Chalk challenges deep-time dogma – errors in such a model

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Introduction

Gavin Cox (2021) has written an article titled: “Chalk challenges deep-time dogma.” See this link.
https://creation.com/chalk-challenges-deep-time-dogma

In this article he proposes that the coccolith deposits in chalk in the White Cliffs of Dover in England were deposited rapidly near the end of Noah’s Flood rather than “gradually over vast eons.” He says that old-earth geologists say that the chalk formed supposedly in placid, shallow warm oceans during the Cretaceous period (Latin creta = chalk) and imagines that the coccoliths settled slowly out of the water and were deposited on the sea floor between 145-66 million years ago. However, he believes that there is strong evidence within the chalk deposits that is consistent with their rapid formation and a biblically youthful age. In this article three of his arguments are examined
that he makes to support his model. The third argument is accompanied by several sub-sections to complete what he says. Shown in a red font are statements that refute his arguments and shown in a bold green font are words in his arguments that particular attention is noted.

1. Chalk purity – hallmark of catastrophe

He says:

*Although chalk may vary in consistency, it does not vary in purity. Thick, worldwide beds of 98% pure calcium carbonate testify that they could not have been deposited over millions of years—otherwise, the chalk would be contaminated with sediments from continental erosion.*

He shows in a Figure 2 the theoretical exposed land during the Cretaceous period in Scotland, but this exposed land is in such tiny areas of very low topographic elevation that they would not likely have shed much debris that would contaminate the White Cliffs chalk deposits in England. Therefore, its purity of composition is consistent with being deposited during millions of years. Other chalk deposits, such as in Kansas, are also far from Cretaceous land of that time with high elevations that could have been eroded to supply any contaminants.

2. The Cretaceous and the biblical Flood

Cox says that secular geologists claim that their Cretaceous period ended with one of Earth’s mass extinction events, but he says that it was a global-level extinction event.
It is true that there was an extinction event at the end of the Cretaceous when a large meteorite hit the Yucatan peninsula during the Chicxulub impact. However, the chalk deposits do not have a narrow age range that would be required if these deposits were quickly deposited during Noah’s Flood. They have ages that range from the Jurassic period (early Bajocian; ~170 Ma) to the late Cretaceous period (Maastrichtian ~66 Ma) (Obke, Mutterlose, and Bottini, 2015). Double click on the following link to see the wide ranges of various species in this time frame.

https://www.researchgate.net/figure/Calcareous-nannofossil-stratigraphy-of-the-Jurassic-and-Cretaceous-modified-after-BOWN_fig3_241015353

Therefore, the argument by Cox (2021) for a rapid deposition of the coccoliths during an extinction event near the end of Noah’s flood in a narrow time frame has no merit.

3. Chalk data debunks deep-time dogma

He says:

Secular scientists have recently suggested that all the calcium carbonate for Dover’s white cliffs came from giant ‘blooms’ of coccolithophore algae. Such blooms form yearly in the Southern (Antarctic) Ocean in the ‘Great Calcite Belt’. This is an area of warmer water in which the algae grow explosively.
The blooms cover a staggering 52 million km\(^2\) (32 million sq. mi). They are even visible from space (figure 5, p. 39), because the sea appears brighter due to sunlight reflecting from the calcite plates. The mass blooming seems to be from large quantities of nitrate, iron and other nutrients upwelling to the surface as different water masses converge.

Clearly the Flood was a tectonic event, catastrophically moving the earth’s crust and radically altering its horizontal and vertical topography. This provides the perfect conditions for the formation of chalk.

On the ocean bottom beneath this yearly algal bloom is a layer of calcite-rich sediment (calcareous ooze) around 500 m (1,600 ft) thick. Deposition rates for coccolithophore oozes are supposed to be very slow. In fact, lab observations have caused researchers to question how coccoliths could ever settle. The rates for ooze formation are typically given in figures of cm/1,000 years.

Long-agers have used this to maintain that chalk can only form very slowly, seemingly contradicting Genesis history.

Importantly, these figures are not from counting sinking coccoliths. They are based on radiometric dating from drill cores, so they completely depend upon assumptions about the unobserved past.

