New Discoveries about Stonehenge vs. Flood Geology

As we learn more about Stonehenge, how does this fit the Young Earth "flood geology model"?

Stephen Mitchell September 8, 2020

Email: Jesus.inHistandS@gmail.com

On the Salisbury plain of southern England sits the world-famous circle of rocks known as **Stonehenge**. My family visited it first in 1990 and we almost drove right by it. I was expecting more fanfare and really thought it would be bigger. We were fascinated, just like it has fascinated people for thousands of years. It causes wonder to think about people long ago, using ancient technology and tools, transporting the stones from their far away origins and then arranging them with precision. Some might expect that we have known the full story about them for hundreds of years. Part of their wonder is their mystery that is only now being unraveled. Here are a few of the recent discoveries and theories:

- **June 22, 2012 – "Stonehenge was monument marking unification of Britain"**
  - https://www.sciencedaily.com/releases/2012/06/120622163722.htm
  - "After 10 years of archaeological investigations, researchers have concluded that Stonehenge was built as a monument to unify the peoples of Britain, after a long period of conflict and regional differences between eastern and western Britain."

- **August 2, 2018 – "New light shed on the people who built Stonehenge"**
  - https://www.sciencedaily.com/releases/2018/08/180802102414.htm
  - "Now, archeologists suggest that a number of the people that were buried at the Wessex site had moved with and likely transported the bluestones used in the early

stages of the monument's construction, sourced from the Preseli Mountains of west Wales."

- **July 17, 2019 – "Stonehenge's Builders Transported Megaliths Using Tallow, Says Archaeologist"**
  - http://www.sci-news.com/archaeology/stonehenge-greased-sled-theory-07398.html
  - A Newcastle University study suggests that because the fragments came from dishes that would have been the size and shape of buckets, not like cooking or serving dishes. They could have been used for the collection and storage of tallow, a form of animal fat to use on 'greased sleds' to move the stones.

It is an appealing idea that 5000 years ago, the early Brits decided to work together to build a monument to unification, but this is still just one proposal. The obvious ties to the sun still imply a strong religious connection, though we don't know what form that took except that the Sun was central in it. The evidence suggests that a variety of people worked together to bring the stones together. Perhaps working 20 people at a time, the rocks were pushed along on logs lubricated by pig tallow. Probably thousands of people were involved. The project took place in several distinct stages over a thousand years.

The Salisbury plain was optimally located to align the winter and summer solar solstices. It was recently recognized that the tallest stone at Stonehenge points towards the midsummer sunset. (https://www.bbc.com/news/uk-england-wiltshire-33205212). It is very interesting that these ancients did not just dig up stones from the immediate area. For whatever reason, they went farther. Notice that the stones are not all of the same lithology. There are actually three types: "sarsen" stones, "bluestone" rocks, and a sandstone altar. None of these were from the immediate area. This was not a spur of the moment idea! It took a lot of effort to quarry stones and to transport them and then to erect them.

Now to investigate the stones and what they tell us about the whole process. (**Figures 1 and 2**)

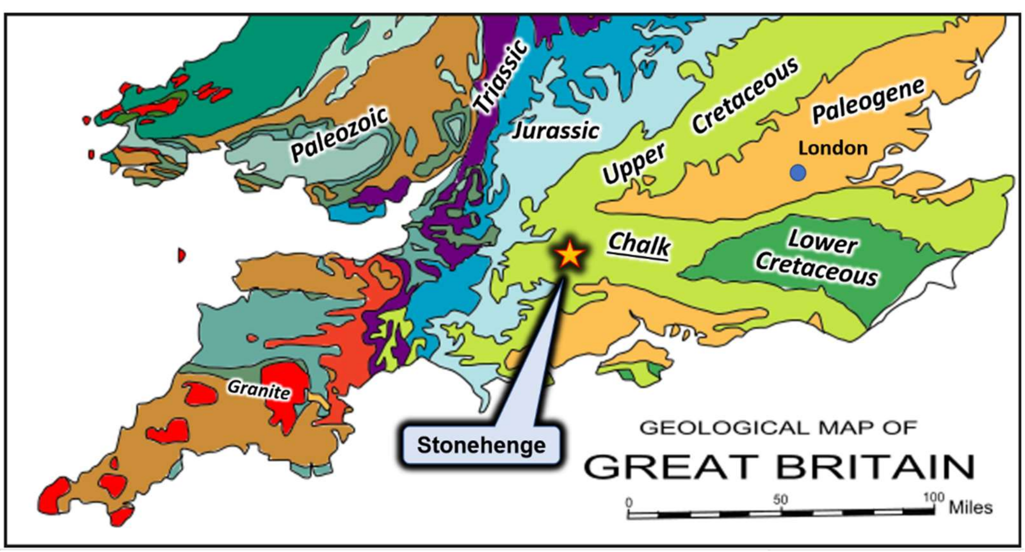

Figure 1: Geological map of England with Stonehenge location. The geologic ages represented include Paleozoic, Mesozoic and Cenozoic eras. See **Figure 7** for the order in which the rock units named here were deposited.

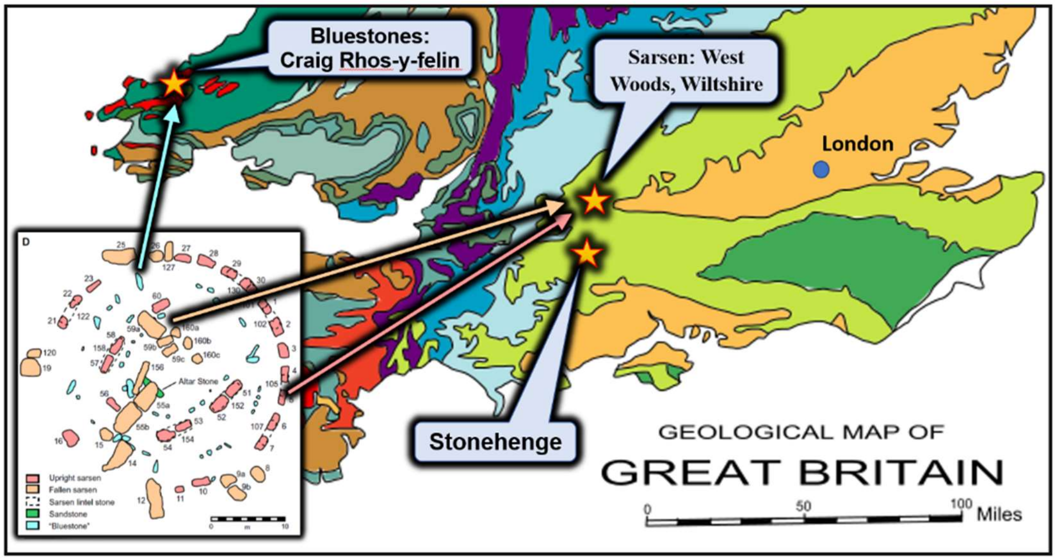

Figure 2: Geologic Map showing where Stonehenge stones were quarried.

