# The Microfossil Record

*Global changes in microfossils point to deposition over deep time.*

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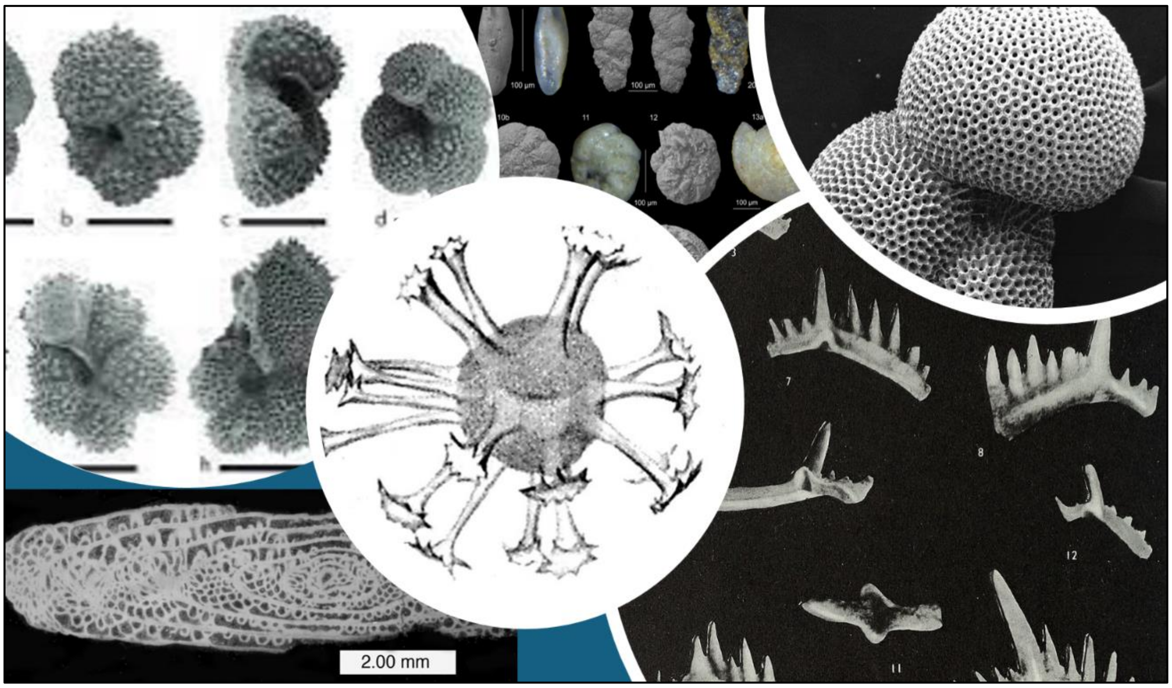


*Microfossil images from Wikipedia*

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**Anyone** who watches or reads murder mysteries knows that detectives try to develop a detailed timeline for any such mysteries. This is fundamental to understanding the crime and who might be guilty. Timelines are important in any understanding of history. The same is true for the history of the Earth. Geologists have developed a timeline for Earth's history. A primary task in studying each formation is to place that formation into its proper position in that timeline with as much precision as possible. One benefit is that when we recognize which units were contemporaneous, this makes it possible to put together a picture of the Earth at that time. The rock record geologists have put together is usually expressed vertically as a hypothetical column of rock, with the oldest on the bottom, getting younger upwards. (**Figure 1**)(Mitchell 2018)

Earlier writers such as George McCready Price (Price 1913), John Whitcomb and Henry Morris (Morris and Whitcomb 1961), and several other early authors did not accept geologist's ability to discern this order of rock formation. Some young earth creationists (YEC) propose that the geologic column that geologists have developed over the last 200 years is a fabrication that was generated to support evolution. Among the problems with this idea is the fact that the geologic column was recognized before Darwin proposed evolution. It also seems that the more training and field work the YEC have done, the more likely they are to recognize the validity of the geologic column even though they have very different interpretations of the duration of the intervals.

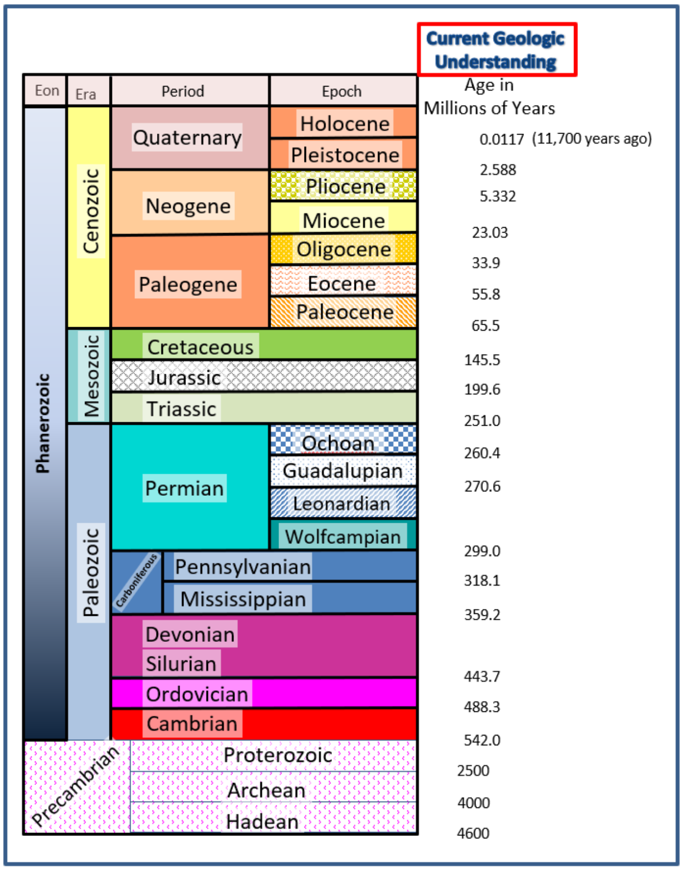


***Figure 1.*** *Geologic column. In this column, the units are the same thickness, thus scaled alike, although the numbers on the right show the ages typically assigned by geologists. By scaling them alike, it reflects the fact that the order is the same regardless how long it took for them to be laid down. (Mitchell, 2018)*

