Manganese nodules and the age of the ocean floor

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Marine manganese nodules, those strange, fist-sized metallic clusters that cover about 30% of the ocean floor, have been known for over a hundred years. At first glance they appear very fresh; yet, according to paleontological and radiometric dating methods, the nodules are supposedly multi-millions of years old, the result of extremely slow growth rates of just millimetres per million years. However, actual observations have revealed that nodules can grow in excess of 20 cm within hundreds of years, a growth rate several orders of magnitude faster. In addition, nodules are found only at the top of the ocean floor, with the greatest density within the first 5 m of sediment and decreasing in size at greater depths. This contradicts the idea that ocean sediment accumulated gradually and continuously over millions of years. Rather it suggests a period of rapid sedimentation that has subsequently waned, a scenario that is consistent with the events of Noah's Flood.

First discovered in 1873 during a cruise of the HMS Challenger, marine Manganese nodules (MNs) have increasingly courted the attention of the geological community. As well as the obvious resource potential, MNs have also been studied for their palaeoceanographic information due to their assumed slow growth rates. MNs are found at "almost all depths and latitudes in all the oceans of the world, as well as in some lakes … The nodules are especially common in the Pacific Ocean … where it is estimated that they cover approximately 10–30% of the deep ocean floor."[1]

MNs are teeming with all types of metals, but five are significant and the target of mining prospectors: Mn, Fe, Ni, Cu, and Co, with manganese being the most abundant, having a mean of about 24% (hence the name Manganese Nodule).[2] MNs come in all different shapes and sizes; Vineesh *et al.* concur: "Large variation in morphological types of nodules are found in the CIB [Central Indian Basin] with spherical, oblong, triangular rounded, sub-rounded or irregular shapes being most common."[3] They also make some interesting observations as to nodule nuclei, "The most common nucleus is altered basalt, while pumice, shark teeth, clay and older nodule nuclei are also present."[3]

Manganese nodule formation

MNs are essentially a conglomerate of minerals that are thought to accumulate in one of two ways: 1) hydrogenetic nodules accumulate chemicals via precipitation directly from seawater, and 2) diagenetic nodules accumulate minerals from within a few centimetres of the ocean floor sediments, metals being derived from interstitial pore water.[1] Most nodules, however, are thought to be an amalgamation of both of these processes. Nodule sizes range from mere mm in diameter to over 30 cm (although the average appears to be around 8 cm) depending on their geographical location, the mineral content of the area and sediment and whether they were derived from hydrogenetic processes, diagenetic processes or a combination of the two.[4] Another, less understood method of Mn accumulation has a biogenetic origin; bacteria that oxidise manganese can also contribute to nodule growth.

Dissolved ferromagnesians and other chemicals are typically thought to interact with chemically reactive ocean floor sediments to initiate nodule growth. During the growth process chemicals in the sediments may begin to attach themselves to a nucleus of basalt or clay through the diagenesis process. These 'baby' nodules will usually begin to develop only cm or mm below the sediment. As the nodule matures, chemicals will also accumulate via precipitation from sea water adding more mass, eventually leading to what we see today.

Manganese nodule growth rates

Perhaps the most volatile data from a young-earth perspective is the assumed age of MNs and their relative growth rates. Achurra *et al.* state, "Their rate of growth varies from about 1 to 200 mm/my [million years] … being normally in the range of 3–4 mm/my."[1] Yet Achurra *et al.* acknowledge that there are drawbacks in using MNs as a source of palaeoceanographic information because "methods applied [to MNs] to date often give ambiguous results".[4] Since most MNs are several centimetres in length, uniformitarians conclude that most MNs took millions of years to reach their current sizes. This assumption is borne out in many textbooks:

> "[Manganese nodules] form in ways not fully understood by marine chemists, 'growing' at an average rate of 1–10 millimetres (0.04–0.4 inch) per million years, one of the slowest chemical reactions in nature."[5]

Yet are these assumptions valid? Have MNs really been growing on the ocean floor for many millions of years? Observed MN growth rates orders of magnitude higher than those postulated above are documented in the secular scientific literature, and some of this data is outlined below.

