The Whale Fossil in Diatomite, Lompoc, California

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Abstract

An on-site investigation at Lompoc, California, has established that the fossilized baleen whale found there in diatomite was **not** buried while "standing on its tail," but is tilted because the enclosing diatomite unit is tilted. However, current slow-and-gradual uniformitarian models for diatomite deposition and whale fossilization cannot explain this Lompoc whale fossil in diatomite. Only a local catastrophe involving volcanic activity, a post-Flood event within the biblical framework of earth history, is consistent with all the evidence that demonstrates the whale was catastrophically buried in the diatomite.

Keywords

Diatomite, Fossilized Whale, Miguelita Mine, Lompoc, California, Monterey Formation, Excavation, Fossilization, Inclined Strata, Fish Fossils, Diatomite Deposition

Introduction

The discovery of a new fossil does not always make headline news, except perhaps if the fossil is of enormous size and is a significant find of a rare creature. Such was the case in April 1976 when workers at the Miguelito diatomaceous earth quarry near Lompoc, California, uncovered the fossilized skeleton of a baleen whale during regular mining operations (Anderson, 1976). An appropriate scientific team from the Natural History Museum of Los Angeles County under the leadership of vertebrate paleontologist Dr. Lawrence G. Barnes was called in by the mining company, Grefco Inc., to carry out a thorough scientific investigation and to excavate the fossil. From the size of the jaws of the whale as they were exposed during excavations, it was possible to estimate that the full length of this whale fossil was somewhere between 75 and 90 ft (22.9–27.4 m) long. Consequently the flurry of activity surrounding the excavation of the bones, of this the largest of this type of whale ever found, naturally brought media interest and exposure in the months following (Anonymous, 1976a; Sawyer, 1976).

This particular whale fossil, with individual skull and jawbones as large or larger than individual bones of the largest of dinosaurs, consequently attracted national scientific interest, with reports appearing in *Chemical Week* (Anonymous, 1976b) and *Chemical and Engineering News* (Reese, 1976). It was the latter report that brought the fossil to the attention of the creationist community, with a brief comment appearing in the very first issue of *Origins Research*, (Anonymous, 1978). The report indicated that a number of letters to the editor on the subject of this fossil whale had subsequently appeared in *Chemical and Engineering News*, particularly focussing on the description in the initial report that the whale had been found fossilized "standing on end" in the diatomite beds in the quarry. Thus Helmick (1977) wrote:

> … the fact that the whale is standing on end as well as the fact that it is buried in diatomaceous earth would strongly suggest that it was buried under very unusual and rapid catastrophic conditions … .

Likewise, Olney (1977) stated how (at least according to his interpretation of the report) a uniformitarian might have to view the situation:

> Everybody knows that diatomaceous earth beds are built up slowly over millions of years as diatom skeletons slowly settle out on the ocean floor. The baleen whale simply stood on its tail for 100,000 years, its skeleton undecomposing, while the diatomaceous snow covered its frame millimeter by millimeter … .

So began the idea that this 80 ft (24.4 m) or so long baleen whale was fossilized while standing on its tail at right angles to the horizontal deposition of the surrounding diatomite—hardly a process to have taken countless thousands of years. Yet Weinshank (1977) wisely cautioned:

> These sorts of letters appeal to "common sense" to support the creationist position … at the moment, I don't know why that … whale is standing on its tail. As a scientist, I am going to wait until somebody with reasonable competence in paleontology … has a chance to look at it … .

However, one does not need competence in paleontology to take a trip to a quarry and see which way the strata are dipping with respect to the disposition of such a large fossil in the process of being excavated. If any creationist did in fact do just that, then he or she certainly did not publicize his or her findings. Consequently, those creationists aware of the *Chemical and Engineering News* report and the finding of this baleen whale fossil at Lompoc were obviously still left with the impression that this whale had actually been fossilized while standing on its tail!

Some years passed, but the "story" must have remained the same amongst those creationists aware of this fossil, for in 1986 the story became entrenched amongst creationists due to wide circulation of a popular book by Ackerman (1986), citing this whale fossil "on its tail" as astounding evidence for rapid deposition of diatomite and therefore a clearly demonstrable error in the uniformitarian timescale.