The general geologic column summarizes thousands of observations from all around the world and provides a general framework and timeline to discuss the rock record. It was developed based on one assumption and one key observation. The assumption is that in a sequence of sedimentary strata, the oldest rocks are on the bottom, unless the rocks have been disturbed tectonically. This is known as “the law of superposition”. It means that it is possible to recognize the order in which strata was deposited. I argue that all of the geologic periods of strata from Precambrian to recent can be recognized across Texas and the Texas offshore in order that is clearly documented by superposition.

The key observation is that the fossils that provide a record of life through the rocks changed through the geologic record, regardless of how long that record took to be laid down.[1] When I was in college, this was known as “faunal succession”, based on the observation that the fossils changed, regardless of the cause. The “charged” term of *evolution* wasn’t the observation. The fossils don’t prove that the mechanisms of natural selection and random mutation are the cause of the marvelous diversity of life recorded in them. Nevertheless, there is a clear change in the lifeforms through time.

Explaining this change is a challenge for flood geology. Why would you get such a definite progression of lifeforms through the deposits of a single catastrophic flood? One aspect that is

[1] A good general description of biostratigraphy is found here: https://geo.libretexts.org/Courses/University_of_California_Davis/GEL_109%3A_Sediments_and_Strata_(Sumner)/Textbook_Construction/Biostratigraphy__Biozones_and_Zone_Fossils

seldom discussed by flood geologists is that posed by the microfossils. Why would we find a progression of microscopic forms that can be catalogued worldwide?

## YEC accepting the Geologic Column

First let's look at my statement that YEC more knowledgeable with geology tend to accept the Geologic Column. This includes most with college degrees in Geology. This quote from YEC geologist, Paul Garner reflects this:

> *"Order of the fossils. One of the areas of contention between George McCready Price and Harold Clark concerned the sequence of rocks and fossils (often summarised in textbooks as "the geological column"). Price argued that this sequence was an artificial construct based on the assumption of evolution. But Clark was persuaded that there really was a consistent sequence, and sought to explain the order of the fossils as the order in which different ecosystems were inundated and buried during the flood. Whitcomb and Morris questioned whether the order of the fossils was as consistent as most geologists had assumed, but appealed to the ecological zones of the pre-flood world as one explanation of any order that did exist. Today there is still debate within creationism about these matters, although it is probably fair to say that* ***most of the creationist geologists with field experience have sided with Clark****."* YEC **Paul Garner**, 2011 "The Genesis Flood" 50 Years On. from the Biblical Creation Society (Garner 1996):
> *(Emphasis added)*

Why would he say this? Here are some quotes that support this point:

> *"It may sound surprising, but the standard geologic column was devised before 1860 by catastrophists who were creationists. Adam Sedgewick, Roderick Murchison, William Coneybeare, and others affirmed that the earth was formed largely by catastrophic processes, and that the earth and life were created. These men stood for careful empirical science and were not compelled to believe evolutionary speculation or side with uniformitarian theory. Although most would be called "progressive creationists" in today's terminology, they would not be pleased to see all the evolutionary baggage that has been loaded onto their classification of strata."* **Dr. Steven Austin** of ICR,(Austin 1984): "Ten Misconceptions about the Geologic Column" Notice that he does not dispute the order that is recognized.

YEC author, **Dr. Joachim Scheven** (b. 1932), a German biologist, describes the fossil record as "*the* ***unassailable palaeontological order*** *which a Biblical earth history does not question at all*" (Scheven 1990) (emphasis added). I strongly agree with this statement, though I interpret the times involved differently.

> *"The* ***global pattern of fossils cannot be denied****. Why certain animals and plants are only found in certain rock layers is still largely unresolved. Creation scientists have often speculated and proposed various ideas to try to explain the pattern we observe in the fossil record. Among these ideas are hydrodynamic selectivity and sorting by size, fossil composition and settling velocity. Other factors relate to mobility, and possible factors like ecological zonation have also been considered."* ***Dr. Tim Clarey*** *of ICR "Carved in Stone: Geologic Evidence for a Global Flood"* (Clarey 2020) *(emphasis added)*
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> *"Nevertheless, if* ***the order of the strata and their contained fossil assemblages is not generally in dispute****, then that order in the strata sequences still must reflect geological processes and their timing responsible for the formation of the strata and their order. If, as it is assiduously maintained here, the order in the fossil record does not represent the sequence of the evolutionary development of life, then the fossil order must be explainable within the context of the tempo of geological processes during the global Flood cataclysm. Indeed, both the order of and their contained fossils could well provide us with information about pre-Flood world, and evidence of the progress of different geological processes during the Flood event*." **Dr. Andrew Snelling**, AIG, "Earth's Catastrophic Past: Geology, Creation & The Flood" (Snelling 2009) (emphasis added).
>
> *"When the theory of evolution was introduced, the order of the geologic column was not affected appreciably. Since it is not possible to predict the path of evolution, no change in the column should have occurred with the acceptance of evolution—and no change did occur. The column also preceded by at least a century any means of affixing absolute ages."*
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> *"When properly used, biostratigraphy thus remains as a valid method of dating."* ***Dr. Kurt Wise****, "The Way Geologists Date!"* (Wise 1986)
>
> *"As far as the broad arrangement of fossils is concerned, the geological column seems to be generally consistent where observed in vertical sections in the western United States. This gives some confidence that the general order can be applied elsewhere in the world."* **Michael Oard**. (Oard 2010) Oard recognizes that the big divisions are correct but questions the smaller divisions.

