Tidal Clocks and Flood Geology

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Tides, both today and in ancient times left distinguishing characteristics that are recognizable. Some of these also help us to measure how long it took for them to be deposited. The time periods demonstrated just don't fit the flood geology interpretation that rocks were deposited very quickly during Noah's flood.

Introduction

If I were to ask you when you were born, I might be looking for different sorts of answers. I might want to know the year, a calendar sort of answer. We might be discussing how often babies are born early in the morning. I was born at 6:30 am, an answer based on a clock. If I were to ask how old Abraham Lincoln was, I might want a calendar answer. For example, this year he will be 213 years old. On the other hand, perhaps, I might want more of a clock answer, a duration that would indicate that he was 56 years old when he died. The first answer would be more of an absolute age, while the second would be a clock answer that expresses how much time elapsed. Both answers are true and useful, but for different purposes.

Measures of time in Nature

Nature gives us different measures of time as well. They also are useful for different purposes. Some are very relevant to the history of the earth and evaluating Young Earth Creation (YEC) proposals. Absolute measurements, primarily radiometric dating measurements, provide absolute dates with varying degrees of precision. These are calendar answers that demonstrate the Earth to be 4.6 billion years old. YEC have expended a lot of resources trying to find a scientific reason to reject this calendar, but have certainly convinced few scientists. In this post, we will look at a few of the natural clocks that reflect various durations of time passage, without telling us the dates involved. Flood geology (FG) interpretations make specific predictions about the passage of time. If much of the geologic record resulted from Noah's flood, then this dictates that depositional rates had to have been vastly more rapid than we see in normal sedimentation today. If most of the sediments were deposited over the course of one year, then the flood interval should not include significant units with sedimentation at modern rates. The FG models just don't have time for the slow modern rates.

Different clocks in Nature

Nature provides many different clocks that show various time intervals. For example, when we identify a tsunami deposit, we recognize that the deposit was formed over a few minutes to a few hours, such as the documented deposit from the 1755 tsunami in Spain (Cuven, et al., 2013). In some places we see features that tell us a minimum of a growing season took place, such as roots from plants that ranged from grasses and bushes to large trees. Some are documented here: Issue 5. Dinosaur tracks and coal. We see direct indications of the passage of a number of years by counting tree rings. Dendrochronology: What Tree Rings Tell Us About Past and Present It is worth noting that, while some tree species are less dependable, some tree types, such as oaks, very consistently produce one ring per year. We often find large fossil trees with tree rings, such as in the Petrified Forrest National Park in Arizona, and we can estimate how many years these trees grew before they died. The logs from the park grew, died and many floated to their final resting place before petrification. We don't have to know the calendar years involved to know the clock period of their life.

Many lakes have seasonal changes in modern times, as summer and winter seasonal water turnover causes sediment bands known as varves. When we find these in ancient sediments, we can tell the passage of years, even if we don't know the calendar year they began or ended (Bradley, 1930). We see other processes today that take place over many years, such as reef growth. We assume that ancient rates were similar and even if they were different, the rates were not such that they would have grown during a one-year flood event. (Issue #1: Ancient and Modern Reefs) Coral fossils have taken many forms over geologic history. Some show clear annual growth patterns, similar to varves reflecting seasonal patterns. (Lough and Barnes, 1997) Some solitary corals, in particular those known as "horn coral" give another type of clock information. They show a different pattern, such that daily growth bands are recognizable in addition to seasonal variations and these bands make it possible, when well preserved, to count the approximate number of days in a year (Digital Atlas of Ancient Life, na; Wells, 1963). They demonstrate, for instance, that the days were shorter back in the Devonian period, conventionally dated as approximately 400 MYA. They systematically have been growing longer since that time. This makes sense because as the Earth's rotation has been very gradually slowing down, less beds were created in each few million years, changing from 400 bands to 365. Again, in terms of FG models, these corals are a challenge to explain. Unless a case can be made that all of these corals preserved in the rocks of the world grew before the flood and were then transported to their final position by the flood, the presence of such corals make it impossible to consider their host formations as deposits from Noah's flood. Each coral demonstrates the passage of several years of time reflected in these bands.