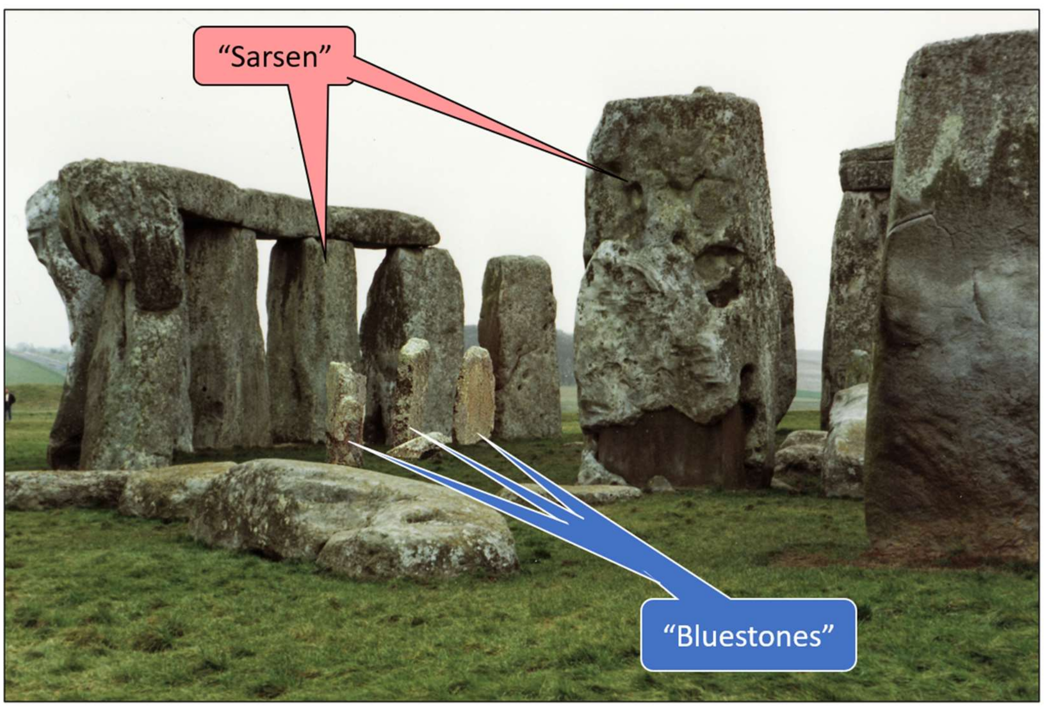

Figure 3: Bluestones and Sarsen stones labeled.

Bluestone:

The smaller stones of Stonehenge consist of an intrusive igneous rock known as "spotted dolerite". (**Figure 3**) (https://www.virtualmicroscope.org/content/spotted-dolerite-preseli-hills) The rock has white spots of the mineral plagioclase that float in a matrix of dolerite that has a slight blue tinge to it, hence the name. The quarry where it is believed to have come from was confirmed in 2019 (http://www.sci-news.com/archaeology/stonehenges-bluestones-06924.html). We don't know why stones from this location were chosen, but perhaps they were symbolic for a certain people group. Even these smaller stones still weigh 2-5 tons each.

We can be sure about some parts of the history of the dolerite. We know it was a molten igneous body at approx. 1200° C., buried deeply under the surface. We know it has cooled and hardened, and that did not happen quickly because it formed the visible crystals. If this magma had cooled quickly, it would have been basalt, which has no individual minerals visible to the naked eye. Just as it takes a turkey a long time to cool when it is left in the oven, even if the heat is turned off, we know it took a long time for this spotted dolerite to cool (Young and Stearley, 2008). If we knew the size of the body, its current temperature and such component details, we could then estimate how long it took for the rock to cool. This has been done for the enormous batholith complex that forms the core of the Sierra Nevada in the U.S. Just as for cooking turkeys, bigger birds take longer to cool than smaller birds, bigger batholiths take longer to cool than smaller ones. Calculations and modeling demonstrate that some of the California batholiths required upwards of six hundred thousand years to cool to their present temperature. (Young and Stearley, 2008). While the igneous bodies from Wales may not have been as large as the Sierra Nevada batholith, the mountains along this trend were huge (think Himalayas size). These mountains were eroded away by the end of the Mesozoic. (See **Figure 7** for the age terms) Explaining intrusive igneous bodies on the surface is an important consideration for trying to explain rocks in a young-Earth timeframe.

Sarsen stones:

The larger stones, known as sarsen stones are modified sandstones that weigh an average of 25 tons. In July of 2020, the location where these stones originated was announced. (Nash, 2020) (http://www.sci-news.com/archaeology/source-stonehenges-sarsen-megaliths-08699.html). (See the **Figure 2**). It is not hard to figure out why these were brought from a closer location than the bluestones! Moving these large stones even 25 km was a great achievement. We also know quite a bit about how these stones were formed. The stones began as sands in a river system or nearshore environment in the Paleocene epoch, conventionally dated 55-65 mya (million years ago). Paleocene fluvial sands are common around the North Sea. Such sands are preserved from high sea level stands typically in what were deltaic complexes. During lowstands of sea level, deepwater fan complexes were deposited. A number of major fans systems are mapped, often stacked. These are great reservoirs for oil in the North Sea. I have had the pleasure of mapping these intervals in the North Sea and north of the Shetland Islands. We understand the deepwater portions of the systems, often in great detail. Portions formed by ancient rivers and deltas have been mapped but many parts have been eroded away. When the sands were first laid down, they were unconsolidated, loose sands. Such sands would not have served the purpose of stones for Stonehenge. Over time, and with burial, the sands were changed from sands to sandstone by processes known to geologists as diagenesis. In most cases, the sand grains are first cemented together by calcite. In this case, probably after some cementation, the calcite cement was replaced by silica to form what is known as "silcretes". (Ullyott, 2006). It is a bit like concrete, except it is silica (quartz) holding the grains together. This is why the stones can stand for 5000 years with so little evidence of weathering, despite the wet climate of England. The process occurred as groundwater slowly leached pyrite from lignites (soft coals) and clays from the overlying host sands forming acids that moved the silica. How long did that take? Ullyott reports "*Formation may be rapid, in the order of 30 kyr [30,000 years] for a silcrete lens.*" A geologist sees such a process as rapid. A young-Earth creationist (YEC) would not. The rocks were solid and hard as we see them today when they were selected for sarsen stones 5000 years ago.