Many other YEC authors use the geologic column tacitly, though I have not found specific overall statements from them regarding their conclusions. Examples include Dr. Larry Vardiman, Dr.

Leonard Brand, Dr. John Whitmore. An excellent description from a former YEC geologist, Glenn Morton is found here: The Geologic Column and its Implications for the Flood countering many objections that YEC have raised (Morton 2001). No doubt there are doubters like "John Woodmorappe", the pen name of a YEC writer who says he has "an M.A. in geology and a B.A. in biology, from a midwestern US state university" and is apparently a high school science teacher. You can read his objections here: "The Geologic Column: Does it Exist?" He provided a table of "Anomalously Occurring Fossils" (Woodmorappe 1982). I examined his examples here: Anomalously Occurring Fossils. Another skeptical article is by Roger Patterson here: "Geologic Column" (Patterson 2008). Similarly, Dr. John Reed argues against the geologic column in this article: "Fossil Distribution in the Flood" (Reed 2009).

## What about the fossils?

Despite the detractors, it is clear that many YEC recognize that the basic order in which sedimentary rocks were laid down is well documented. This means that the order of the fossils contained therein is known. Recognize that the fossils, both the flora and fauna, have been documented, in most cases in exhaustive detail. No doubt as workers continue to study units, additional species will be recognized and some fossil ranges extended, but don't hold out for any major revisions. Here are some observations that can be made:

1. The fossil assemblages changed over the course of the time in which the rocks were deposited.

2. The fossil assemblages are recognizable and can be used to identify the relative order of deposition in areas away from other control.

3. Most of the ancient fossil species are not present today.

4. Most of the modern animal forms are not present in the rock record, particularly considering the Paleozoic and Mesozoic strata.

In terms of large animals, this means that we never find dinosaurs in Paleozoic or Cenozoic strata, for instance. We find no mammal fossils in the Paleozoic and just a few species in the Mesozoic. We don't even find fish or petrified wood in the early Paleozoic Cambrian units. One important observation is that just as the macrofossils changed, the same can be said of microscopic fossils.

## Microfossils used in Biostratigraphy

Biostratigraphy, using fossils to determine the relative position of units within the overall timeline is a huge subject for geologists and in particular for micropaleontologists.  Microfossils are hugely important in the oil industry. They are used at many scales to understand the order of events, correlate between wells and to construct paleogeographic maps. From my perspective, it consists basically of using microevolution to develop a stratigraphic framework that can be used to explore and develop hydrocarbon resources.  The tools used vary with the stratigraphic interval.

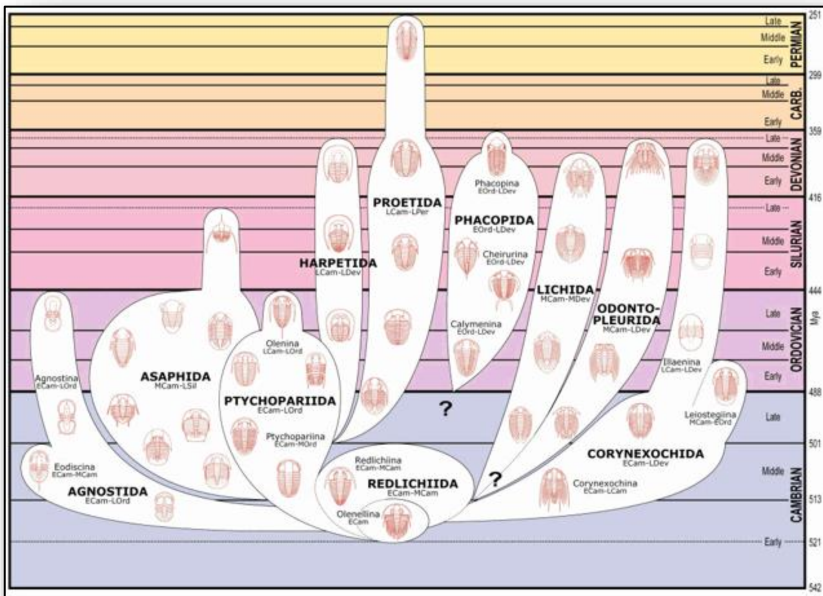


***Figure 2**. Trilobites changed in form throughout the Paleozoic Era. Identifying the species provides a strong means of correlating strata deposited during this time. (Gon 2009)*

In the lowest Paleozoic period, the Cambrian, microfossils are not abundant and when found, they are often poorly preserved.  In the Cambrian and Ordovician periods, the most useful tools are **trilobites**.  The microevolution of these kinds is used to correlate.  A good reference for this is here: https://www.trilobites.info/biostratigraphy.htm (**Figure 2**) (Gon, Sam III 2009):

Trilobites appeared in the Cambrian Explosion with no candidate identified as a predecessor. Since these are not microfossils,  their identification is mostly from outcrops and occasional core samples in wells.