Clocks from tidal deposits

The main "clocks" that this article will discuss will be an additional type: tidal deposits. The gravitational pull of the moon sets up a long-wavelength water motion that drives tides in the world's oceans. We know that they provide consistent predictable cycles such that there are two high tides and two low tides each day. The flow reversals associated with these cycles provide distinctive features along today's oceans. Would we expect such deposits through Earth's past? Of course. Geologists are accused of dogmatically bowing to uniformitarianism, the idea that the present is the key to the past. In university, I was taught that the present is <u>one</u> key to the past. We recognize that rates and processes may have been very different at times and in places in the past and that catastrophic events have occurred. Even so, there is still much to be learned from studying present day processes. I have not read any studies from YEC that do not also apply this same thinking repeatedly. Even during Noah's flood, the moon was still circling the earth. YEC writers such as Dr. John Baumgardner and Dr Andrew Snelling make tidal effects part of the processes involved in their "cataclysmic tectonics" model (Baumgardner and Barnette, 1994; Snelling, 2020).

Features of tidal sediments

When we examine tidal sediments from modern settings with sands, we commonly find a number of features, such as various ripple mark styles including: flaser bedding, wavy bedding, lenticular bedding, and single lenses of sand; reactivation surfaces, horizontal laminations;

rhythmic lamination changes; desiccation cracks (mudcracks), local bioturbation zones, stromatolites, trace fossils (animal tracks); vegetation from tidal environments and units commonly capped with peats (Davis, 2012). If you want to learn more about these and don't have access to the article by Davis, just Google the feature with word "geology" and you will find many images and descriptions. When we see such features in sedimentary rocks, we should certainly consider that they may have formed in a tidal setting. Many of the individual features can also be formed in other settings. How would we strengthen the case for a tidal interpretation? Geologists will also look for features that indicate other environments and if none are present that also is a clue. They will consider the types of rocks that were deposited in adjacent settings. While many features are individually non-diagnostic, if a set of typical tidal features are found together, particularly with fossils that would have favored such settings, and with rocks that were likely deposited in deeper water on one side and rocks that might have been formed on a continental setting on the other, an interpretation of an ancient tidal setting would be very reasonable. Some features are found that would be difficult to explain in any other setting. We will look at two that are typically considered diagnostic of tidal sediments and also have clear implications for the period of time involved in their deposition. They can be considered short duration clocks for rocks where they were found.

We look for features in the sediments that formed at the time of deposition. We look at cross-stratification, layering within beds of rocks that formed an angle to the overall main bedding. This kind of layering develops today in many different settings and we can use it to recognize how fast the water was moving at the time of deposition. We can also recognize the direction of sediment transport. If you think about tides, at least in some situations, we should expect to find the preservation of flow in two directions, something that would be quite difficult to form in other settings. When we find these preserved, they represent a short-term clock for the sediment. A set of cross-strata flowing in two directions represents one tidal cycle. Such features are known as "herringbone