However, recent studies have shown how coccoliths reach the ocean bottom quickly. The section below explains four different mechanisms for this—even present-day rates are much faster than previously thought.
Cox like many young-Earth creationists disagree with the accuracy of radiometric dating. However, the arguments that refute his model are not dependent on radiometric dating. Other kinds of scientific data clearly indicate that millions of years of time are involved in the formation of the chalk coccolith deposits. For example, he says

“‘that all the calcium carbonate for Dover’s white cliffs came from giant ‘blooms’ of coccolithophore algae.’”

But he fails to realize or think through what this means geologically. That is, the huge amount of calcium ions that are required to make the very large volume of coccoliths consisting of calcium carbonate in this deposit at the White Cliffs of Dover was not magically (miraculously) available if the Earth is 10,000 years old and if all the needed calcium ions had to be provided in 5,650 years prior to the Noah’s Flood (~4,350 years ago). In his model this sequence must occur: (a) great volumes of volcanic basalt must be erupted and crystallized, (b) stream erosion must cut into the basalt layers to expose calcium-bearing silicate minerals to the atmosphere, (c) rain water then must percolate into fractures in the basalt to dissolve out the calcium ions, and (d) this water carrying the calcium ions must move to the oceans for the coccoliths to incorporate them in their calcium carbonate structures. Basalt on average contains 9.62 % calcium oxide (CaO) whereas the calcium carbonate in coccoliths in chalk contains 75 % CaO. Therefore, the volume of basalt that must have been weathered to provide enough calcium ions to make an equivalent volume of chalk is more than 8 times an equivalent volume of the chalk. The four steps (a-d) described above require great lengths of time to go to completion. On that
basis, millions of years of chemical weathering would have been needed to provide all the calcium ions that would form “the giant ‘blooms’ of coccolithophore algae” that were supposedly formed in Cox’s model. Moreover, because he is focused on the origin of Cretaceous chalk, he fails to realize that many more kinds of limestones (e.g., the Muav, Redwall, and Kaibab limestones in the Grand Canyon), exist in the geologic column that are supposedly deposited during Noah’s Flood and which are not composed of coccoliths but still consist of calcium carbonate (either chemically precipitated or composed of shells of other kinds of marine life). Because all limestone is ~20 percent of the sedimentary rocks in the continental crust, even more vast volumes of basalt must have been erupted in the past geologic history to provide the needed calcium ions via weathering to produce the additional volumes of other kinds of limestone that are not chalk that clearly cannot happen in 10,000 years and must have taken millions of years. Such is definite scientific evidence that the Cox model has no merit.

Cox goes on to say:

*Long-agers claim that 500 meters of calcareous ooze on the Southern Ocean floor could not build up in only 4,500 years. However, this only requires an average deposition rate of about 11 cm/year (4 inches), a perfectly reasonable figure.*

That is true if the calcium ions are already available to make the calcareous ooze, and Cox has not demonstrated scientifically that such availability is possible in recent times even after Noah’s Flood 4,350 years ago.
(a) Noah’s Flood accounts for chalk!

He says:

However, the position of most chalk in the geological record indicates it is a Flood rock, formed as the floodwaters were rising towards their peak levels. To explain the huge quantities of chalk laid down over this much shorter period requires far more catastrophic processes.

He suggests that the coccoliths did not settle as single cells but were larger masses of coccoliths in fecal pellets (Figure 1) that sank dramatically faster and reached the floor of even the deepest oceans.

Figure 1. Masses of coccoliths in a pellet.
Cox says that grazer predators, deep water zooplankton, and jelly fish fed on the coccoliths and secreted the coccoliths in pellets. I agree that such faster deposition could be possible with pellets, but his argument for this greater rate of settling of coccoliths does not overcome other arguments that are made later in this article that refute his model for the rapid deposition of the coccoliths that produced the great thicknesses of the chalk formations at the end of Noah’s Flood.