In Ordovician, Silurian and Devonian sediments, microfossils known as **conodonts** are used. They were not found earlier and disappeared later, but consistently changed through this period. **Figure 3** is a picture that I took. I will include a chart from the Ordovician. **Figure 4** is a chart illustrating changes in conodonts used in dating Ordovician strata (Bergström 1983). Wikipedia has a reasonable article on them. These were used to correlate stratigraphy since the 1800s, but when I was in college, no one knew what they were from. It wasn't until 1983 that they found examples with soft imprints of a creature with conodonts, and they learned how they worked. They were teeth for a type of boneless sea creature resembling eels They are a great example of microevolution used to correlate stratigraphy with no inference about overall evolution. Most geologists are more interested identifying relative age than the species involved.

***Figure 3.*** *My photos of Mississippian conodonts from the Chappel Limestone in central Texas. Typical sand grains of various types for scale.*

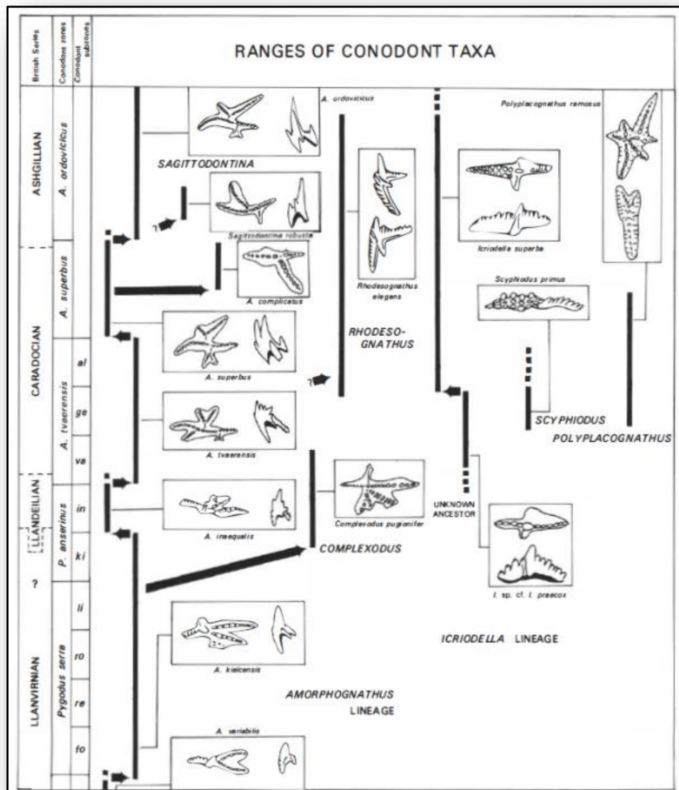


***Figure 4****. From Bergstrom, 1983, "Biogeography, evolutionary relationships, and biostratigraphic significance of Ordovician platform conodonts".*

In the Pennsylvanian and Permian rocks, the best stratigraphy is from **fusulinids**, though they are also useful in the Silurian and Devonian periods. These were one-celled animals, similar to forams that as they grew, their floating structure, known as a test, grew larger and the pattern of the tests changed over time… microevolution but very useful. Wikipedia has a good article. The chart in **Figure 5** illustrates the changes in tests through a part of the Carboniferous (Mississippian and Pennsylvanian). (Ueno 2021) The changes in these small tests are recognizable often from just portions of the tests.

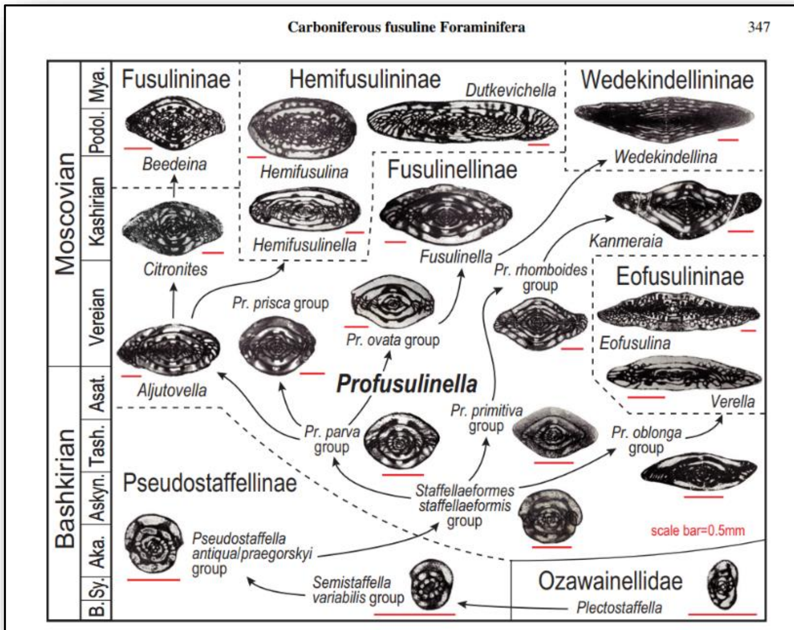


*Figure 5. from Ueno, 2021, "Carboniferous fusuline Foraminifera: taxonomy, regional biostratigraphy, and palaeobiogeographic faunal development*

The crowning biostratigraphy for the Mesozoic is from **ammonites** (not the people from the Bible). These floating creatures were abundant and floated everywhere in marine environments. As they grew larger they added chambers and the chambers were separated by sutures or septa (**Figure 6**). These are not microfossils, but often not a lot is necessary to identify the species. Wikipedia's article is good on this topic as well. The image is from Bureau of Economic Geology at the University of Texas, published in 1932. (Sellards, Adkins, and Plummer 1932) This is a classic volume and it used to be available for free, but now costs $20.