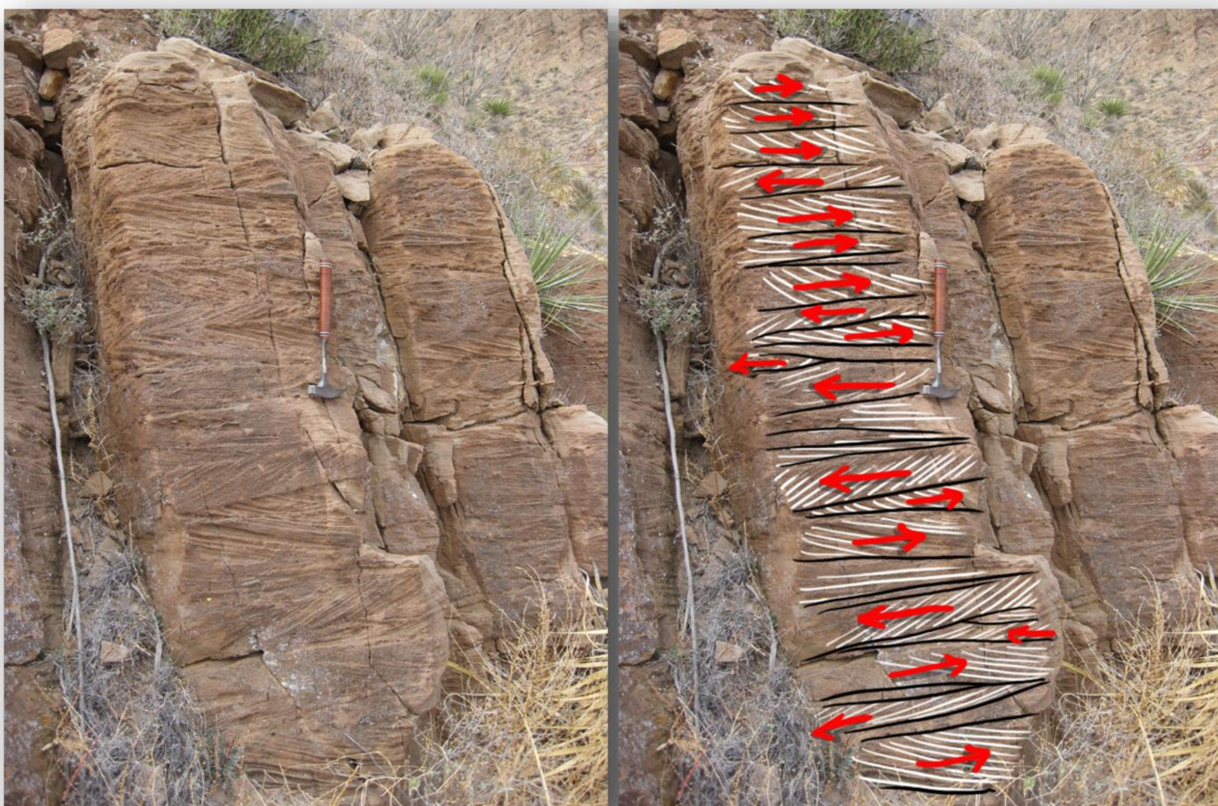

Figure 1: Herringbone cross-beds from the Bliss Sandstone, Franklin Mountains, El Paso, TX. Used with permission of Callen Bentley (Bentley, 2014)

cross-stratification". (**Figure 1**) While it is likely that at any one particular setting, every tide would not be preserved, we should be confident that each of the preserved sets was deposited over the course of six hours. In Figure 1, we see preserved at least portions of 16 cycles representing deposition over a minimum of 4 days. It probably took a bit longer to form, as at several points, it is likely that deposition was not even and only portions of cycles are preserved. It is entirely possible at several points that periods of days or weeks passed before the next set was formed. Often reactivations surfaces are found with the herringbone cross-beds, just as we see in modern settings today. (**Figure 2**)