Below Stonehenge

The stones of Stonehenge imply an Earth history of millions of years, on the basis of forming and cooling a dolerite and depositing sands that are later converted to silcrete. The monument is just a small part of the geologic story of this area. The stones sit on a limestone unit known as the "Chalk" that was deposited during the Upper Cretaceous epoch, conventionally dated as 100-65 mya. This chalk overlies rocks deposited in the Lower Cretaceous epoch, a Jurassic period and eventually thick units formed in the Paleozoic era. The Paleozoic rocks were folded in a mountain building event known as the Caledonian orogeny that formed when North America and Europe were joined together. Younger Paleozoic rocks include those from the **Carboniferous** period. During this period vast amounts of coal were deposited contemporaneous with large deposits in the eastern U.S. These fueled the industrial revolution of Britain.

Mesozoic sediments above these Paleozoic rocks included many from non-marine environments, with dinosaur fossils in many places. They also include **Jurassic** marine shales known as the 'Kimmeridge Clay'. This shale is formed in marine conditions where much organic matter was preserved. It covered much of the North Sea, and when buried deeply enough, it sourced much of the oil produced in the area. Many other formations are recognized and each unit has its own story of deposition, faulting and folding.

The **Cretaceous** chalk units on the surface at Stonehenge once extended over large portions of Europe. Calcareous mud and tiny platelets or "coccoliths" were formed by algae and settled on the ocean bottom through the Late Cretaceous Period (**Figure 4**). The light green area shown on **Figure 2** shows the onshore area covered today with chalk. Spectacular exposures are found along the southern coast, including the "White Cliffs of Dover" (**Figure 5**).

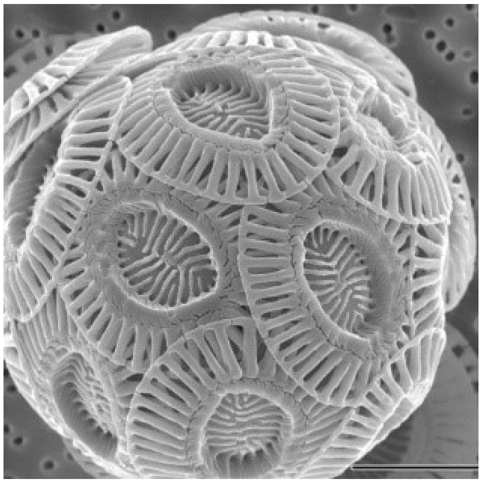

Figure 4. Scanning electron micrograph of an algal coccolith cell

By Alison R. Taylor (University of North Carolina Wilmington Microscopy Facility) - PLoS Biology, June 2011, Cover ([1]), CC BY 2.5, https://commons.wikimedia.org/w/index.php?curid=15662212

Figure 5. Chalk cliffs near Dover, England. These beautiful cliffs are composed of thick units of chalk with coccolith fossils throughout. The rocks in front of the cliffs consist of flint that has weathered out of the cliffs.

Geologist Lorence Collins (in press) described one of the problems that the chalk units cause for YEC this way:

> *"The White Cliffs of Dover on the eastern coast of England consist of chalk layers of Upper Cretaceous age that are more than 350 feet thick and composed of fossilized coccoliths (a kind of algae). These layers are the same age as the sedimentary rocks that overlie giant cross-bedded sandstones in Zion National Park. Therefore, they were supposedly also deposited by Noah's flood. But coccoliths are very tiny spherical creatures (0.025 to 0.1 mm in diameter) and have chloroplasts that require sunlight, so they must float close to the ocean surface to get energy from the sun. Because of this, enough algae to produce layers of more than 350 feet could not have been living at the same time in the one year in which the Noah's Flood is said to have occurred. That many organisms (trillions and trillions of them) in the water at the same time would have blocked out the sun from reaching other coccoliths a few feet below the surface."*

A detailed geologic evaluation of the Stonehenge area is available that was prepared as new road systems were evaluated in the area (Mortimer, et al, 2017). They document thick chalk, marine fossils, flint beds and nodules, and unusual phosphatic chalk units that fill channels that locally cut down into chalk units. The phosphatic channel fills include notable hardgrounds where the sedimentation paused for period of time, allowing the sea floor to harden. Hardgrounds, often correlatable over substantial distances are also found elsewhere in the chalk.

The flints that are characteristic of the chalk beds also help us to understand the conditions under which the chalks formed and what happened to them subsequently. (Gale, 2013; Aliyu, 2016). This siliceous rock commonly is in odd shapes that formed as the silica selectively replaced burrows. Multiple intensely burrowed units make perfect sense in a shallow sea environment but would not have had time to develop in a rapid flood deposit. The formation of flint also speaks to the antiquity of the rocks. Originally the sediments would have been almost entirely calcareous. The nodules formed as sparse silica from sponge spicules and other siliceous components was concentrated to form nodules and thin beds. This happened slowly after deposition. Today, the chalk has been folded and faulted in many areas but the flints were formed before this and after the units were completely lithified.

Figure 6. Burrows within the chalk that have been replaced by flint

Implications for flood geology

The young-Earth model for Earth history has the Earth created 6,000 to 10,000 years ago. It has most of the rock record either created as to appear mature or resulting from Noah's flood. YEC Flood geologists are divided, but most consider rocks from the Cretaceous period to have been deposited during the one-year-long event recorded in Genesis as Noah's flood. A few YEC authors consider the Cretaceous to have been deposited after the flood, but well before the time of Abraham. It is worth noting that many of the hills in and around Jerusalem are composed of Cretaceous limestones. I have tried to show that in this area, flood geology has to account for a lot of separate events, each of which imply considerable amounts of time. A fellow Christian geologist / Geographic Information Specialist, Kevin Nelstead describes this as the "too many events... too little time" problem. In this post, I have pointed out several geologic events demonstrated in Stonehenge and the surrounding area. They include the following:

- The spotted dolerite from the Preseli hills in Wales.
    - Buried deeply and emplaced at ~1200° C. in the Devonian Period.
    - Cooled slowly while the mountains that were above it eroded away.
    - Quarried and transported to Stonehenge 4,000-5,000 years ago.
- Sarsen stones.
    - deposited as sand bodies in the Paleogene Period.