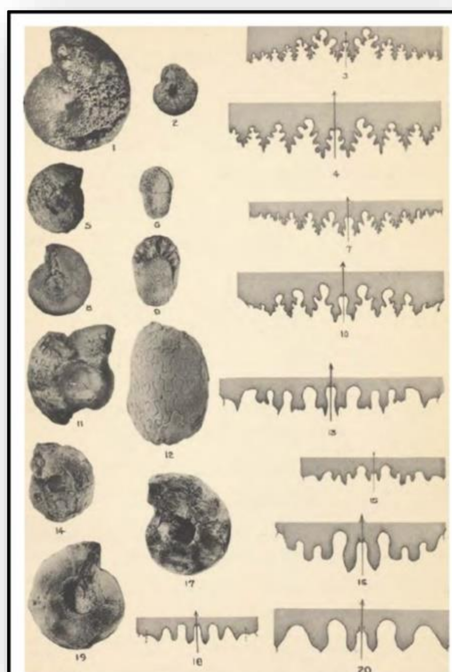

*Figure 6. Image from Sellards, Adkins, and Plummer 1932, "The Geology of Texas, Volume 1, Stratigraphy". Austin: University of Texas Bulletin*

Much well constrained stratigraphy comes from using **foraminifera**, one-celled animals that leave tests that are usually calcareous. A good general article is here: [FORAM FACTS — AN INTRODUCTION TO FORAMINIFERA](). Forms that floated, known as planktonic forams provide great stratigraphic markers.

The image in **Figure 7** is a good example of the changes in planktonic forams around the base of the Cenozoic and top of the Cretaceous. I chose this image just because it very clearly illustrates the sharp changes in foram species preserved above and below this marker. This particular image is from India. (Keller et al. 2009) Many more equally good images are available over different stratigraphic intervals. They often provide excellent data through the Cenozoic. In my work in the Gulf of Mexico, often I was making structure maps using seismic data and made interpretations across faults and through the regions. In several instances later, I received well biostratigraphic information that conflicted with my initial interpretations. Without fail, the biostratigraphic data based on forams proved to be correct. My initial interpretations across faults proved to be wrong.

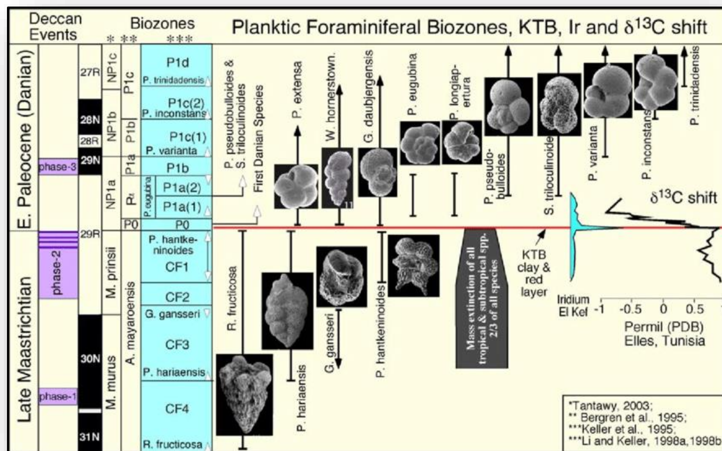


*__Figure 7__. from Keller, et al., 2009, "Early Danian Planktonic Foraminifera from Cretaceous-Tertiary Intertrappean Beds from Jhilmili, Chhindwara, District, Madhya Pradesh, India"*

Other types of forams lived at or near the water bottom. These, known as benthonic forams, provide great information about the water depth at the time of deposition. They also provide great information on the climate, particularly using the oxygen isotope data.

Perhaps the best constrained data for the Cenozoic comes from tiny algal fossils known as **nannofossils**. Unfortunately, their occurrence is limited to some limestones and marine shales, but the changes are distinctive and really tie down the stratigraphy because the changes are recognizable, widespread and consistent. A very good summary article is available from Agnini, Monechi, and Raffi where the image in **Figure 8** is from. (Agnini, Monechi, and Raffi 2017)

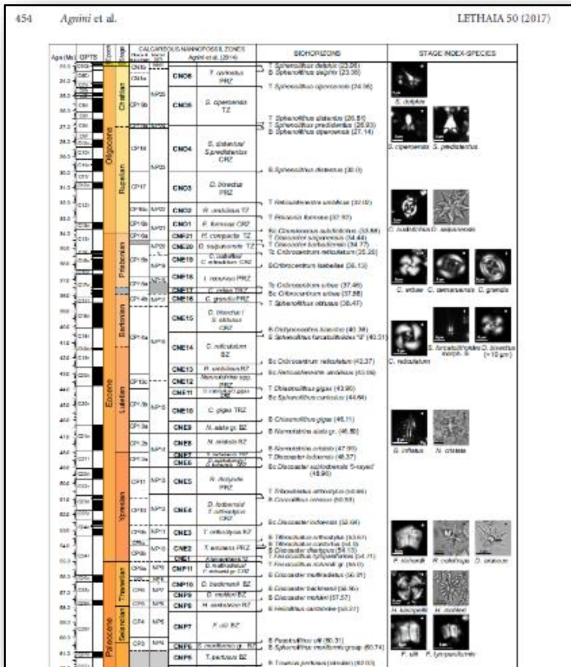


*__Figure 8__. from Agnini, 2017, "Calcareous nannofossil biostratigraphy: historical background and application in Cenozoic chronostratigraphy"*

