, which implies an ice sheet that reaches the ocean, the age of the ice sheet increased by a factor of ten:

> "Increasing the duration of the Ice Age by a factor of about 10 greatly increases the stress upon the creation scientists, who must compress the events of 15 m.y. into 4,000 y. of post-Flood time."[48]

The Antarctic Ice Sheet is now believed to have initiated between 32 and 42 Ma, and reached equilibrium at 15 Ma.[49] So, in regard to the Antarctic Ice Sheet, the post-Flood boundary would be near the uniformitarian Eocene/Oligocene boundary. The boundary is typically Miocene or younger. But if evolutionists change their dating of events that obviously mark the boundary and creationists rely on uniformitarian stratigraphy, we should expect the boundary age to bounce around, regardless of the field evidence that shows the location of the boundary.

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Figure 3. Typical landscape at Riversleigh, northeast Queensland, Australia

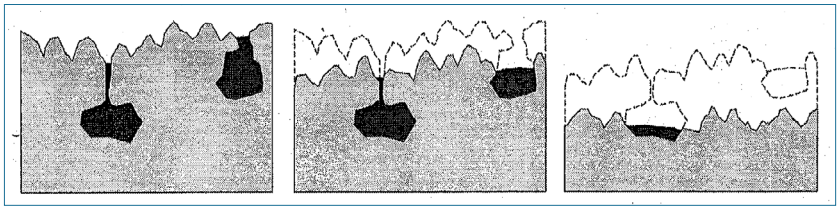

Figure 4. Schematic of the progress from cave and crevasse fills to unroofing caused by the dissolving of the surrounding limestone, leaving the deposit at or near the surface (from Arena *et al.*, 2014, figure 6, p. 34. Used in accordance with federal copyright (fair use doctrine) law. Usage by CMI does not imply endorsement of copyright holder).

How can early Cenozoic IRD be explained?

In the case of Antarctica, how do we explain ice-rafted debris (IRD) in biblical earth history? There are several possibilities. First, it is possibly not true IRD. At the end of the Flood, receding waters would have transported coarse sediments into the oceans (e.g. the Whopper Sand[50]). Coarse sediments can also be moved along the ocean bottom by currents or mass flows. Second, if the debris is IRD, then the host sediments are post-Flood, regardless of the uniformitarian age.

The study of ocean bottom sediments is a relatively new part of earth science. Creation scientists have not yet examined them closely and confidently explained them in biblical earth history. This must include evaluating the dating systems for ocean bottom sediments and any correlations to continental sediments. Ocean sediments are predominantly dated by microorganisms. Like terrestrial biostratigraphy, it relies on the assumption of evolutionary changes in those organisms.

Geological evidence that Riversleigh marsupials are post-Flood

Despite the uniformitarian ages, Australian fossil marsupial sites can be explained by the Ice Age.[51–53] The 35 criteria that determine the Flood/post-Flood boundary[2] do not seem to apply to the Riversleigh fossil sites. The fossil sites appear to be mostly near ground level with little relief (figure 3).

But other criteria indicate the sites are likely post-Flood. First, undeformed fossils are found in the soft limestone.[17] Some are articulated. Second, the fossils originated as deposits from crevasses and caves in the karst bedrock and are often found in flowstone, a type of speleothem. Third, numerous bat fossils occur with bat guano, better preserving them.[28,54] It is difficult to envision bat guano surviving the violence of the Flood. These lines of evidence suggest that the site is post-Flood, although dated into the Oligocene.

These fossil locations are out in the open because the caves were 'unroofed'; the top has dissolved and the walls have widened (figure 4).[17] Similar caves are found elsewhere:

> "The occurrence of surface outcrops of deposits originally formed in cave interiors, also referred to as 'unroofed caves' (Mihevc, 1996), has been recognized as a common occurrence on the surface of karst terrains, particularly in the 'classic' karst terrains of Europe ... . Such deposits had previously been interpreted as clastic fluvio-lacustrine deposits formed by surface processes … . Denudational surface lowering is now widely recognized as a common process responsible for the attrition of enclosing solution-prone rocks with consequent exposure of cave deposits that include speleothems, detrital fills, biogenic deposits and phreatic flow deposits … ."[55]

Uniformitarian scientists believe unroofed caves are old, based on present-day erosion rates.

Image: Tentotwo/Wikimedia, CC-BY-SA-3.0

Figure 5. Colour-coded map of South Australia, showing the locations of Lakes Eyre and Frome today