  - Buried by later sediments
  - Groundwater concentrated silica to form silcretes
  - Eroded to the surface
  - Hardened rocks quarried and moved to Stonehenge 4,000-5,000 years ago.
- Triassic, Jurassic, Cretaceous and Paleogene rocks deposited over southern England area
  - These include non-marine rocks with dinosaur tracks and thick marine shales
  - Cretaceous chalk deposits
  - Paleogene non-marine deposits
- Rocks were lithified and uplifted and folded
- Rocks deeply eroded including removing the Paleogene rocks off from the Salisbury Plains

If the YEC flood geology model is correct, then it must account for all of the above items. **Figure 7** shows events recognized in Earth history from a YEC perspective. Some would extend the period by up to 4,000 years by making either unit 2 or unit 4 longer. This time extension usually means that the genealogies are taken to have gaps in them. I have not found any documentation on how YEC feel this extended period should be split or how they support such a placement. From a geologic perspective, extending the period to 20,000 years, for instance, doesn't really affect the geologic disconnect. Adding a few thousand years just creates more problems for their desire to maintain an interpretation consistent with their particular literal interpretation. It adds problems on the one side without solving any on the other.

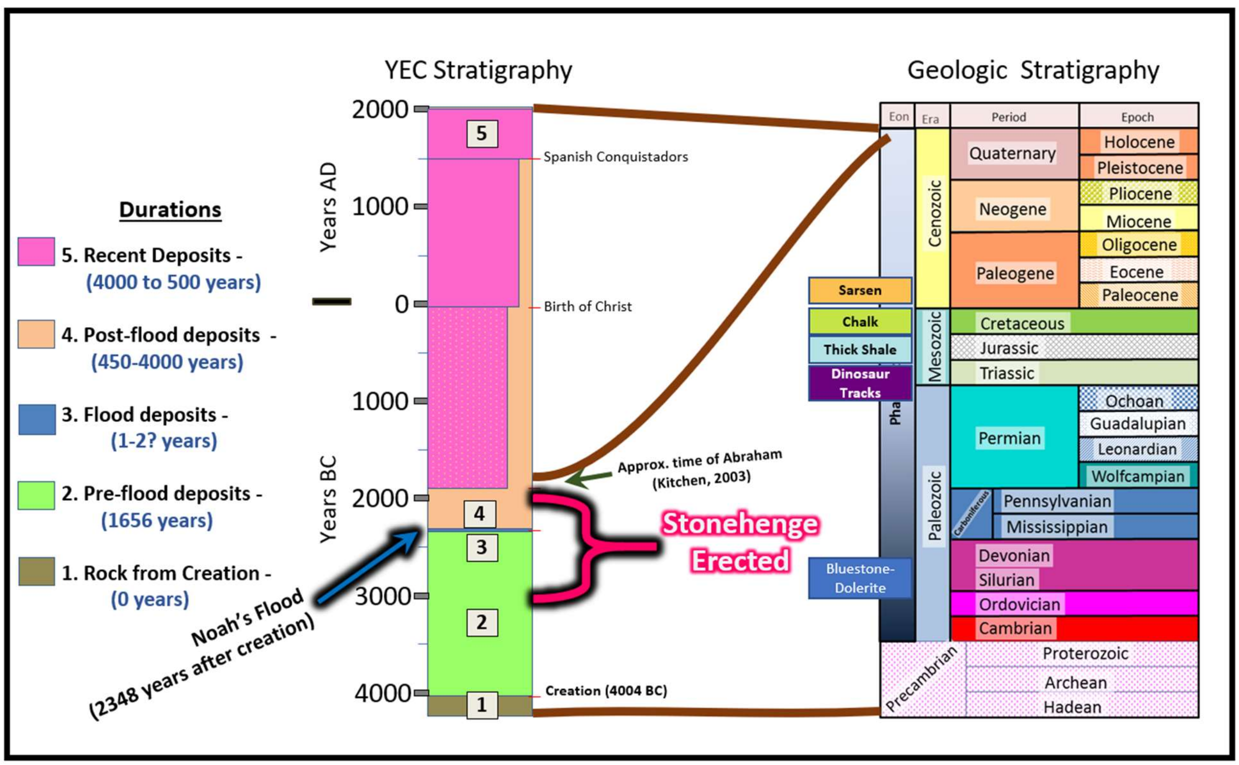

Figure 7. Stratigraphic column showing YEC geologic events and the geologic column recognized from the rock record. The second column is draw with the intervals the same thickness so as not to assume the conventional age model true. The time over which Stonehenge was built is labeled as well as some of the stratigraphic level of some of the features discussed.

Many Christians interpret Genesis differently and have no problem with the geologic events representing just what they appear to be. If any of these events are as they appear, then the YEC timeline would collapse or need major revision. Most YEC authors consider the sedimentary rock beneath Stonehenge to have been cataclysmically deposited over a few days or weeks. If any rock bed or set of beds took more than one year to deposit, then that unit cannot have been formed during the flood. When sediments enter standing water, sediment settles to the bottom in a very predictable order and rate based on their size calculated according to Stokes' law. The sheer settling time for the fine-grained shales and chalk sediments would seem to negate the YEC model.

YEC Explanations

Young-Earth creationists at least since the time of George McCready Price (1870-1963) have proposed explanations for geologic features to fit units into their interpretation of Genesis. Many of the explanations have been dropped because they proved to be undefendable. The YEC have made proposals for the issues raised here, but few modern geologists consider any of them adequate. I will examine some of them briefly.

Intrusive dolerite:

The cooling of intrusive igneous bodies has been discussed by YEC authors, Snelling and Woodmorappe (2009). An article is found here: https://answersingenesis.org/geology/the-cooling-of-thick-igneous-bodies-on-a-young-earth/. They make the point that igneous intrusions with access to large meteoric water systems can cool more quickly than relatively dry bodies. Once such magmas have cooled enough to behave as brittle rock that sustains fractures, then it might be possible to dissipate heat out of a buried body. They propose that a large body could be cooled in 3000 years by such a method. They suggest that this could explain the Sierra Nevada batholith. Here are two issues with this:

> *1. Something like the Sierra Nevada batholith is not just a single isolated intrusion, but is composed of dozens or hundreds of individual bodies of intrusive igneous rocks that crystallized from magma, slowly cooling below the surface of the Earth known as plutons. Individually they show chilled margins, indicating that older plutons were intruded before subsequent plutons were intruded. (Kevin Nelstead, personal communication)*
>
> *2. The Sierra Nevada batholith is Jurassic, and there are younger, Cretaceous-aged volcanics that include sediments. Some of these sediments contain cobbles of Sierra Nevada batholith rocks. (Bateman, 1992). Similar cobbles are found in younger early Cenozoic sediments. This demonstrates that a magma cooled to form granitic rocks. The rocks were uplifted and eroded, forming cobbles that were then deposited as sedimentary rocks that were exposed by subsequent erosion. If the Mesozoic rocks were deposited by Noah's flood, then that all had to happen in a few days or weeks. Where did all that heat go? If, as a few interpreters claim, the Mesozoic rocks were deposited after the flood, then the time problem is still just as severe. The mountains as we see them today were clearly here 5,000 years ago because the oldest trees in North America come from the White Mountains in this area where one has been dated by counting rings as 5062 years old (Rocky Mountain Tree-Ring Research, n.d.).*