So far, the fossils considered have been mostly found in marine sediments. Micropaleontologists find very rich beds concentrated in microfauna in intervals deposited in marine environments, particularly when they were deposited in deeper water. That does not mean that microfossils have nothing to offer in shallow water intervals or non-marine. Key microfossils used in such intervals are **<u>spores and pollen</u>**. Those of us prone to allergies can wonder if the ancient beasts were allergic to these little reproductive wonders. Just like the other fossils described, the types of spores and pollen found along the geologic column changed through time. The study of these fossils is known as palynology. A general summary can be found here: [Palynology](Palynology) [Pollen and Biology](Pollen and Biology)

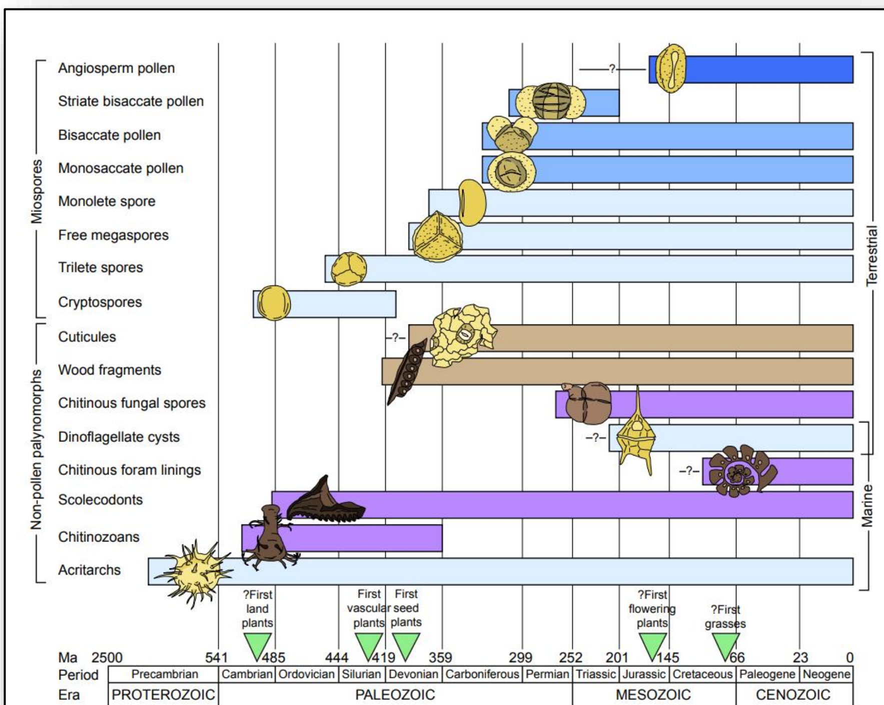


*__Figure 9__. from Bercovici and Vellekoop 2017, "Methods in Paleopalynology and Palynostratigraphy: An Application to the K-Pg Boundary", modified after Traverse, A., 2007. Paleopalynology. Springer, New York, 814 pp*

Palynology involves the recognition of a number of types of fossils as shown in **Figure 9**. (Bercovici and Vellekoop 2017) As Bercovici and Vellekoop say, "The fact that they are very resistant, microscopic, produced in large numbers, and disseminated over large areas makes them an ideal biostratigraphic group."

## Explanations from Flood Geology

I have tried to summarize a few of the major types of fossils used to build stratigraphic frameworks for various regions or basins and then ultimately globally. These help to demonstrate that not only did macroscopic lifeforms change over time (regardless of how long that was), but also microscopic forms changed as well. In industry, the analysis of microfossils is done by specialists. It is not enough to be a specialist in forams but often they specialize in forams from specific latitudes such as polar regions. Geologists use this information and test it over and over again. This progression of changes, this faunal succession is clear. Any explanation for the origin of the rocks needs to account for it.

Here are some of the common explanations that have been proposed by YEC to explain the distribution of fossils in the geologic column. We can examine each of these in terms of the microfossils.

1. Early burial of Marine Creatures

Snelling (2009 p. 731) proposes that the catastrophic tectonic model for the global flood would have resulted in dramatic movement of water onto the continents, bringing with it marine animals that were soon fossilized. This is proposed as an explanation for why we see little evidence of non-marine animals in the lower Paleozoic. This, of course, does nothing to explain the order that we find the marine animals in. In this paper, we saw that the fossilized trilobites changed through time and that they can be used to recognize the position of Paleozoic sediments in the stratigraphic column. I do not see why that would be true in any of the global flood models.

In regard to microfossils, we find marine microfossils from the Precambrian to the very recent. It is also true that non-marine macrofossils don't occur in the early Paleozoic. That is not true for microfossils. They are found as shown in Figure 9. This includes fossils from terrestrial plants in the Ordovician (Wellman, Cascales-Miñana, and Servais 2023). Early marine burial does not account for the absence of pollen in the early Paleozoic if the sediments involved have microfossils. Pollen derived from onshore is commonly found in marine sediments today. A simpler explanation is that pollen-generating plants just didn't exist in earlier times.