Ackerman reported the details of this whale fossil as they appeared in the initial write-up in *Chemical and Engineering News*, complete with a very graphic sketch (Figure 1), and portrayed to his widespread creationist audience that here was telling evidence against the evolutionary timescale and for a young age for the earth and its strata. And so this story became entrenched in the creationist literature. It has been retold many times since, and used as evidence to quite legitimately inform the lay public of the evidence against the evolutionary worldview in order to open their minds to the biblical worldview (Strauss, 1993). Yet sadly it would appear that in all these years no

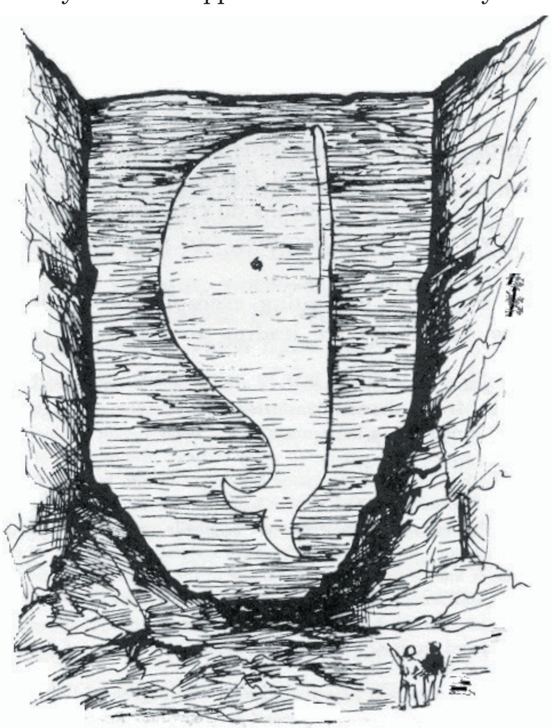

Figure 1. Artist's conception of the whale on its tail at Lompoc, according to Ackerman (1986).

creationist has visited this quarry to verify this story and then publicized his or her findings.

My colleagues and I here in Australia naturally took this story at face value, accepting its authenticity and assuming its accuracy had been based on actual site visits by creationists. Such dramatic evidence capable of so easily convincing lay audiences of the creationist position of catastrophic geology within a young-earth time framework could hardly be ignored, but powerfully put to good use. However, niggling doubts remained, particularly as enquiries amongst U.S. creationist colleagues revealed that they generally ignored this evidence, and yet it was still not clear whether any creationist had visited the site, let alone circulated some documentation to either confirm or refute this longstanding creationist story. Thus it was on April 18, 1994, while visiting the Los Angeles area, due to the liaison work of a creationist colleague with Dr. Lawrence Barnes, I had the opportunity to make an on-site investigation with paleontologist Dr. J.D. Stewart of the Natural History Museum of Los Angeles County under the guidance of geologist David Jenkins of Grefco Inc. Dr. Stewart also arranged for a visit to the museum the next day to view those bones of this baleen whale fossil that had been recovered from the quarry and stored in the museum collection.

The Lompoc Diatomite Deposits

Situated at approximately 34°40'N, 120°15'W, the Lompoc area is about 170 miles (or 275 km) west-north-west of downtown Los Angeles (see Figure 2) (Jenkins, undated). The township of Lompoc is about 10 miles (16 km) from the coast and serves the nearby diatomite mining and processing operations. Grefco Inc. operates two mines in the Lompoc area—the large Palos Colorados Mine located approximately seven miles (11 km) south-east of Lompoc, and the Miguelito Mine located about two miles (3 km) south of Lompoc (see Figure 2). Diatomite from the two mines is trucked to the Grefco plant at Lompoc for processing.

The baleen whale fossil which was the subject of this investigation was found in the Miguelito Mine in a diatomite unit within the late Middle Miocene section of the Monterey Formation. Figure 3 illustrates a typical stratigraphic column for the Miguelito Mine, this section of the Monterey Formation being characterized by alternating beds of diatomite, siltstone, argillaceous diatomite, silty diatomite, volcanic ash, and an abundance of cherts. The beds of the Monterey Formation being mined are now an isolated remnant due to post-depositional folding and erosion, but were originally formed in a basin that covered a wider area. For the most part the beds in the mine are folded into east-west anticlines