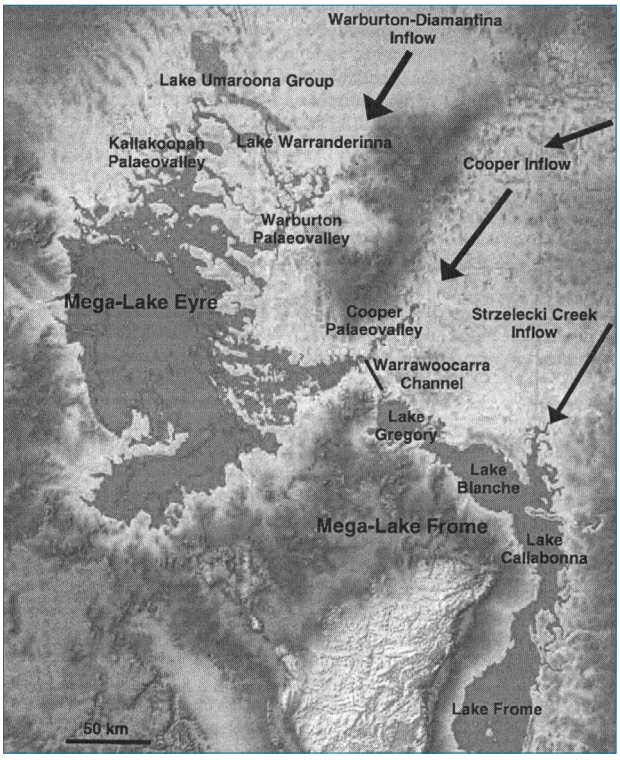

Figure 6. Mega-Lake Eyre and Mega-Lake Frome, based on paleo shorelines. The two megalakes were once connected through the Warrawoocarra Channel (from Webb, 2010, figure 2, p. 314.[63] Used in accordance with federal copyright (fair use doctrine) law. Usage by CMI does not imply endorsement of copyright holder.). The lake basin is assumed to be from a highstand during the Quaternary, which likely corresponds to the water level during the wet early post-Flood Ice Age.

Geological evidence from central Australia likely post-Flood

Marsupials are also found in northern South Australia, within the ancient lake basins of Lake Eyre, Lake Frome (figure 5), and other nearby lakes. These lakes may have once been joined (figure 6). Fossils have been found in the correlative Etadunna and Namba formations. The Etadunna was once dated at 15 Ma, but jumped to about 25 Ma, based on biocorrelation and paleomagnetism.[34] The fossils are believed to be in lake and river deposits, which suggests post-Flood, if the paleoenvironmental interpretation is correct. Other areas in central Australia, such as the Kangaroo Well and Pwerte Marnte Marnte Local Faunas, are also likely post-Flood, though dated lower in the Cenozoic by biocorrelation.[35,36]

Marsupials related to the Ice Age

Moreover, the geology of the sites is best explained by the Ice Age. At Riversleigh, limestone caves could have formed during the Flood.[56] Marsupials and other animals arriving early in the Ice Age may have lived in the caves. This was a time of mild winters, cool summers, and heavy precipitation due to high evaporation from the warm ocean.[51] The area could have been similar to a tropical rainforest,[15] although plant fossils are mysteriously rare.[57] This could be because the limestone created a high pH, and plants are best preserved in acidic conditions.[58] Uniformitarian scientists claim that northern and central Australia had an early- to mid-Miocene monsoon climate, but climate models cannot duplicate it.[59]

Immediate post-Flood volcanism created aerosols, which in turn caused acid rain. It could have dissolved the karst and exposed the cave fill within a few centuries. This timing suggests rapid animal migration from Ararat. Caves would offer shelter. Many of the animals that died in the caves could have been covered by 'soft' limestone, or flowstone. Others may have fallen into sinkholes. Then the area was denuded by heavy acid rain, dissolving cave roofs and walls (figure 4). In the mid to late Ice Age, volcanism decreased, the oceans cooled, and the climate transitioned to warmer summers and cooler winters.[60] Uniformitarian scientists put this climate change mainly in the Miocene, although they claim that the Pleistocene climate oscillated between wet

and dry, likely influenced by Milankovitch theory's claims of multiple Pleistocene ice ages.

In central Australia, pluvial lakes covered a large area (figure 6) during the early to mid-Miocene: "Several lines of evidence suggest that one or more inland water bodies of considerable size existed in central Australia."[61] If the current playa Lake Mega-Eyre were raised 25 m (82 ft), based on its 'Quaternary depth', it would combine with Lake Mega-Frome to form an immense lake in central Australia.[62]

The enclosed basin of this lake likely was initially filled during the Flood, as shown by marine foraminifera.[34] Heavy early Ice Age rain maintained the lakes and resulted in rapid sedimentation. Marsupials were buried in lake and river sediments. During the mid to late Ice Age, the pluvial lakes dried, and marsupial fossils are found in the lakeshore sediments of those dying lakes.

Conclusions

Arment is to be applauded for tackling the vexing problem of biogeography for the Australian marsupials. However, evidence shows that strata now assigned as late Oligocene, Miocene, and Pliocene were dated by the questionable method of biochronology. Secular scientists frequently move dates, such as pushing the age of the Antarctic Ice Sheet back to the Eocene/Oligocene boundary. Radiometric dates for these fossil sites were not published until after 2015, and, based on typical practice, seem to have been cherry-picked to fit the 'known age'. All the marsupial sites in Australia, except Murgon, are likely from the Ice Age. That would push the post-Flood boundary a little 'deeper' with respect to the geologic column at these sites. However, those dates are much less significant than the cumulative field evidence. Arment's concerns are vitiated, and the perceived need for improbable two-way migrations voided.

Finally, I need to emphasize that the boundary just below the late Oligocene *only* applies to these fossil sites and not uniformly across Australia. Neither does it apply to other continents, since each continent and each site must be viewed on its own merits.

Acknowledgments

I thank John Reed and other anonymous reviewers for reviewing this manuscript and offering significant changes. I also thank John Reed for compiling the change of stage dates within the Geological Time Scale series.

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