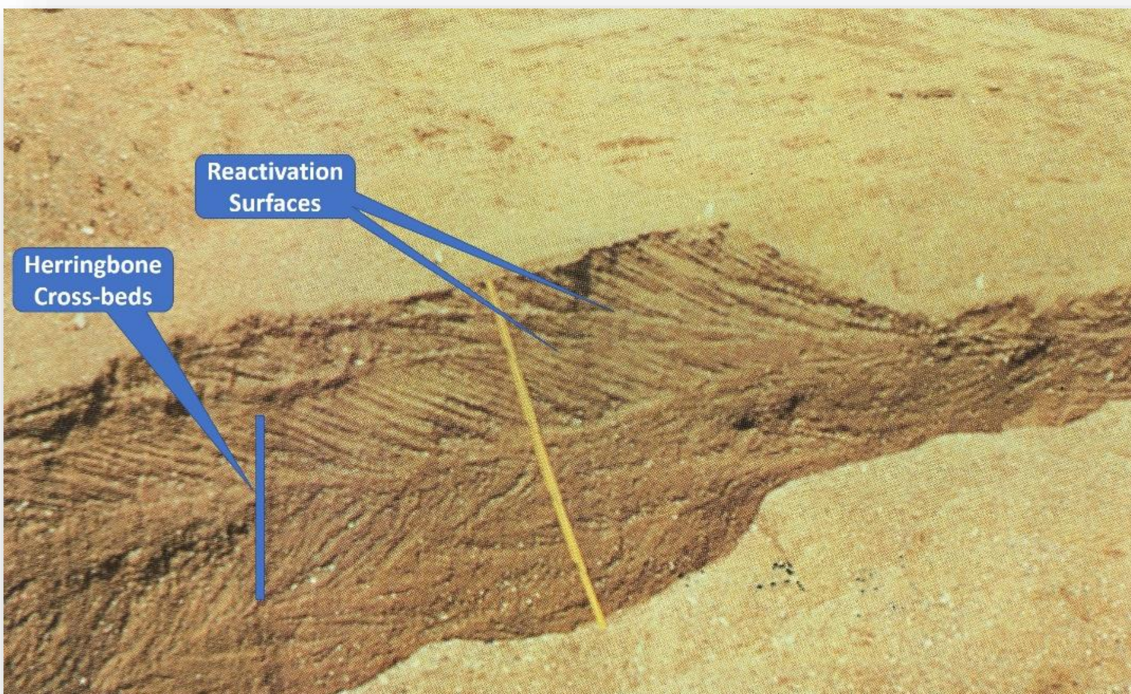

Figure 2: Herringbone cross-beds and reactivation surfaces from modern tidal deposits in the Minas Basin, Canada. (photo by G. de Vries Klein from Weimer et al, 1982)

Another quantifiable tidal clock is provided by what are known as tidal bundles. Just as in recent sediment cycles, in places like the North Sea and Bay of Fundy, daily tides often result in repeated packages when both high tide and low tide sediments are preserved. Several different styles are recognized. One interesting aspect is that the bundles are not the same size. They actually vary in a rhythmic pattern (Davis, 2012, p. 49. Kvale, 2012, p. 1). The bundles typically are preserved in sets of ~28, the same number of days as in a lunar month. Just as tides vary in strength through the month, tidal bundles vary in thickness. The gravitational pull of the moon, when it is aligned with the sun, is higher, giving rise to higher tides, known as spring tides, whereas the weakest tides of the month, known as neap tides occur when the sun and moon are at 90° to this. Tidal sediments, whether recent or ancient show this same pattern. Here are a few tidal bundle examples from the literature, though numerous others can be found:

1. Recent, North Sea (Berne, et al., 1988)
2. Recent, Netherlands (Coughenour, et al., 2009)
3. Miocene, Switzerland (Allen and Homewood, 1984)
4. Miocene-Pliocene, Arizona and California, (O'Connell, 2016)
5. Paleogene, Nigeria (Ekwenye, 2014)
6. Permo-Carboniferous, India (Bhattacharya and Bhattacharya, 2006)
7. Cambrian, Minnesota (Tape, CH, et al., 2003)

Curtis Formation, Utah

I want to highlight a particular set from the Jurassic Curtis formation in Utah. Much work has been done on this formation and all workers conclude that the formation was deposited in a tidal flat setting. Time equivalent sediments to the west and south are interpreted as terrestrial deposits, including eolian dune deposits whereas sediments to the north and east are interpreted as more marine. (Kreisa and Moiola, 1986) Sedimentary structures recognized are all typical of modern tidal settings, including herringbone cross-beds, tidal bundles, desiccation cracks, local bioturbation, shallow erosional channels, ripple marks, etc. (Zuchuat, V, et al, 2018; Zuchuat, V, et al, t; Sleveland, 2016). What type of trace fossils might one expect in a tidal and near coastal region? Tracks of various animals might be found. The Arches National Park Paleontological Survey noted their presence:

> *Within the same strata, and not too geographically distant, Lockley (1991) reported the presence of potentially millions of theropod tracks. Named the Moab Dinosaur Megatracksite, these tracks extend from Moab to Crescent Junction and can be found within Arches (Duffy, 1993).*

Hunt, et al., 2016 described this “megatracksite”, which includes large numbers of tracks from several locations. This site fits well with deposition in an ancient tidal flat. The tracks are not from some population of dinosaurs running from an advancing flood. These are tracks in many different beds going in many directions that developed over time.

The Curtis formation is about 180 ft (55 m) thick in the central Utah area where the key features of interest for this discussion are located. (**Figure 3**). Large numbers of tidal bundles represent many, many different tidal cycles. Kreisa and Moiola (1986) carefully described a particular set of sigmoidal tidal bundles (**Figure 4**). These authors, colleagues of mine when I worked for the Mobil Oil Company, measured and described the bedset. They recognized that the bedset consisted of sigmoidal packages of sand extending across several exposures before the unit was eroded away at the edge of the outcrops. Individual packages were found to have a characteristic pattern of cross-bedding, reflecting water movement that accelerated, reached a maximum velocity, then decelerated to a pause of fine-grained sediment. This pattern was repeated over and over again. In their paper, they show measurements of the thickness of the packages and the length of 40 consecutive bundles. The bundles thicken and are longer, then thin and grow thinner, then again became thicker and longer. They interpret these as spring tidal bundles, followed by neap bundles and then another set of spring tidal bundles. Spring tide bundles are 50-85 cm thick and more sigmoidal. Neap tide bundles are 15-30 cm thick, more gentle, simple foresets.