He goes on to say:

Clearly the Flood was a tectonic event, catastrophically moving the earth’s crust and radically altering its horizontal and vertical topography. This provides the perfect conditions for the formation of chalk. Fast-moving warm water, with vast quantities of suspended biological material, would have triggered an explosive worldwide growth of algal blooms.

All mechanisms for rapid coccolith sinking (see below) would have been amplified to a huge extent during the Flood. Because the availability of algal food was greatly increased, grazing plankton would massively proliferate. And they would excrete their coccoliths in the form of fast-sinking fecal pellets.

... Genesis 8:3 describes how, after the Flood’s first 150 days, the waters receded off the land continually for more than 7 months. This, and the wind God sent (Genesis 8:1) would have greatly enhanced water velocities both at the ocean surface and at depth. This, in turn, would cause the small particles to clump together (flocculate), and direct ocean currents...
downward. This would cause the coccolith matter to settle catastrophically, likely in days.

Flood currents would have swept this calcareous material into deeper areas on the ocean floor, which geologists call ‘basins’. In some places like the North Sea and northwest Europe, the chalk has accumulated to a thickness of 1,000 m (3,000 ft) or more.

But scientific studies of waves show that wind driven waves could not have “greatly enhanced water velocities both at the ocean surface and at depth.” Presumably, Cox believes that winds in giant hurricanes produced waves that caused horizontal water movements on an oceanic scale, but this is not what happened (Figure 2).
**Waves** – circular motion

![Waves Diagram](image)

**Figure 2.** Circular wave forms produced by hurricane winds.

The only motion of hurricane-created giant waves is circular. Its circular motion could not lift particles off the ocean floor to transport them or suspend them. Cox’s supposed high speed of water movement that he says occurs during Noah’s Flood just does not happen. The water in such a wind-formed wave is not physically moving fast. It is just a circular wave form that is moving fast – not the water. The water mostly stays locally in place.
(b) Fast coccolith deposition

Cox provides four major present-day factors.

1. Zooplankton digesting coccolithophores

   Multicellular plankton species and jellyfish graze on the single-celled coccolithophore plankton, digesting them to produce coccolith-containing fecal pellets. These are large enough to quickly sink to the ocean floor by gravity (figure 3). This process can transport the coccoliths past the calcite compensation depth of 5 km. Sinking-rate estimates for individual coccoliths are \( \leq 0.15 \) metres/day, but are 160 m/day in a fecal pellet—over 1,000 times faster!\(^1\)

   This topic has already been discussed, but possible rapid deposition of coccoliths does not necessarily mean that all the coccoliths were all deposited in the short time of Noah’s Flood.

2. Ekman spiral currents

   Cox describes the Ekman spiral effect that is created by wind, a force from above, the effective direction of the ocean current, and the Coriolis effect that is caused by the earth’s rotation. He further states:

   Sinking rates are further enhanced by **increased water velocity driven by surface winds**. It is now known that surface wind velocity can cause a structure known as an Ekman spiral consisting of sinking, spiraling currents
(figure 4). This produces **downward water velocities** up to 1 m/s that have strong impacts on deep sea environments, to depths of thousands of meters.

In order to understand the falseness of Cox’s arguments, the Ekman spiral model must be explained. It was a model proposed by Walfrid Ekman (1874-1954, a Swedish physicist) when he was on a ship and observed that surface ocean currents moved in an opposite direction from the wind direction swirling around icebergs. He resolved the problem of why the wind current and water current were not the same when he came up with the model that is now called the Ekman spiral model. Ekman said that the force of the wind affected surface water molecules, which in turn, **dragged** deeper layers of water molecules below them (**drag** is caused by **friction** between water molecules). The deeper below the surface, the slower the water moves compared to the water layer above it. But these movements cease at a depth of about 100 meters (300 feet). It is the Coriolis effect that causes the surface and deeper water to be deflected – 90 degrees right in the northern hemisphere and 90 degrees left in the southern hemisphere. The depth of the water movement is important. Each successive deeper layer of water moves more slowly to the right (or left), creating a **spiral effect** (called the Ekman spiral). Because the deeper layers of water move more slowly than the shallower layers, they tend to **twist around** and flow opposite to the surface current. The net transport in surface currents is 90 degrees from the wind direction and is the result of the balance between the Coriolis effect and turbulent drag forces.
(within surface waters and a geographic feature such as a shoreline and seabed or an iceberg).