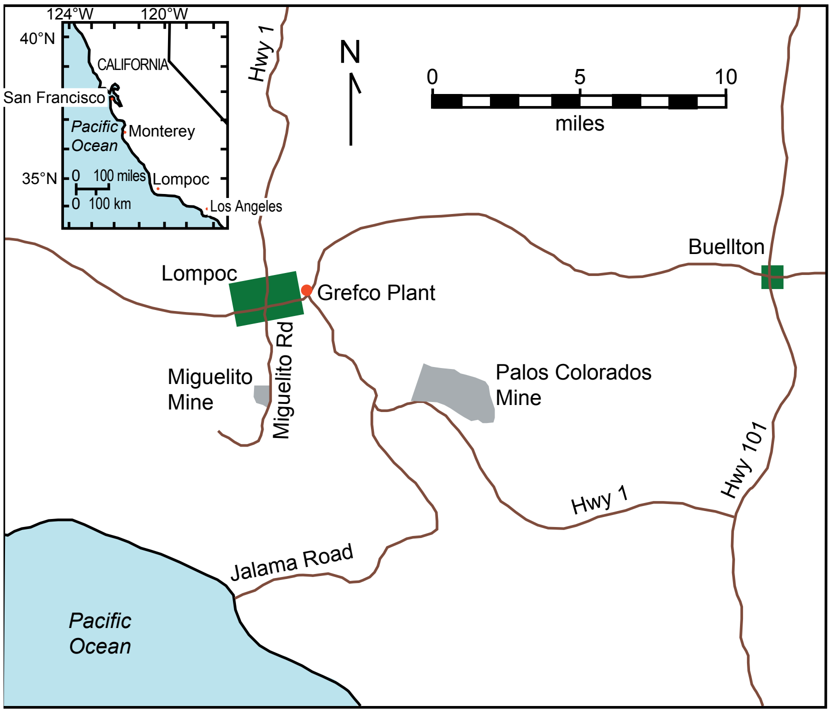

Figure 2. Location map showing the Miguelito Mine near Lompoc in California.

The skull was never transported to the museum, but was moved to a disused bench at the edge of the mine, where it still is in a plaster and burlap frame today (see Figure 10). The head and forepart of the whale alone required some 2400 lb (1089 kg) of plaster and 700 yd (640 m) of burlap 36 in. (0.9 m) wide to encase and preserve it (see Figures 11 and 12). At least 24 segments of the whale fossil were recovered, including the thorax. Also found were the baleen plates of the whale, which are fibrous plates like a comb, a type of filter the whale uses to screen food.

It seems that only the head and a small part of the body were ever exposed by the mining operations; so a final measurement to ascertain the length of the once living whale was never undertaken. However, estimates can be made based on the sizes of the skull and lower jawbone which were 18 ft (5.5 m) and 16 ft (4.9 m) long respectively. Also available are the measurements

and synclines, and at the western end of the quarry the beds rise sharply, terminating the deposit. The economic beds of diatomite vary in thickness from a few feet to ten feet (1–3 m) thick and may be laminated or massive.

The Baleen Whale Fossil

This baleen whale fossil that was found in April 1976 in the Miguelito Mine was assigned, by Dr. Lawrence G. Barnes and his team when they excavated it, a site number designation of LACM4156 and a field number designation of LGB#1583. The fossil was found on the western edge of the mine where the diatomite beds are upturned so that they dip at an angle of about 60° to the east (Figure 4). That this was the location from which this whale fossil had been excavated was easily verified by comparing the area with the photographs that had been taken during the excavation work (see Figures 5 and 6).

Not all of this fossilized whale was excavated and recovered. When found, the remains of the right flipper were up and under the lower jaw (mandible) and were the first bones to be dug out and transported to the museum (see Figure 7). The lower jawbone was removed next (see Figures 8 and 9), the diatomite having to be taken from around the fossil with great care because the bones were found to be fragile and liable to disintegrate quickly when exposed to the air. As sections of the bone were exposed, they were coated with a plastic cement, which hardened, and covered and reinforced with bandages of plaster and burlap.