Author Marcin Zych; courtesy of www.wikipedia.org

Figure 1. Manganese nodules

Spatial distribution of manganese nodules

As one peruses the literature on MNs, one finds a large consensus concerning the spatial distribution of MNs on the ocean floor. Images of MNs (see figure 1) reveal a rather strange accumulation of what look like potatoes littering the sea floor in every direction for several kilometres. The seafloor–water interface seems like the perfect environment for MN growth.

Although the vast majority of MNs are found scattered at the sediment-water interface, many MNs have also been discovered buried in the sediment. In the Central Indian Ocean Basin (CIOB), a research team recently pulled 50 buried nodules from twelve 6-m long cores extracted over the last two decades. Most of the nodules were found in the top 1 m of sediment, although some reached depths of 5.5 m.[6] It seems to be commonplace at other geographic locations that the top few metres of sediment contain the greatest concentration of MNs. Pattan and Parthiban said, "In the Pacific Ocean, … [various researchers] … encountered 27 nodules buried between depths of 0.73 and 2.50 m in four long box cores."[7] They also quoted others who collected 18 m long sediment cores and again found nodules only in the upper few meters of sediment: "Martin-Barajas … collected sediment cores up to 18 m long in CIOB and observed that the maximum depth of occurrence of buried nodules was … 4.4 m below the seafloor."[7] Some nodules have been found at greater sediment depths, usually less than about 300 m below the water-sediment interface, but there are questions associated with their emplacement.

Where are all the sub-surface manganese nodules?

The almost complete absence of MNs below the ocean sediment surface is completely unexpected when the ocean floor is assumed to be many tens of millions of years old. If sediment has been accruing at current rates (which are faster than the assumed rates of MN formation) for millions of years, then we would expect to find a MN stratigraphical record throughout marine sediments. Yet such a record is almost completely absent.

In the 1970s a major project, called the Deep Sea Drilling Project (DSDP), was undertaken to obtain deep-sea sediment cores of the world's ocean floors. One of the first studies of the MNs found in these cores was published by G.P. Glasby. He said this of deeply buried nodules: "The most striking feature of the data is the extreme paucity of nodules in the cores."[8] Moreover, "The major question arising from this survey is why nodules occur in such paucity at depth in the sediment record."[9]

Glasby studied 370 cores from Leg 1–41 of the DSDP. Of those 370 cores, only 10 contain MNs at depths greater than 200 m below the sediment surface. Of those 10, most of the manganese minerals are not enrolled into nodules but are simply present as "bands, flecks and laminae".[10] At the time, however, even the few found at greater depths were discounted on the basis of contamination:

> "Buried nodules were observed a few hundred meters below the sea floor in [DSDP] cores … Later it was suspected that the occurrence of buried nodules was due to slumping of the upper sedimentary layer during drilling operations."[6]

Glasby's comments are pertinent: "It should be emphasized that one of the major problems here lies in establishing whether the nodules are *in situ* [in growth position] deposits or whether they have merely fallen down the drill hole from the sediment surface during drilling."[11] Furthermore, "some of these apparently older nodules [i.e. those buried at greater depths] may merely be recent nodules that have fallen down the drill hole."[12]

Later, in 1998, Ito *et al.* challenged these conclusions by comparing the strontium isotopic compositions of the buried MNs with those of surface MNs. Their conclusions are compelling, but even they use caution, "However, it is possible that buried nodules in DSDP cores were slumped down cores during drilling."[13] Even if the deeply buried nodules are accepted as *in situ* artefacts, their scarcity when compared to the abundance of buried nodules found near the surface is significant. When one begins to stitch together all of the available data, one is left quite stunned by the

Image courtesy of www.wikipedia.org

Figure 2. The Glomar Challenger scientific vessel used on the Deep Sea Drilling Project

picture presented: there are salient intervals of hundreds of metres in the sedimentary record where there is a complete absence of nodules.