On that basis, Ekman spiral currents would require (1) high velocity winds as produced in category 3, 4, or 5 hurricanes to move the surface water and (2) the Coriolis effect. But such spirals would have very wide diameters near the ocean surface and not of low diameter that would supposedly cause coccoliths to spiral downward in Cox’s model. Cox imagines that the spiraling is like what is seen in a sink full of water and the bottom plug is pulled and the Coriolis effect causes the draining water to spiral down a hole at the bottom of the sink. But there is no hole in the bottom of the ocean floor into which water can drain (spiral) down into. More importantly, what makes the Cox model have no merit is that the water is not physically moving downward in a spiral. The diameter of the spiral just changes in size from a large diameter near the ocean surface to progressively smaller diameters until the movements become zero at about a depth of 100 meters (300 feet). That is, the water is not able to carry dead coccoliths downward in a spiral. The water is moving in horizontal circles whose diameters become less and less with depth.

However, the Ekman effect can cause some water transport where prevailing winds blow parallel to a coast and cause surface water to flow offshore. This movement of water away from the coast at the surface causes deeper water to up-well, whereas wind blowing in the opposite direction pushes surface water towards the coast. As water piles up at the shore, it is forced down, creating down-welling. But these water movements are near-shore
movements and do not occur out in the deep ocean where Cox wants the Ekman currents to cause the coccoliths to be carried downward. Moreover, his model can only have the wind blowing in the right direction to cause down-welling. At any rate, such movements of water in coastal areas are very slow and not fast as is required in Cox’s model for rapid deposition of the coccoliths during Noah’s Flood.

Cox goes on to say:

**Factors operating especially during the biblical Flood**

3. **Flocculation**

Chalk coccoliths have a fine covering of smectite, a type of clay mineral. Smectite is a hydrothermal product (from the action of hot water, generally in a volcanic setting), likely injected into the ocean by the fountains of the Great Deep (Genesis 7:11). Interestingly, smectite makes coccoliths settle out of suspension quickly. Industrial water treatment involves a process called flocculation, using clays (bentonite, containing primarily smectite). These cause contaminating particles (like lime) to instantly come out of suspension, clump together and sink. Flocculation would greatly enhance the settling of coccoliths during the Flood.

The coccoliths in the White Cliffs are far from the hot water supposedly generated in a volcanic setting that are said to be produced by the “fountains of the Great Deep (Genesis 7:11) in mid-ocean spreading centers and no currents from such a great distant source would bring the
smectite to the White Cliffs as indicated by the in-place circular motions in Figure 2. Furthermore, no great volumes of free water could ever exist in the mantle that could emerge in mid-ocean centers because of the enormous pressures that exist there that force water molecules to be in the interstices between crystal grains or as trace amounts inside crystal lattices. Likely, the fountains of the Great Deep are local in Mesopotamia at the time of Noah’s Flood (Collins, 2020).

It is true that flocculation could cause coccoliths to clump together and become heavier masses that would settle at a faster rate than single coccoliths. Cox estimates (as previously said) that the sinking rate for individual coccoliths is about 0.15 meters/day, but is 160 m/day for a falling fecal pellet – over 1,000 times faster! Therefore, rapid deposition of coccoliths is possible if all other requirements are met to make their sinking occur in a short time of Noah’s Flood in Cox’s model. But such requirements are not met as already pointed out for the need to produce huge quantities of calcium ions by weathering processes prior to the time in which they are needed to produce the coccoliths.

Cox provided the 4th factor as the following.

4. Fast currents

Uniformitarian geologists have long claimed that, like coccoliths, mud particles took a very long time to settle under tranquil conditions. During periods of turbulence, they would be kept in suspension. However, experiments in glass-sided flumes have shown these long-age ideas of
mudstone formation to be false. At high water velocity very fine mud particles will flocculate and come out of suspension instantaneously to form laminated sediments. Sedimentologists have admitted that “mudstone science is poised for a paradigm shift” (a radical change in thinking). This effect of fast water movements is clearly relevant to the speed of coccolith sediment formation, too.