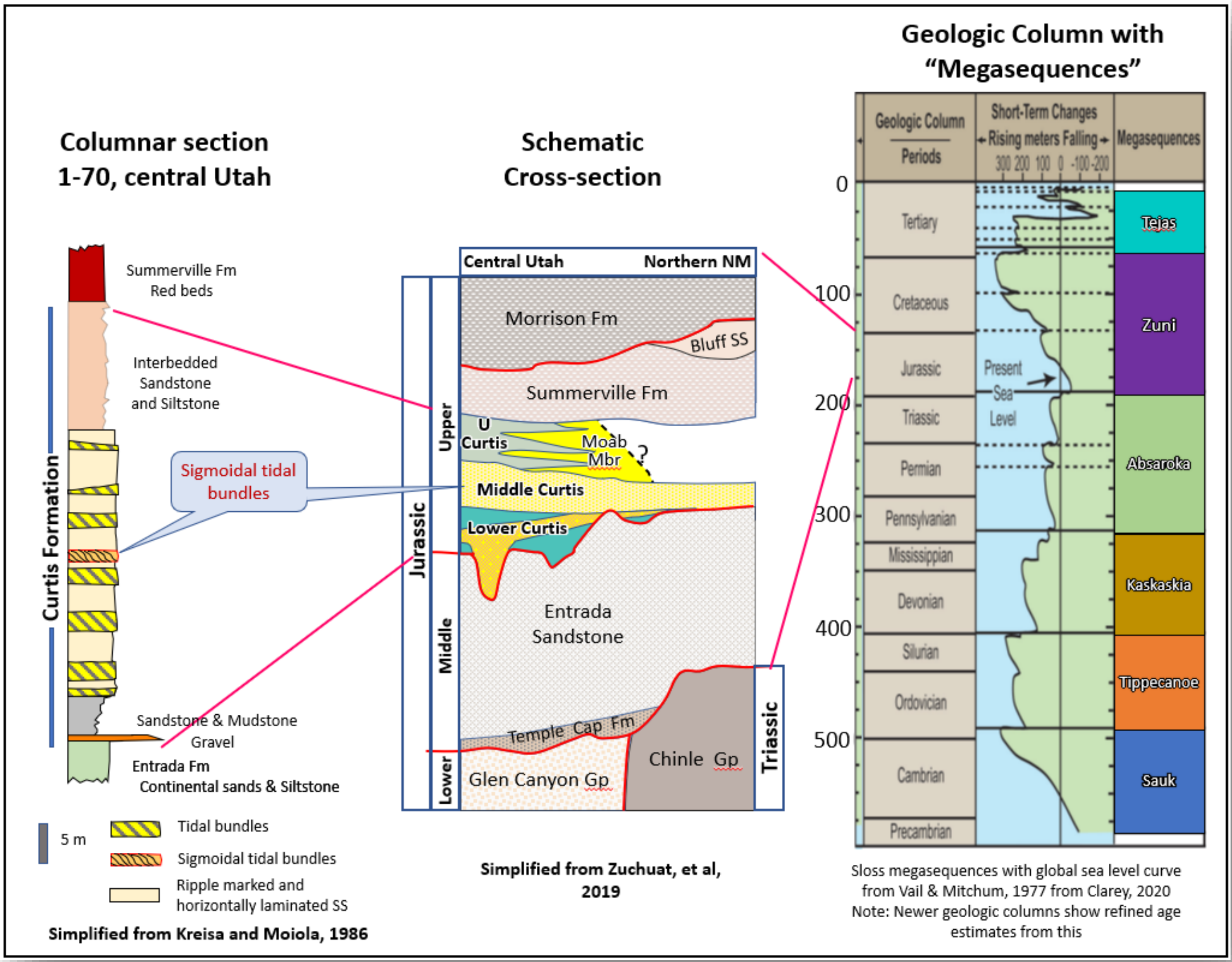

Figure 3. Measured section and schematic cross-section from Curtis Formation with the global geologic column to show the relative position of these rocks in relation to other sedimentary rocks around the world.