The dolerites in question in Wales differ from the Sierra Nevada trend in several ways. I do not know if fragments of the dolerite are found in the overlying sedimentary rocks but I would expect that they are. The dolerites of the Preseli hills in Wales are not huge batholiths but dikes and other smaller bodies. They also were hotter than the granites. Though the dolerites were hotter, I would expect that they still would have cooled somewhat quicker than large batholiths. In both cases, large mountains have been eroded away (unroofed). Eroding away solid rock takes a long time. As shown in **Figure 7**, the YEC time table needs the rock to have been emplaced, cooled and unroofed at least instantly.

Triassic non-marine stones:

The Triassic rocks preserved in southern Britain are dominantly non-marine rocks deposited onshore in a variety of environments. Similar rocks occur along the US eastern states, as would be expected if Europe and North America were joined. Why are they considered non-marine? The fossils found in them are from non-marine flora and fauna. They are characteristically reddish, reflecting iron content that is ferric, the oxidized form, typical of onshore settings. They contain tracks from onshore animals in rocks consistent with lake environments and others where we find such tracks today. Many of the tracks are from dinosaurs. The most famous example is described here: https://www.geolsoc.org.uk/GeositesDinosaurBendrick. The Geologic Society article describes the setting this way:

> *"The exposure itself provides extensive outcrop of the Upper Triassic, Mercia Mudstone Series where the stratigraphy is dominated by fine red mudstones, marls, ripple bedded sandstones and occasional conglomerates. The sediments here are recognised as important palaeoenvironmental indicators, recording a time when climate in this area was predominantly arid and terrestrial but with occasional periods of heavy rainfall. The sediments and climatic conditions that existed in the Triassic Period are similar to those found in a modern sabkha or playa basins like those found in North Africa around Abu Dhabi."*

Dinosaur and other animal tracks are simple to explain with a conventional geologic understanding. Young-Earth articles suggest that it is difficult, but that is just not true. It is very easy to have a local storm deposit to rapidly cover sediment where animals have walked, preserving tracks. How do they fit within a global flood?

Dr. Elizabeth Mitchell, a pediatrician and AIG author apparently drew on Dr Andrew Snelling's ideas in writing:

> *"Thus, mineral-rich water would have surged over various habitats, perhaps resulting in fleeing animals leaving their footprints in wet surfaces temporarily exposed during tidal fluctuations or lulls between the violent upheavals of water. Sand hauled in by surging Flood waters would have rapidly filled many of these footprints and, under great pressure, compressed and set them like quick-setting cement." (Mitchell, 2013)*

In another article she observes:

> *"For instance, paleontologists often attribute tracks to a flash flood that swept away animals by a muddy riverbank. However, flash floods are known for washing away everything in their paths, not for preserving prints for posterity. While the global Flood was far more destructive than any*

> *flash flood, it actually does an excellent job of explaining how footprints became fossilized in the first place." (Mitchell, 2014)*

I certainly agree that a global flood as described by AIG would be more destructive. That would seem to make it really difficult to explain why tracks would be preserved at all in such cataclysmic settings. If we assume that they could be preserved, why would dinosaur tracks only be found in Mesozoic sections. Where were they when all of the Paleozoic rocks were deposited? Snelling thinks that the Cretaceous rocks were laid down "not long before day 150". It doesn't work to say that similar rocks were not laid down earlier. Why would the classic Old Red Sandstone (Devonian) not have at least some examples? It has been studied for hundreds of years, but without dinosaur tracks. Rocks from similar environments are common in the Paleozoic globally, but without dinosaur tracks. We find trackways preserved in Paleozoic rocks, but not from dinosaurs. Trackways are common from the Cenozoic era, but without dinosaur tracks. I could consider YEC proposals if tracks were rare earlier, but became common over a later period. It is often claimed that the dinosaur tracks formed as these large animals were running from the advancing flood. As it happens, the tracks go in many directions at track sites and most are not running. You can learn more about the problems involved where I described examples in Texas and Utah in these earlier blog posts. https://jesusinhistoryandscience.com/?p=1520, https://jesusinhistoryandscience.com/?p=1561.

Jurassic Marine shales

Many very thick formations that started as soft mud are found in the geologic record. The YEC model demands that these were deposited by very rapid processes. Most geologists were taught the generalization that such shales always represented very slow deposition in very quiet water. It is undeniable that when a sediment load enters a body of water, the coarse fractions drop out first under higher energy conditions, followed eventually by muds in quieter water, with very slow settling velocities. YEC geologists declare, based on a 2007 article by Schieber, et al., that at least Paleozoic and Mesozoic mudstones were deposited very rapidly and fit their flood model. (Schieber, 2007, 2009).

This quote from Dr Tim Clarey from ICR is an example:

> *"Secular science has long taught that many of Earth's sedimentary rocks were deposited slowly over vast ages. It says the slow rates of deposition for sediments like clay and lime mud are arguments for an old earth, claiming these layers form through sediments slowly settling out of stagnant water. People have been indoctrinated with the notion that enormous periods of time are necessary to explain these thick rock layers.*
>
> *Yes, we do see clay settling out of stagnant water today, but the rocks we observe didn't form that way. Clay, Earth's most common sediment, doesn't slowly settle out of still water to form rocks. Clay-rich rocks like shale and mudstones often exhibit fine laminations or thin-bedded layers that only form through moving, not stagnant, water. How do we know? Recent empirical evidence demonstrates that laminated clays must be deposited in energetic settings by moving water. Finely laminated clays rarely form today since biological activity (burrowing or bioturbation) usually destroys the thin layers."(Clarey, 2019)*

It is true that there are situations where fine-grained beds were laid down relatively rapidly. Applying this ubiquitously through the rock record is just not reality. When I began in geology 40 years ago, shale units were often just considered drilling challenges, source rocks for oil and gas, or seals for reservoirs. They were often ignored and considered boring. The last 10 years have changed that dramatically. Some of these drilling challenges are now producing a lot of oil and gas. This has prompted a lot of intense study. Shale units can be divided into depositional sequences that are predictable. We find that there are units that formed more quickly as turbidite aprons when sediment slumped down into deeper water. Some of the muds travel near the water bottom and don't have to settle as far to reach the sea floor. I don't doubt that Schieber is right that muds can travel as flocculated masses where matter clumps together. There are also units that formed very slowly as pelagic units, where very fine-grained muds, microfossils and organic matter rained down on the waterbottom. These more condensed units represent a lot of time.