Oceanographic study has demonstrated that ocean waves are not just restricted to the surface. They can also propagate underwater and down the slope of continental shelves to generate high-speed water currents. The Flood wind of Genesis 8:1 would also play a major role in increasing current velocities (see point 2 above).

The above two paragraphs give totally false models for two reasons.

First, Figure 2 shows that there is no turbulence of water that is generated by giant waves produced during hurricanes that would suspend particles or transport them. The experiment that Cox describes in glass-sided flumes occurs where the flumes have relatively small widths or diameters to create high velocity that cause fine mud particles to flocculate and come out of suspension instantaneously to form laminated sediments, but such experiments do not apply in any way to the coccolith deposits in the White Cliffs area where these deposits occur in areas of enormous width and diameter and where bounding enclosures (like the glass-sided flumes) do not exist. Moreover
the water in these coccolith areas was not travelling at high speeds in a horizontal circular motion as indicated in Figure 2. What Cox proposes is just scientific nonsense. What applies to small-scale glass flume does not apply to water in the dimensions of an ocean where high-speed horizontal-moving currents are not produced. Therefore, arguments by Cox in his model have no merit. Furthermore, these experiments do not apply to clay particles that are deposited in shales (mudstones) which is explained in a final section.

Second, Cox observes that:

*ocean waves are not just restricted to the surface. They can also propagate underwater and down the slope of continental shelves to generate high-speed water currents.*

This observation by Cox shows that he has no understanding of how ocean waves produce a continental shelf or the real cause of the high-speed water currents (Figure 3).

![Figure 3. Continental shelf and continental slope.](image)
The huge waves that are generated in the strongest hurricanes have circular motions that agitate the sediment to a depth of 600 feet. During such strong-wave-generating hurricanes sediment can be moved slowly (perhaps in a few fractions of a centimeter at a time) by the tiny circular motions of the water at depths of 600 feet, as shown in Figure 2. That is, during each powerful hurricane a gently-sloped continental shelf is slowly built out from the continent but no farther than the 600-foot depth.

To understand the geology better – the width of a continental shelf varies from less than a kilometer (0.62 mile) along the coast of California to as much as 1,500 kilometers (780 miles) along the northern coast of Siberia. At a width of 1,500 kilometers the continental shelf is barely a sloping surface (almost flat). Because the tiny, flat, agitated clay particles eventually settle with their flat surfaces parallel to the surface of the continental shelf, these particles form a laminated clay surface. But note that such a lamination was not caused by the high speed motion of water as is proposed in the Cox model for sediment deposition during Noah’s Flood. Moreover, to make a continental shelf that is 1,500 kilometers (780 miles) wide cannot possibly be done in just 10,000 years considering how slow the sediment particles are moved to a depth of 600 feet.

Beyond the maximum depth of 600 feet of the distant edge of the continental shelf is a steeper continental slope but generally it is not very steep because it only represents the
slumping of tiny clay particles. With time the continental slope becomes over-steepened such that an underwater landslide breaks loose and slides at very high speeds (rates as much as 37-62 mph on the basis of the timing of the breakage of telephone cables on the ocean floor in 1929). The landslide debris eventually comes to a stop after traveling hundreds to thousands of miles and consists of a jumbled chaotic mass of sediment that is not in horizontal lamination beds as seen in some coccolith deposits. These landslide debris deposits are well known by sedimentologists and they are called turbidites.

**Clay particles in shales (mudstones)**

The reasoning of how tiny particles must settle slowly at the distant end of continental slopes and not quickly from high-speed moving currents that cause their lamination also applies to large thicknesses of clay particles deposited in thick shale formations such as the Mancos Shale (Figure 4).