Compare this to the data above where, for example, 15 buried nodules are found in one drill core to a depth of only 5.5 m. Essentially, over 90% of the MNs found in the sedimentary record of all the world's oceans occur in the top 250 m, and most in the top 50 m (66%) with the greatest density in just the top 5 meters (25%). These figures represent estimates taken from Leg 1–41 of the DSDP cores.[10] It must be remembered that these figures include microscopic manganese material such as streaks, bands and laminae, characteristics mainly of deeper cores, as well as MNs that probably fell into the drill holes from higher in the column.

Uniformitarian theories fail

Some workers have wrestled with this phenomenon, trying to explain why MNs are almost completely absent in the sediment record: "Various theories have been proposed to explain the enigma of heavier nodules resting on lighter sediments especially when the rate of sediment accumulation is higher than the growth of the nodules."[14] And this, "Various processes have been suggested to explain the phenomenon of keeping manganese nodules at the sediment-water interface. Possible mechanisms to maintain nodules at the sediment-water interface could be the influence of ocean bottom currents and the reworking of sediment by benthic organisms."[15]

Again, even if this dual churning of the sediment/ water current process is granted its rather unlikely result, the challenge still remains as to why buried nodules don't *persist* in the sedimentary record. This is key. If the majority of MNs are indeed kept at the sediment-water interface by benthic organisms and soft water currents, and if it is assumed that a few get buried, then these buried nodules should remain in the sediment and thus consistently appear throughout the marine stratigraphical record, a record that in some places measures depths of many kilometres! Yet this record of MNs is virtually absent.

This phenomenon is so strange that workers have had to furnish some rather colourful solutions. Some have suggested that MNs are a recent phenomena, only appearing in the last few million years as first generation nodules.[4,16] However, this simply begs the question because it abandons the uniformitarian principle, assuming conditions were different in the past based solely on the absence of MNs from the sedimentary record, but does not provide any corroborating evidence or reason for the change. Others have suggested that perhaps the MNs dissolve after burial, but this has been demonstrated to be false by some research on this exact possibility: "Once the nodules are buried within the sediment column, it therefore appears that they neither grow nor dissolve."[17]

Another possibility

There is of course another possibility, one that fits a relatively young ocean floor model. The MNs that are found buried in shallow sediment represent a generation of nodules that grew on the freshly deposited seafloor of the post-Flood world. Although initial post-Flood sedimentation rates would have been much higher than today, these rates would have eventually established equilibrium, slowing to their current rates. According to this model, buried MNs represent first-generation nodules that were covered within a few decades or a few hundred years after the world-wide Flood as the initial high rate of sedimentation slowed. This is supported by the decreasing size of buried nodules as they increase in depth,[18] "Thirty-eight nodules out of 50 are only 2 cm in diameter. This suggests that nearly 80% of the buried nodules are of small size. The majority of surface nodules are between 2–6 cm in diameter … buried nodule sizes decrease with core depth."[7]

As sedimentation rates began to decline to those of the present day, more and more nodules had more time for growth before being buried in sediment. This subsequently allows for greater individual nodule size and special frequency as one moves through time, and thus through the sediment column, till the present. Those nodules that now reside in the upper few meters of sediment represent nodules that have had the greatest opportunity due to extremely low, contemporary sedimentation rates. This explains why enrolled nodules are, for the most part, only found in the top 50 metres of ocean sediment, with the majority of larger nodules found just a few meters below the surface or at the water/seafloor interface.