2. Hydrodynamic selectivity of moving water

Many YEC authors, (Morris and Whitcomb 1961; Snelling 2009; Reed 2009; Clarey 2020) propose that some of the distribution of fossils in what they see as flood deposits is related to hydrodynamic sorting of fossils. When water transports gravel, sands and mud, it is important in sedimentology to recognize that as the water slows down, the most dense and largest particles fall out first. You can see this in your bathtub after a trip to the beach. This same process also applies to animal and plant material. It is a little more complicated to calculate which would be laid down first, but we expect there to be differences. If sediments were laid down by a giant flood, differences in the animal and plant life carried by the flood would have some impact on which were buried first. Of course, this assumes that the sediments were formed from the deceleration of rapidly flowing flood waters and this is contrary to much evidence.

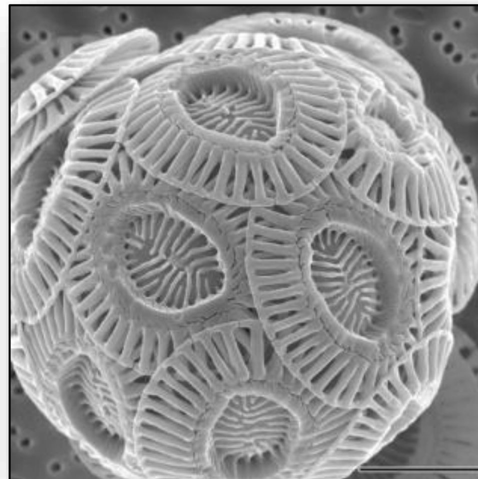

***Figure 10.*** *Scanning electron micrograph of an algal coccolith cell. by Alison R. Taylor (University of North Carolina Wilmington Microscopy Facility) - PLoS Biology, June 2011, Cover ([1]), CC BY 2.5, https://commons.wikimedia.org/w/index.php?curid=15662212*

Regardless of how this might relate to macrofossils, would it be a component of explaining the distribution of microfossils? The different conodonts should have behaved hydrodynamically alike. The same would be true for the forams, the fusulinid and the nannofossils. Larger animals such as the trilobites and ammonites are more variable, but this still is not the major reason for the order.

Think about how this would have worked in the Cretaceous chalks of the North Sea. Cretaceous chalk units 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 10**). The coccolithophore algae that formed the coccoliths contained chlorophyll. They needed sunlight to live. The trillions of them took time to grow. This was not the largest algal bloom. This represents millions of years of algal blooms, exposure and hardening, erosion, water deepening and repeat. (Collins 2022; Püttmann and Mutterlose 2021). Similar concerns need to be addressed for the other microfossils listed here.

As with the other microfossils: nannofossils and forams changed through the time over which the units were deposited. (Bailey et al. 1984; Hopson et al. 2011) Such chalks raise many issues for flood geology, but the main one in focus here is why do you see systematic changes in microfossils through this unit of thick chalk deposited in a very short period of time by apparently the same processes? Isn't it interesting that these same microfossils can be correlated outside of the chalk?

3. Behavior and higher mobility of vertebrates

A common explanation appealed to for larger fossils is their mobility. The proposal is that those who could, ran or flew to get away from the advancing flood. Thus, dinosaurs escaped during the time when the Paleozoic rocks were being deposited. Almost all of the mammals ran ahead. The ICR model would have them dying in the late flood. That is incredible. A dramatic flood where all of whole groups of animals could escape. Were there no old or weak or unlucky? This also says nothing about the distribution of the life that was attached to the substrate (sessile). How about the microfossils? This explanation does nothing to explain the differences in the assemblages of these.

Snelling (2009 p. 736) considers three aspects of life that can be considered when looking at fossil distribution: ecology, behavior, mobility. Each of these is important in the distribution of life and thus in fossil distribution. Certainly, differences in ecological niches were important for all of the forms. However, the ecological niche of open marine waters was perfect for many microfossils and the changes in fossils are not related to that. There is no reason to believe that the behavior of the tiny animals systematically changed over a one-year flood to account for the change in fossils.

Another related explanation that has been used is that the fossils are different through the column as a result of the same changes that we see between different regions today. Today we can see real differences in the animals found in North America vs. Africa vs. Australia. Price (1913) proposed that the fossil distribution through geologic time was like that. Could it be that similarly, the different rock formations were sourced from areas with different animal life? Certainly, fossil assemblages from different continents have differences. However, the global changes are real. Trilobites seemed to rule the world and their fossils are found on every continent. The same can be said of conodonts, fusulinids, other forams and nannofossils.

4. Floating forests

Dr Joachim Scheven proposed an additional means that might affect how fossils are distributed. He suggested that the fossil distribution might have been partially the result of large floating forests (Scheven 1996). He proposed this in part as a flood friendly explanation for the massive coal deposits that are mined today. Few seem to have bought into it today. The shear original thickness of material that would have been involved makes it hard to consider this. If it were viable, it would be an alternative for some of the spores and pollen. Perhaps the changes might have resulted from different islands floating by, but again doing the same time during the flood globally seems ad hoc at best.

## Other Key information from microfossils

Biostratigraphic information is just one of the things that microfossils are studied for.  As Snelling pointed out, fossils are influenced by the ecological setting. In some cases, these data are direct enough to provide valuable information. As I mentioned before, benthonic forams lived along the water bottom. Different species adapted to different water depth ranges. (**Figure 11**) Although the species changed through time, the type of forams are quite comparable to modern forms.