The Kimmeridge clay in this area is a 550m thick unit of predominantly mudstone that reflects a lot of slow deposition. So much organic matter is preserved in it that where it outcrops in Kimmeridge Bay, it is possible to break open pieces and burn them. It was deposited in very oxygen poor environments (anoxic) in a series of basins that were restricted, cut-off from open ocean circulation. It is very cyclic and the cycles reflect changes in the paleoenvironments, probably related to Milankovitch 100,000-year cycles. (Hart, 1995, Gallois, 2004). Geologists would describe these units as being rapidly deposited, but by many widely separated depositional events. This allowed for all the organisms to live and die that are preserved as organic matter. Where the Kimmeridge clay has been buried deeply, it was heated up, and generated large amounts of oil and gas in the North Sea. The geochemical signatures of the oil and gas tie clearly to the Kimmeridge.

In general, the idea that because some shales can be deposited relatively rapidly, all of the Paleozoic and Mesozoic shales were deposited by a global flood is just not true. The Kimmeridge clay is a great example to show that more events and more time was involved.

<u>Cretaceous Chalk</u>

YEC geologist, John Matthews has written about the Cretaceous Chalk from a young-Earth perspective (Matthews, 2009). He proposes that the chalk units were deposited "within the timescale of a few days." He critiques the old-Earth explanations by claiming:

1. "Coccoliths do not settle naturally."
2. "Diagenesis does not always occur in deep chalk."
3. The geologic column, such as is on the right in **Figure 7**, is not really true. In this case, he claims that part of the late Cretaceous was deposited at the same time as the Paleogene sediments.
4. Though the chalk is a major reservoir in the North Sea, the oil in it had to have been created by God in Creation Week.

I appreciate that Matthews has attempted to provide a more complete application of flood geology in this area than most writers do. Many of his comments reflect a lot of work in the UK and North Sea. For instance, he also critiques the origins of various specific river valleys. I have not worked these units in the field or studied the onshore in detail and I am not qualified to comment on them. I will address the specific points above where they link to areas I have studied.

1. Coccolith settling.

We recognize that tiny coccoliths settle very slowly, but it is not true that they do not settle. We don't see settings quite like the Cretaceous seas today, but we do find coccoliths in oozes that settled. Susumu Honjo, 1976 described the process this way:

> *The presence of coccolith ooze on the deep-sea floor and the well preserved suspended coccoliths in the undersaturated water column is explained by accelerated and communal sinking of coccoliths and coccospheres in small zooplankton's fecal pellets.*

The conventional time of 34 million years for the Upper Cretaceous provides ample opportunity for deposition. Internal evidence from the hardgrounds and the burrows support that the sedimentation took a long period.

2. Diagenesis does not always occur in deep chalk

It is true that high porosities are preserved in some of the oil fields, such as Ekofisk. Typical burial diagenesis did not occur, preserving high porosity in some places. Lower than normal diagenesis occurrences happen in many places. This quote describes how chalk diagenesis was controlled.

> *"With a few exceptions, the porosity (and permeability) of chalks decreases as a direct function of burial depth. The exceptions include cases where: (1) oil entered the rock, reducing or terminating carbonate reactions; (2) chalks are overpressured and therefore are not subject to the normal grain-to-grain stresses expected at those depths; and (3) tectonic stresses increase solution and cementation. In areas where fresh water entered the pores before major burial, chalks show a much steeper gradient of porosity loss versus burial depth as compared with regions where marine pore fluids were retained. In areas such as the Ekofisk field in the North Sea, major quantities of oil are produced from chalks having as much as 40% porosity (largely primary) at depths greater than 3 km. This appears to be related largely to the widespread overpressuring of the Central graben in that area." (Scholle, 1977)*

> *"However, abnormal pressures on the basin scale may take tens or hundreds of millions of years to dissipate. There is thus no need to invoke zero-permeability seals or capillary-pressure seals in order to explain the existence of abnormal pressures over geological time." (Scholle, 1977)*

The preservation of porosities in the North Sea Central Graben occur because of overpressure that develops when geologic processes predictably act over time.

3. The geologic column does not really reflect the order of sedimentation.

Matthew presents the view that parts of the geologic column developed at the same time. I want to emphasize that the geologic stratigraphic column order was developed before evolution or radiometric dating. It is was not developed to support either. Geologists consider this the relative order in which rocks were formed regardless of how many years were involved. Many YEC authors also accept this point as well. I am always a bit frustrated when YEC authors refer to this as the "uniformitarian view". Modern geologists certainly recognize great value in studying modern processes and rates because they also occurred many times in the past. We also recognize that in many cases processes such as asteroid collisions occurred in the past that do not happen today (fortunately).

Matthews uses the example of one area in the chalk where a fault known as the "Ballard Down Fault" juxtaposes sediment of different ages, Cretaceous and Tertiary (units that include those known today as Paleogene and part of the Neogene). You can find a good photograph of the fault by following this link: http://www.southampton.ac.uk/~imw/Harry-Rocks.htm. Matthews contends that what most geologist recognize as a fault is actually an unconformity. In my view, the picture clearly shows a fault. The picture does not show enough to be certain what all of the relationships are, but some sort of reverse fault is clear.

The basic issue is that Matthews and some other YEC authors take a piece of complex structurally deformed rock and interpret it to prove that the geologic age interpretation is flawed. When unstructured sections are considered the order is always 100% consistent. This is where the validity of the age order of the rock must be evaluated.

4. Origin of oil

Matthews recognizes that generating, migrating and filling reservoirs with oil and gas does not fit the YEC model. He proposes that the oil must have been created before the flood and Adam (unit 1 on **Figure 7**). In the North Sea, part of the problem is that we can we find Kimmeridge clay with organic matter that is a source rock for producing oil when buried deep enough to be heated up in nature. In a laboratory, we can heat it and generate oil. Chromatographic analysis and other tests demonstrate that such oil matches the oil in many reservoirs. In regional studies of frontier areas, perhaps the single most important thing to look for is a good source rock from which to generate hydrocarbons. We then try to find an area where it has been buried deeply enough to be hot enough to generate oil. If a really rich, mature source rock, such as the Kimmeridge clay is present, then it is very likely that the other components needed will be found. No source rock presence tells us to walk away from an area. All around the world, we find that oil and gas are generated from rocks that YEC interpreters consider to have been formed a few thousand years ago. That means that the source rocks were buried very recently, heated until oil was generated, expelled from the source beds and migrated to the reservoirs. I can understand why a YEC would prefer oil to have been created, but we know where it was generated and often when.