If we consider the current uniformitarian rates for ocean sediment deposition we find it yields similar conclusions. Deep ocean sediment containing at least 30% biogenous material

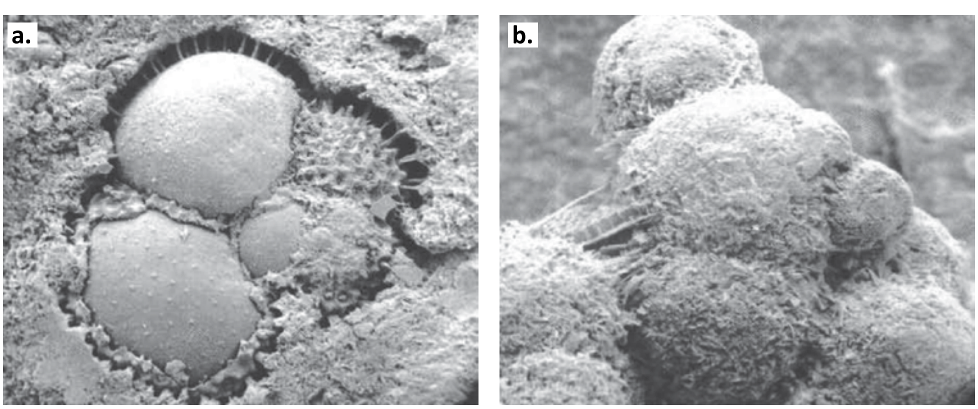

Figure 3. Electron micrographs of manganese micro-nodules from DSDP Leg 29, Site 278 formed by manganese replacement of foraminifera tests. a. fractured aggregate. b. unfractured aggregate. (From Margolis, ref. 25, p. 1089)

is called ooze; one textbook states: "Oozes accumulate slowly, at a rate of about 1–6 centimetres (0.5–2.5 inches) per thousand years." Clays, on the other hand, which mostly constitute terrigenous particles, are even slower: "Terrigenous sediment accumulation on the deep-ocean floor is typically about 2 millimetres (1/8 inch) every thousand years."[19] These extremely conservative rates consign a blanket of sediment over the deep ocean floor of only tens of centimetres in a total of 5,000 years—the timeframe assumed since the end of the global Flood. True, this is short of the few metres or so depth that characterize most buried MNs, but it's close.

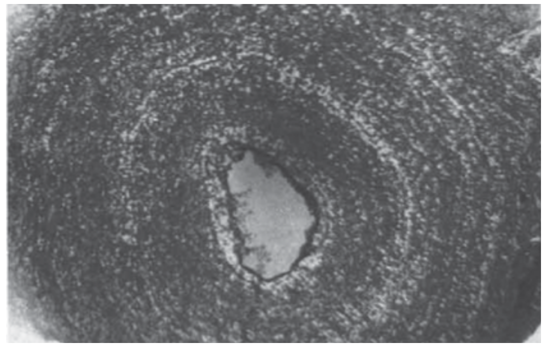

Figure 4. Polished section of manganese nodule showing concentric laminations around a sandstone nucleus, from DSDP Leg 29, Site 280 (from Margolis, ref. 25, p. 1087).

What of MNs buried at greater depth? If it is assumed that these nodules are actually *in situ* artefacts, they can still be incorporated into this hypothesis without much fuss; sedimentation was rapid, but not rapid enough to disallow nodule growth over several centuries of deposition. Moreover, one must keep in mind that MNs buried at great depth are not only rare, but they are extremely small and most represent simple manganese rinds, flakes and chips. This hypothesis is dependent on one crucial factor that will now be addressed: MN growth rates.

Manganese nodule growth rates revisited

The issue of MN growth rates still, of course, remains, even without a viable nodule-growth hypothesis. The issue for the uniformitarian is which rate is the rate to stand by: current growth rates or current sedimentation rates?

Manganese as a free element dissolved in water, much like iron, can be precipitated in a number of ways. One method that has not received as much attention as the hydrogenetic and diagenetic methods involves the participation of bacteria, specifically Manganese Oxidizing Bacteria (MnOB).