Figure 4. Sigmoidal shaped tidal bundles, Curtis Formation, central Utah (from Kreisa and Moiola, 1986)

Given the setting and features recognized in the surrounding sediments, these analyses are very logical interpretations. When I visited the outcrop on a field trip led by Dr Moiola, I remember that he was asked how far these packages extended, but I don't remember how far he estimated. What we can say is this bedset, less than one meter thick was deposited over a period of more that 40 days long. It is not hard to see that the entire formation took a much longer period to deposit. Geologists do not expect that every tidal cycle is preserved. As the area subsided or sea level rose, space was created in which sediment could be preserved. After that space filled, the sediments were preserved in another place where space existed. Most tides were never preserved. We see this today.

Tidal deposits vs. Flood Geology models

Popular YEC models interpret the vast majority of the sedimentary record to have been the result of the Genesis flood that occurred over 1 year. For these to be viable, sedimentation had to have taken place at tremendous rates. Individual beds had to have been deposited very quickly. Remember the issue that this article is discussing does not relate to radiometric dating or how many millions of years the record comprises. If the rock record includes packages that took months or years to form, then those units cannot have been part of deposition that resulted from Noah’s flood.

How long do YEC models interpret it to have taken for formations to have been deposited? Dr. Andrew Snelling predicts that the entire Tapeats Sandstone (Cambrian) from the Grand Canyon was deposited “within 3–10 days”. (Snelling, 2021, p.243). That would mean that the Tapeats Sandstone would have averaged approximately 9-30 m/day (28-100 ft/day). Other units through the column had to have formed at similar rates. The Bliss sandstone example (Figure 1) is part of the same depositional trend as the Tapeats Sandstone. If six feet (2 m) of the Bliss represents four days of deposition how would that have worked?

Figure 5 shows the Bliss Sandstone and Curtis Sandstone formations and how they would fit within the two most popular YEC models for the timing of Noah’s flood. If the figure is approximately what is predicted by the FG models, then the entire Bliss SS and Curtis SS formations were each deposited in 3-20 days. If less than 1 meter of the Curtis Formation took over 40 days to deposit, then that would be difficult to reconcile. One could speculate that deposition slowed dramatically for a month, but that would only exasperate the issues with the rest of the column. Earlier I listed a number of other areas where tidal bundles are recognized. In fact, in other cases such as in the Carboniferous of Illinois (Davis, 2012) and in the Cambrian of Minnesota (Tape, et al., 2003) from 200 to over 300 tidal cycles have been measured. Many such examples could be sited. Each of these would have taken most of the time available in the flood model.

A particularly interesting example is presented by Mr Wilford of the "Mountain Railroad" website. In his post, he describes the tidal deposits from the Hindostan Whetstone Beds from the Pennsylvanian Mansfield Formation in Indiana. https://mountainrailroad.org/2021/08/18/carboniferous-tidal-cycles-vs-yec/ His post points out research by Kvale, et al., 1989 who measured more than 2000 laminations within a 10 m (33 ft) interval. The tidal cycles clearly show the same cyclicity at multiple levels as modern tidal deposits do. Other observations are also consistent with a tidal setting, such as arthropod trackways and plant fossils, including upright lycopod trunks.

Mr Wilford referenced YEC writer, Warren H Johns (2019) who investigated the beds and also recognized the validity of the tidal interpretation and their incompatibility with deposition by a year-long flood. Kvale, et al., 1989, noted that

> "*Within the lower most 6.9 m of the whetstones, there occurs what appears to be 6 years of nearly continuously generated laminae in an intertidal to subtidal setting*."

It seems that the Pennsylvanian is another interval that cannot be part of a global flood deposit. The most common YEC explanation given is that such deposits were not formed by tides. It will be a challenge for YEC to come up with another explanation for the small-scale repetitive beds embedded in overall cycles of approximately 28 smaller cycles. The reversal of flow direction demonstrated in herringbone cross-beds are easily explained as tidal deposits, but another explanation would be required.

Conclusions and Summary

Many sedimentary rocks tell us in many ways that they were deposited over many years showing that it is impossible to reconcile these sediments with deposition that occurred during Noah's one year-long flood. The book of Genesis does describe a large flood event that covered the known world, but making it global is not required by the biblical text nor is it supported by the geologic record. The creator of the universe certainly has the power to flood a planet, but the question is what did He choose to do. We can use the record of the Bible and the record of nature to understand that. Throughout the geologic record, rocks are found that are not compatible with a global flood model, whether because the processes that formed them would not have taken place under flood conditions or because internal clocks show that they took more time than would be possible under flood assumptions. The tidal examples provided in this article are just a few of those involved.