Human Culture Issues

The YEC model of Earth history conflicts with the sciences, perhaps most notably geology, physics and astronomy. It also conflicts sharply with the historian's view of human history and prehistory, the history before written records. **Figure 8** shows a few of the ancient cultures and monuments around the world. The Egyptian Nabta megalith is interesting because it is considered the oldest astronomical megalith, making it Stonehenge's "older brother" (**Figure 9**). The circular pattern is similar in many ways to Stonehenge. In Nabta stones are called "quartzitic sandstone" (Wendorf, 2000). It is very likely that a study of the stones and the surrounding geology in Nabta or the Göbekli Tepe in Turkey would produce multiple more conflicts with flood geology.

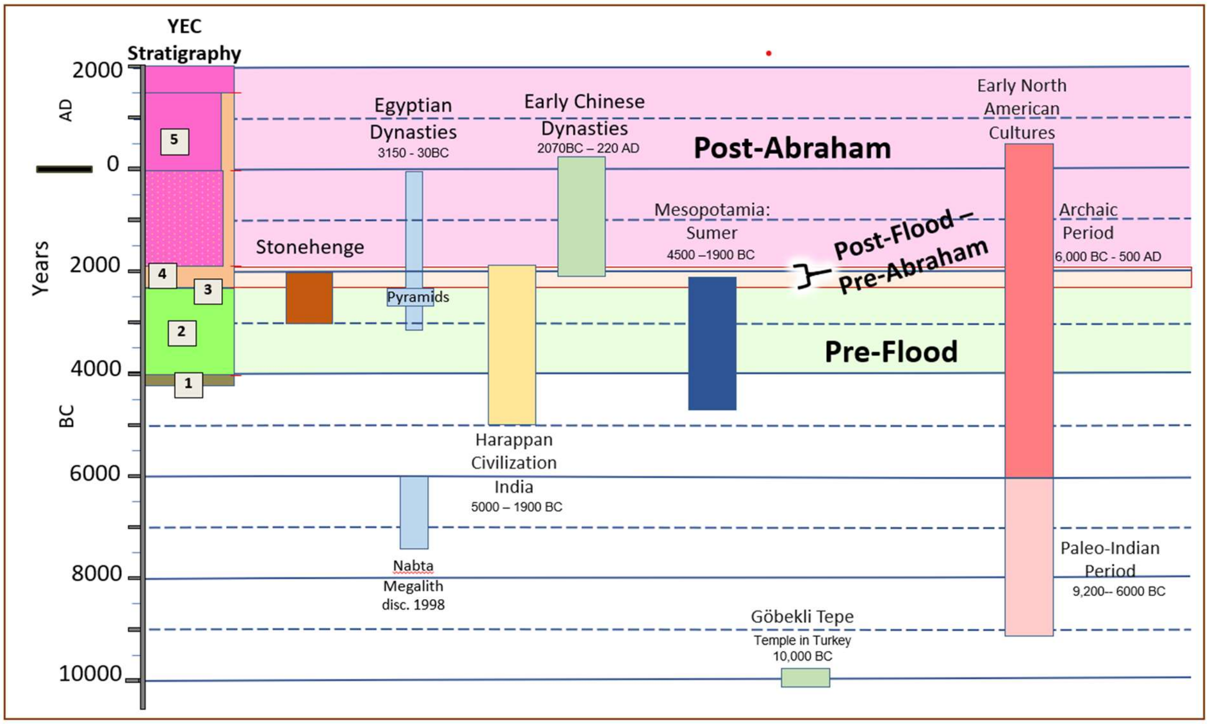

Figure 8. Column showing various ancient cultures compared to the YEC 6000-year earth interpretation. Most date ranges from Wikipedia.

Figure 9. Nabta Playa Calendar Circle, reconstructed at Aswan Nubia museum By Raymbetz - Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=7525976

Many YEC argue that the conventional dates are based on radiometric dating, a method that they consider unreliable. Radiometric dating uses the predictable decay of unstable radioactive elements to determine the age of various igneous rocks and plant materials. The physics is very predictable and well understood. Many different isotopes are available, often allowing the same rock to be dated by multiple methods. Even so, the geologic points made in this post do not depend on radiometric dates. I tend to think that the antiquity of the Earth is demonstrated by three key lines of evidence:

1. The basic geology that tells us long times were involved and that no significant portion of the rock record results from a global flood.
2. Modern physics and nuclear chemistry, including radiometric dating
3. Astronomy which tells us that light has taken millions of years to reach us.

The YEC model does not allow for the timeframes demonstrated by any of these methods. YEC authors recognize the challenge of radiometric dating and this has forced its adherents to look for ways to invalidate these dates. The most prominent work in this regard is the RATE (Radioisotopes and the Age of the Earth) project first published in 2000. The study provided no clear evidence of concerns that should cause us not to trust the radiometric techniques, neither based on a theoretical basis nor with the methodology used. I recommend this article by Jeff Zweerink, Christian astrophysicist from Reasons to Believe: **Comments on the RATE Project,** https://reasons.org/explore/blogs/todays-new-reason-to-believe/read/tnrtb/2012/11/20/http-www.reasons.org-articles-comments-on-the-rate-project

Radiocarbon (C^{14}) dating is one of the most important methods used in dating the human monuments and cultures shown in **Figure 8**. Is this reliable? It is interesting that even YEC author, Andrew Snelling accepts the reliability of this technique for materials after 400BC (Snelling, 2009). Christian geologists, Gregg Davidson and Ken Wolgemuth published this paper in 2018: **Testing and Verifying Old Age Evidence: Lake Suigetsu Varves, Tree Rings, and Carbon-14**. The paper presents a great test case where the radiocarbon rate of decay and dating are independently verified using a wonderfully documented example from Japan. They show how a number of YEC explanations do not work. There is an uncertainty range inherent in laboratory methods. Small adjustments may be possible, but the general method has high confidence when the samples are good. If YEC feel that the dating of the features on **Figure 8** are much younger than commonly accepted, then the onus is on them to show how old they really are and to show support for this.