Krishnan *et al.* conducted a study on the metabolic capabilities of MnOB in the presence of Mn and their contribution to Mn cycling in the brackish water lakes of Larsemann Hills region, east Antarctica.[20] They took water samples from 12 lakes in the region and then subjected them to a number of rigorous experiments, which included the addition and/or removal of several organic and chemical compounds including Mn. The MnOB colonies were analysed before, during and after the experiments to see how these environmental changes affected Mn redox reaction rates. The results are surprising:

> "The presence of Mn in bacterial culture media enhanced their growth by six orders of magnitude … Mn oxidation in the lakes ranged from 0.04 to 3.96 ppb day^{-1} [ppb per day], while under in-vitro the isolates oxidized Mn from 10 to 100 times faster."[21]

This study was of course controlled; maximum levels of Mn oxidation were the desired outcome and thus experimental manipulation of what went in and what was kept out of the isolates was crucial. Of consequence, however, is the rapid nature of Mn oxidation given "diverse environmental factors". The point is this: given the theory of rapidly subducting plates and a recent global Flood, such "diverse environmental factors" are not only probable, but are essential. Rapidly altered ocean chemistry, geology, salinity and temperature make for equilibrium extremes that will no doubt catalyse various chemical and biological systems by many orders of magnitude.

A more absolute determination for rapid MN growth has been observed in an artificial reservoir built in the 1930s. In only 70 years, MNs very similar in chemical composition to those found in marine environments, have grown to sizes of more than 2.5 cm:

> "Nodules of various compositions, including ferromanganese nodules, have been found in bottom sediments of an artificial reservoir in the central Altai Territory [Kazakhstan]. The nodules were formed in the alkaline environment against the background of a high carbonate content and saturation with oxygen. The rate of nodule growth is no less than 1.7–1.8 mm/yr [This is per year!]."[22]

And a similar story for MNs in Lake Oneida, New York, although having somewhat slower rates:

> "Growth of manganese nodules in Oneida Lake is characterized by periods of rapid accretion (<1 mm/100 years [or 50 mm in 5,000 years]) alternating with periods of no-growth or erosion. Rapid growth of nodules may be aided by the stripping of Mn from the water column by algae and bacteria."[23]

Nodules have even been observed growing on splinters from shells dating from WWII with growth rates of between 0.6 mm/yr–1 mm/yr, as well as on other man-made items of the last century.[24] Again, each of these situations has diverse environmental factors affecting MN growth rates, and it just won't do to apply, say, those rates of >1 mm/yr directly to MNs growing at the ocean seafloor. To do so would see MNs grow to diameters of greater than 3 kilometres in only a few million years! Yet these fanciful kinds of figures do stress the equally fanciful figures associated with conventional MN growth rates; are we to really assume that the current potato sized MNs have only reached their current, rather pathetic size, given millions of years of growth? Logic and reason must be applied here.

Conclusions

Manganese nodules are mostly found at the sediment-water interface, although it is not uncommon to find them buried within the first 50 m of marine sediment. That nodules are rarely found at greater depths has raised legitimate concerns as to their origin and rates of growth. Why don't they persist throughout the sediment record? Why is the greatest density of buried nodules only found within the first 5 m of sediment? Why do buried nodules decrease in size at greater depths? Secular research has failed to query what would seem to point to a very obvious solution: the sediment on the ocean floor initially accumulated at a rapid rate that has subsequently waned. MNs, which were unable to form during the period of rapid sedimentation, accumulated when the rate of sedimentation had sufficiently reduced. Thus, the ocean floor and the MNs are actually only thousands of years old and not millions of years old.

What about the growth rates of MNs? For years, geologists have been using paleontological methods (dating a nodule on the basis of the microfossils it contains) and/or radiometric analysis to 'discover' the age of MNs. Yet the best and most effective method for dating MNs—actual observation—has revealed significantly greater growth rates by several orders of magnitude! If nodules can grow to sizes of more than 20 cm in only hundreds of years, then it would seem that paleontological and radiometric methods used thus far have overestimated MN growth by tens of millions of years! One wonders what kind of growth rates would have been calculated had radiometric and paleontological dating methods not been applied. Observed MN growth rates therefore are a challenge not only to the age of the ocean floor, but also serve to challenge the conventional dating paradigm itself.

In summary, the data (found almost exclusively in secular sources) presents a formidable challenge to the secular view of slow MN growth rates on the basis of observed MN growth rates combined with shallow MN burial depths.

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