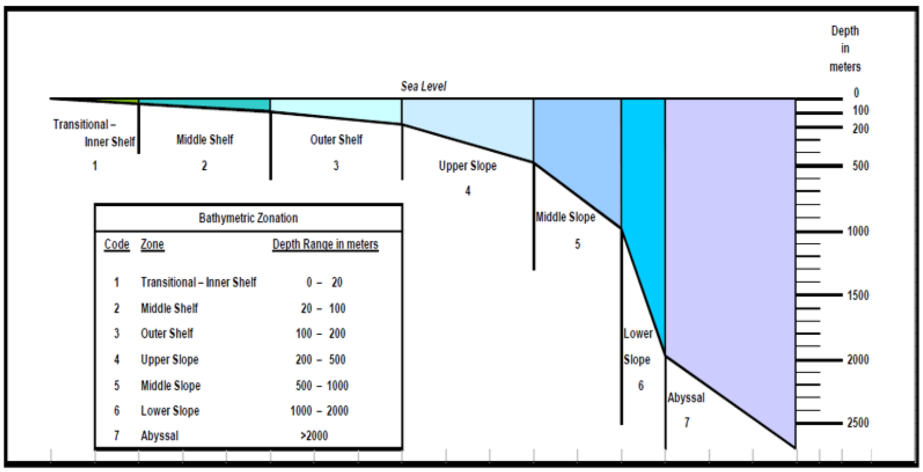


*Figure 1.  Typical depth ranges recognized by benthonic foram populations.*

Routinely in the oil industry, water depth estimates based on benthonic forams are used to develop an understanding of the depositional setting for sediments. The paleowater depth systematically deepens around basins such as the Gulf of Mexico. Any explanation for the microfossil distribution found needs to explain why this systematic pattern should be found in sediments deposited by a global catastrophic flood.

There is at least one more piece of valuable information that comes from microfossils. Some of them provide a maximum reading thermometer. This works in effect like a thermometer that you might find in a Thanksgiving turkey. It will tell you how high the turkey was heated to, not what its current temperature is. Similarly, microfossils, such as spores and conodonts change color as they are heated. This is valuable information in oil and gas exploration. One important use is to recognize when the source rocks, the rocks bearing the organic material with potential to generate oil and gas, were heated enough to do so. Exploration geologists usually want to know that the source rock (proven or postulated) was buried deeply enough to have heated enough to generate oil but not so deeply that oil will no longer be generated, but only gas and finally nothing. Examining pollen is one indication because as it was buried it was heated up and depending on the highest temperature reached, turned from near colorless to yellow, orange, red and finally black. An example from a study is shown in **Figure 12**. (Al-Ameri and Al-Obaydi 2011) (AAPG Wiki has a good article here: https://wiki.aapg.org/Thermal_maturation )

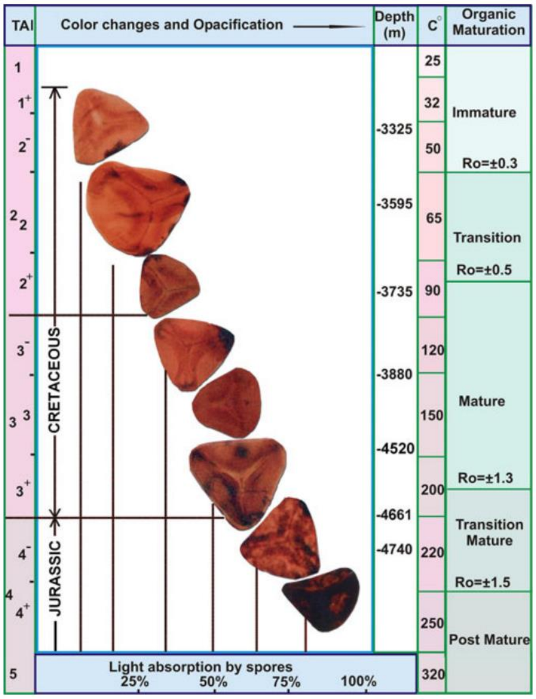


*Figure 2. Thermal maturation of pollen from a study of an oil field in Iraq*

Some YEC have noted that oil and gas can be generated from source rocks very quickly. This is quite true, but in order to do so, the rocks must be heated to much higher temperatures than current temperatures. Studies of pollen maturation (TAI) and other microscopic indicators demonstrate that the rocks were never subject to such heating.

## Summary:

Geologists use the "geologic column" to describe the overall order in which layers of strata were laid down. Leading YEC authors recognize the validity of the order while maintaining that most of it was formed by Noah's flood over the course of one year. Recognizing the order in which rocks were formed, geologists have been able to characterize the order in which life forms appear in the column. It is demonstrated that the lifeforms changed over whatever period was involved in the deposition of the sedimentary rocks. This can be attributed to the progressive way God brought about different lifeforms over millions of years.  It is more challenging for flood geology. Microfossils are real challenges for this. Why would these microscopic plants and animals have changed over the course of the one-year event in ways that can be correlated globally? Why would this be true for multiple types of microfossils, such as the five major kinds described here? Other microfossil types could also be included, such as silica-based forms: radiolaria and diatoms. An old earth allows for microfossils to have settled in ways that can be used to recognize the position of the sediments in the overall timeline, the paleo water depth and how much the sediments were heated to by burial or other geothermal heat sources. No effective answer has been presented by flood geologists.

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