For more discussion related to this issue: Age of the Earth

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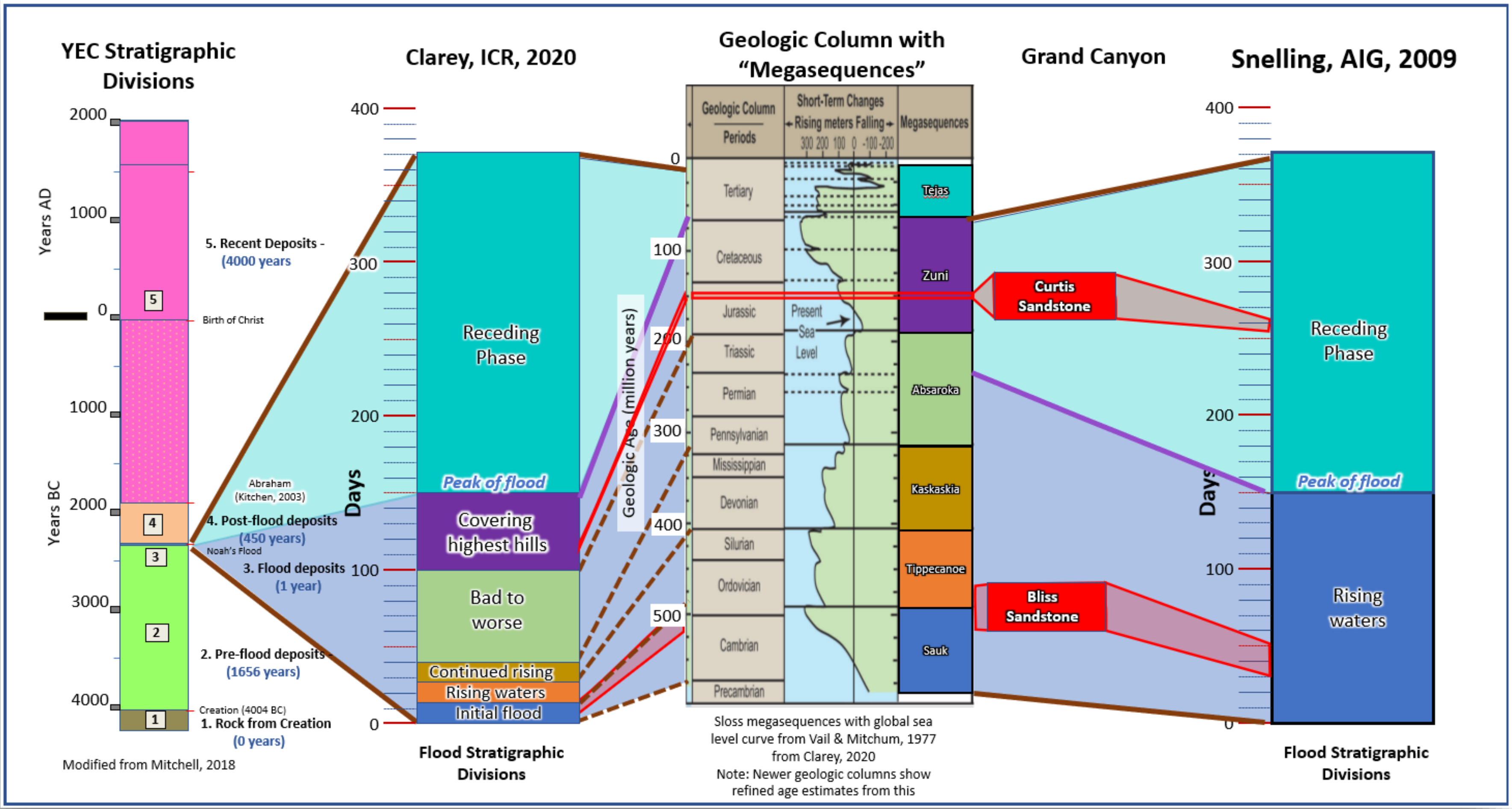

Figure 5. *Geologic columns based on YEC flood geology models compared to geologic models based on standard geologic timing.*

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