![Figure 4](image-url)  
**Figure 4.** Cretaceous Mancos Shale in Colorado.
In Cox’s model of the one-year Noah’s Flood the Mancos Shale of Cretaceous age would have had to have been deposited by rapidly-moving oceanic-currents to cause their abrupt deposition of tiny clay particles and their lamination near the end of the Flood. But, as has been shown in Figure 2, no rapidly moving currents are ever produced by hurricanes no matter how strong the winds are that create the circular wave forms in the ocean waters. The clay-mineral-rich layers in the Mancos Shale (more than 3,000 feet thick) had to have been deposited very slowly following infrequent storms that transported the eroded clay particles from weathered continental rocks where streams carried the clay particles to the ocean in which they settled very slowly (according to Stoke’s law). This Mancos Shale formation must have taken millions of years to form and did not form during the one year of Noah’s Flood. This example is not meant to indicate that all laminated sediment is deposited slowly because the explosion of Mount St. Helens on May 18, 1980, deposited 100 feet of laminated layered ash debris in Spirit Lake, but it is clear that this was a catastrophic event that uniformitarian processes for slow deposition of fine sediment do not explain. Moreover, in some places in other parts of the world, clay layers are interlayered with volcanic ash layers in shales that could not have happened if these shales were deposited quickly during Noah’s Flood because the flood waters would have mixed the clay and ash particles so that they would not have been deposited in separate layers. Cox’s model overlooks this evidence and he chooses
only data that seem to support his model without utilizing all the evidence that exists that show that his model is wrong.

Furthermore, shales compose ~60% of the volume of sedimentary rock layers in the Earth’s crust and consist mostly of clay minerals but also a small percentage of tiny grains of quartz. Clay minerals are formed by chemical hydration of non-water-bearing feldspar silicate minerals in basalt and in granitic rocks and these feldspars generally form more than 75% of the volume of these igneous rocks. This large percentage means that, like the weathering of large volumes of basalt to produce the calcium ions for the calcium carbonate in coccoliths in chalk, even greater volumes of basalts and granitic rocks must be weathered in the 5,650 years prior to Noah’s Flood in Cox’s model to produce the clay minerals in the Mancos Shale and all the other shale layers around the world. Such is scientifically impossible when the formation of the clay minerals must go through the same kinds of steps (a-d) as described earlier. Clearly millions of years are required for this weathering to happen which provides even more scientific evidence that the Cox model has no merit.

Conclusions

Cox’s claim that “chalk challenges deep-time dogma” has no merit. What is apparent is that his model for a young-Earth is just dogma for those Christians who want to believe that sediments composed of coccoliths are deposited rapidly. The
purity of coccolith deposits can be explained by the lack of nearby topography of high elevations that could be eroded to produce contaminants. The Chicxulub meteorite impact did produce an extinction event 66 million years ago which Cox says is the timing in the Cretaceous period in which most of the coccoliths were deposited rapidly late in Noah’s Flood, but the ages of the coccolith layers extend as far back in time to the Jurassic period with ages of 170 million years ago. His claims that rapid deposition of coccolith in fecal pellets is certainly possible but that does not mean that such rapid deposition was confined to a narrow limited time period in the one year of Noah’s Flood. He fails to recognize that to make all the trillions of coccoliths in the White Cliffs deposits requires that vast quantities of calcium ions must first be created before the coccoliths can utilize them and that the time to create this enormous supply of calcium ions takes millions of years. He fails to understand that hurricane waves and winds do not create fast moving horizontal oceanic currents when these waves are only moving with circular motions that have no translation of water – the water mostly just stays in the same geographic location. He does not realize that the Ekman spiral currents are unable to cause coccoliths to spiral down from the ocean surface to the floor of the ocean. He mis-applies experiments on glass-sided flumes in which high speed moving water causes suspended clay particles to come out of suspension and be deposited quickly in laminated layers when there is no evidence that high speed motions of water ever occur in mid-ocean waters.
either at the ocean surface or on its sea floor. Finally, he has not understood how continental shelves are formed and how the steepening of the continental slope causes high speed landslides to occur that produce turbidites. In short, he has almost no scientific evidence to support his model that coccolith deposits “give strong evidence for their rapid formation and a biblical youthful age.”

References

https://www.csun.edu/~vcgeo005/Nr64Fountains.pdf
