Ooids grew rapidly in the Flood

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Ooids are small, nearly spherical, layered grains, usually of calcium carbonate, that are less than 1–2 mm in diameter (figure 1). Pisoids, or giant ooids, are similar to ooids but are larger than 2 mm, often much larger. Ooids form today in shallow, warm littoral zones (shallow marine environments), the kind found in the Bahamas or Persian Gulf. After further sedimentation, the ooids can be cemented together to form a sedimentary rock called oolite.

How do ooids form today?

The ooid forms as a series of concentric shells around a nucleus, which can be a shell fragment, quartz grain, or other small fragment. The concentric shells, called the cortex, are added and then rounded by abrasion. The elongated calcium carbonate crystals can be arranged radially, tangentially, or randomly. Most present-day ooids are of aragonite, a polymorph of calcite. They have abrasion bands that increase in number away from the centre.

They mostly form today in the water column during suspension in a Ca-rich environment but undergo abrasion from grain-to-grain and grain-to-bed contact that rounds and erodes them, forming the thin, dark abrasion surfaces (figure 2). Modern ooids are small because abrasion is more efficient than the precipitation of carbonates.

Ancient ooids different from modern ones

Ooids are common in sedimentary rocks of all ages from the Mesoarchean to the present (figure 2).[1,2] Ancient ooids, those in sedimentary rocks, differ from modern ooids. They are predominantly calcite, having either formed as calcite or as a replacement of metastable aragonite. Ancient ooids are larger than modern ones, especially in the Proterozoic, and can reach 1 cm in diameter. Ancient ooids also have a predominantly radial crystal arrangement within the cortex with fringing carbonate cement that has a rough, angular surface. Modern ooids have predominantly tangential crystals. As a result of these differences from modern ones, ooids are not well understood: "A comprehensive explanation for the formation of these remarkable carbonate grains still eludes geologists after over a century of study."[3]

Uniformitarian scientists believe ooids can tell us something about the geochemistry and paleoenvironments of the oceans in the past. However, modern environments make poor analogues for ancient ooids. So, if the origin of ooids is not understood, ooids cannot be used to infer past conditions.

One would think that ooids that continue to grow in the sediments and in contact with 6–8 other ooids would grow into one mass. However, ooids retain their sphericity because the force of crystallization pushes the spheres apart, keeping the individual spheres separate.[1] Thin abrasion bands that increase toward the outer layers are believed to be from greater abrasion with increasing grain mass.

Some believe ooids can form within the sediments

Some researchers believe ancient ooids are larger than present-day ooids because they mostly formed within sediments that had a high supersaturation of calcium carbonate or carbon dioxide.[1] Anderson *et al*. state that there are "exquisitely preserved oolites through time that suggests that some ancient ooids may have grown within the sediment pile".[3] However, the porewater in modern carbonates has *low* dissolved carbonate and carbon dioxide. As a result, ooid growth does not occur within carbonate sediments today. The researchers believe conditions could have been different in the past, with high levels of carbonate dissolved in the porewater. If this were true, ooids could have grown larger in the past because they were not restricted by the dynamic balance of calcium carbonate precipitation and abrasion in the water column. However, such a mechanism depends upon non-uniformitarian conditions.

Anderson *et al*. suggest that the properties of ancient ooids can be explained by their 'bedform model' in which ooids cycle in and out of underwater dunes. While in the dune, the ooid grows because high porewater carbonate or carbon dioxide precipitates carbonate cement. Then the ooids pass through the dune as the dune migrates. They then pass out of the dune and into the water column where abrasion forms

Figure 1. Modern ooids from a beach on Joulter Cays, the Bahamas

the rounded abrasion bands. The abrasion bands would thus be a measure of the number of cycles through and out of the dunes. Thus, the cortical part is just carbonate cements, which are the same as the fringing cement. With a longer time in the sediments, assuming deep time, and a short abrasion period, some researchers believe they can explain the growth of larger ooids in the past.

Questions on the dune cycling hypothesis

However, the researchers have to abandon the uniformitarian principle in order to claim that ancient sediments, usually deposited at a rate of a few cm per thousand years, had much more porewater carbon dioxide or dissolved carbonate than observed today. Although theoretically possible that ooids could pass through a dune during dune migration, it is unknown whether they actually have. Based on the number of abrasion bands, the ooids would have had to cycle through the dunes multiple times. Wouldn't ooids be eroded by abrasion in a dune? The scenario seems unlikely.

The classic model

A better model has been suggested by Trower *et al*.[2,4] They support the classic model in which ooids grow fully suspended above the bottom of a Ca supersaturated water column. The ooids grow proportional to the amount of Ca supersaturation that causes faster precipitation. Increasing agitation for a longer time of suspension allows for greater growth until the ooid is finally buried. They examined ooids in a high-energy shoal environment, but the ooids were small. Microorganisms did not aid growth, as some mechanisms postulate, but in fact were destructive. Trower *et al*. also applied the conditions of the natural environment in a lab and discovered that ooids grow much faster to equilibrium than postulated for carbon-14 measurements on natural ooids:

Figure 2. A thin slice of calcitic ooids from the Carmel Formation, Middle Jurassic, southern Utah, USA

> "Ooid abrasion and precipitation rates in the experiments were four orders of magnitude faster than radiocarbon net growth rates of natural ooids, implying that ooids approach a stable size representing a dynamic equilibrium between precipitation and abrasion."[5]

The problem with this mechanism is uniformitarianism demands too little agitation. Also, when the ooid is buried, the undersaturation of Ca can cause dissolution of the ooid.

The Flood would provide a better mechanism

It is unlikely that during the Flood rapid sedimentation would have allowed ooids to pass out of the sediment and back into the water column. The water column as well as the porewater during the Flood would have had some areas that were supersaturated with calcium. Greater turbulence would be expected, allowing for a longer time in suspension. This would have allowed enough time for greater growth and less abrasion, as Trower *et al*. discovered in the shoal area with the most agitation.[4] Therefore, the ooids could have grown rapidly in Flood conditions without needing the amount of time that radiocarbon measurements indicate. The abrasion marks likely occurred within the water column during fast growth, but abrasion likely was less because it would have been from grain-to-grain friction and not grain-to-bed friction. The latter would have caused greater erosion.

If the Proterozoic sedimentary rocks are from the very early Flood as indicated by impacts and other features,[6] greater Ca supersaturation and turbulence would have occurred when the biblical mechanisms would have been the most powerful. This may have allowed for especially large Proterozoic ooids. Ooids could even be a proxy for floodwater chemistry.

References

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