Conclusions

Stonehenge and the adjoining area show a rich history, both from the standpoint of human culture and from geology. This site is one of many examples where the YE model breaks down. God reveals himself through both the Bible and the book of nature. While I appreciate the YEC desire to be faithful to the book of scripture, I would suggest that their eisegesis of the book of nature comes to wrong conclusions. They are starting out with the answer they want to see and trying to force the data to fit it. A better answer is to examine the Bible, letting it speak for itself and to examine nature and let it reveal its story. Where there are conflicts in our interpretation, we should then look for options that reconcile the two, without forcing either to be violated. An interpretation model that honors both datasets is more likely to be true. In my view, the geology points to a Creator who prepared Earth as a beautiful place for amazing life, including humans who would be able to see and appreciate the beauty. Stonehenge points to the consistent human desire to seek God, recognizing the wonder of nature, in this case, in both stones and stars.

Many thanks to Lorence Collins, Michael Mitchell, and Keven Nelstead for many helpful suggestions and edits.

References

Aliyu, M.M., 2016, *The Origin and Properties of Flint in the Upper Cretaceous Chalk,* Doctoral Dissertation, from University of Leeds, UK

Bateman, P.J., 1992, *Plutonism in the Central Part of the Sierra Nevada Batholith, California*, from USGS Professional Paper 1483, retrieved from https://pubs.usgs.gov/pp/1483/report.pdf

Clarey, T., 2019, *Four Geological Evidences for a Young Earth*, from Institute for Creation Research website, https://www.icr.org/article/11295/

Collins, in press, *A Christian Geologist Explains Why the Earth Cannot Be 6,000 Years Old - Let's Heal the Divide in the Church*; Dorrance Publications

Davidson, G, Wolgemuth, K, 2018, *Testing and Verifying Old Age Evidence: Lake Suigetsu Varves, Tree Rings, and Carbon-14*, from Perspectives on Science and Christian Faith, retrieved from: https://www.asa3.org/ASA/PSCF/2018/PSCF6-18Davidson.pdf

Gale, A.S., Surlyk, F., Anderskouv, K., 2013, *Channelling versus inversion: origin of condensed Upper Cretaceous chalks, eastern Isle of Wight, UK* from Journal of the Geological Society

Gallois, R, 2004, *The Kimmeridge Clay: the most intensively studied formation in Britain*, Open University Geological Journal, Vol. 25, Part 2., retrieved from https://www.researchgate.net/publication/277850785_The_Kimmeridge_Clay_the_most_intensively_studied_formation_in_Britain

Hart, M.B., and Fitzpatrick, M.E.J 1995, *Kimmeridgian Palaeoenviroments; a Micropalaeontological Perspective*. from Proceedings of the Ussher Society, 8, retrieved from https://pdfs.semanticscholar.org/5d35/a605026c0e42d55bd15805e4cf22f600fa39.pdf

Honjo, S, 1976, *Coccoliths: Production, transportation and sedimentation*, in Marine Micropaleontology

Matthews, JD, 2009, *Chalk and "Upper Cretaceous" Deposits are Part of the Noachian Flood*. Answers Research Journal 2 (2009): 29–51., retrieved from https://assets.answersingenesis.org/doc/articles/pdf-versions/arj/v2/chalk-upper-cretaceous.pdf

Mitchell, E, 2013, *Alaskan Dinosaur Tracks Buried in the Global Flood,* from Answers in Genesis website, retrieved from: https://answersingenesis.org/dinosaurs/footprints/alaskan-dinosaur-tracks-buried-in-the-global-flood/

___, 2014, *Bird X-Rays Shed Light on Dinosaur Tracks*, from Answers in Genesis website, retrieved from: https://answersingenesis.org/dinosaurs/footprints/bird-x-rays-shed-light-on-dinosaur-tracks/

Mortimer RN, Gallagher, LT, Gelder, JT, Moore, IR, Brooks,R, Farrant, AR, 2017, *Stonehenge—a unique Late Cretaceous phosphatic Chalk geology: implications for sea-level, climate and tectonics and impact on engineering and archaeology* from Proceedings of the Geologists' Association, retrieved from https://www.sciencedirect.com/science/article/abs/pii/S001678781730024X

Nash, DJ, Ciborowski,TJR, Ullyott, JS, Pearson, MP, Darvill, T, Greaney, S, Maniatis, G, Whitaker, KA, 2020, *Origins of the sarsen megaliths at Stonehenge*, from Science Advances, Research Article, retrieved from https://advances.sciencemag.org/content/6/31/eabc0133

Rocky Mountain Tree-Ring Research. (n.d.). OldList. Retrieved March 17, 2013, from Rocky Mountain Tree-Ring Research: http://www.rmtrr.org/oldlist.htm

Schieber, J, Southard, J, Thaisen, K, 2008, *Accretion of Mudstone Beds from Migrating Floccule Ripples*, from Science, retrieved from https://www.researchgate.net/publication/5769990_Accretion_of_Mudstone_Beds_from_Migrating_Floccule_Ripples

Schieber, J, Yawar, Z, 2009, "*A New Twist on Mud Deposition - Mud Ripples in Experiment and Rock Record*" The Sedimentary Record. https://pdfs.semanticscholar.org/a9ad/b7d63fcf636555fb57c57258ee31ea5e6665.pdf

Scholle, PA, 1977, *Chalk Diagenesis and Its Relation to Petroleum Exploration: Oil from Chalks, a Modern Miracle?,* AAPG Bulletin

Snelling, A, Woodmorappe, J, 2009, *The Cooling of Thick Igneous Bodies on a Young Earth*, from Answers in Genesis website, retrieved from https://answersingenesis.org/geology/the-cooling-of-thick-igneous-bodies-on-a-young-earth/

Snelling, A. 2009. *Earth's Catastrophic Past, Vol. 2*. Dallas: Institute for Creation Research.

Ullyott, JS, Nash, DJ, 2006, *Micromorphology and geochemistry of groundwater silcretes in the eastern South Downs, UK,* from Sedimentology

Wendorf, F, Schild, R, 2000, Late Neolithic megalithic structures at Nabta Playa (Sahara), southwestern Egypt. https://web.archive.org/web/20110806140123/http://www.comp-archaeology.org/WendorfSAA98.html

Young D, Stearley, R. 2008. *The Bible, Rocks and Time*. Downers Grove, IL: IVP Academic.

More good websites:

King, HM, ?, Chalk: A marine limestone composed mainly of foraminifera and algal remains. From Geology.com website, retrieved from https://geology.com/rocks/chalk.shtml

Sheperd, R, 2002?, *What is chalk?*, from Discovering Fossils: Introducing the palaeontology of Great Britain website, retrieved from http://www.discoveringfossils.co.uk/chalk_formation_fossils.htm