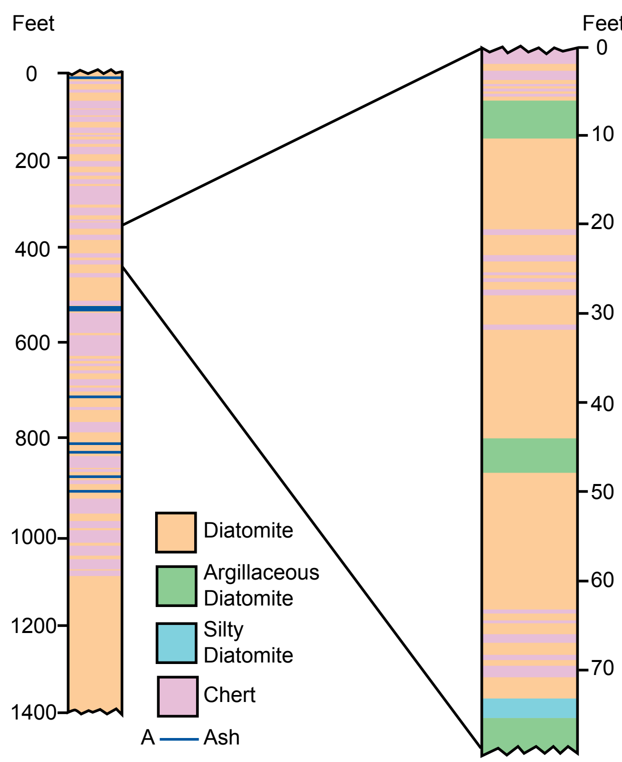

Figure 3. The stratigraphic column of the Monterey Formation sediments in the Lompoc area (left), with an enlargement of the stratigraphy in the Miguelito Mine (right) after Jenkins (undated).

Figure 4. View of the tilted diatomite beds at the western end of the Miguelito Mine, close to where the baleen whale fossil was found.

made of the right flipper bones stored in the basement of the Natural History Museum of Los Angeles County (see Figure 13):–

humerus 68 cm ulna 93 cm radius 7 cm
humerus + radius = 1.45 m

These measurements can be compared with the full skeleton of a related fin whale caught in 1926 and put on display in the museum. This 70 ft (21.3 m) long whale has a combined humerus plus radius length of about 1.25 m, and a skull about 14 ft 5 in. (4.4 m) long. Thus based on comparing skulls, the fossil baleen whale from the Miguelito Mine at Lompoc would have been about 87 ft (26.6 m) long, whereas comparison of the flipper bones suggests the total body length was about 81 ft (24.7 m).

From the descriptions and photographs of the excavations of this fossil baleen whale it is clear that because the fossilized skeleton was found essentially intact, the bones not disarticulated, the whale died and was entombed whole. Furthermore, the disposition of the fossilized skeleton when discovered indicates that upon death its body came to rest on the sea floor on its back with its right flipper up over

Figure 5. View of the western end of the Miguelito Mine in 1976 when the baleen whale fossil was being excavated. In the center can be seen the frame and plaster being built around the skull, and just to the left on the quarry floor another bone lies after excavation. (Photograph courtesy of L. G. Barnes.)

its lower jaw, in which position it was subsequently buried by diatomaceous ooze (see Figure 14a and b). Following further deposition, the strata sequence containing this fossilized whale was tilted by earth movements to the approximate 60° angle it is at today (see Figure 14c). Thus the whale was **not** fossilized while standing on its tail, that impression only being given because its fossilized remains were tilted with the strata.

Figure 6. View of the western end of the Miguelito Mine as it looks today. The tilting of the diatomite beds can be clearly seen. The view in Figure 4 is a close-up from the top bench, while the baleen whale fossil probably came from the wall below.

Figure 7. Excavation in 1976 of what looks like one of the right flipper bones. Note the iron oxide staining (darker patches) of the diatomite nearby, but the bone and its outer surface is both clean and intact. (Photograph courtesy of L. G. Barnes.)

The Diatomite of the Monterey Formation

According to Grefco mine geologist Jenkins (undated), the diatomite unit in which this fossilized baleen whale was found belongs to the "upper" Monterey Formation. However, Barnes' assessment of the whale fossil was that it is "between 10 and 11 million years old," (Anderson, 1976) of "some 10 to 12 million years old," (Anonymous, 1976a; Reese, 1976; Sawyer, 1976) which would place the fossil in the late Middle Miocene and in the upper section of the middle Monterey Formation (see Figure 15) (Barron, 1986). The coastal section of the Monterey Formation just to the west of Lompoc (at Point Pedernales) has been informally subdivided by Compton (1991) into members, and the section of the Monterey Formation exposed in the Miguelito Mine would thus correlate with his "Upper calcareous-siliceous member."

Figure 8. Excavation around the lower jawbone came next, the diatomite being carefully removed to expose the bone. (Photograph courtesy of L. G. Barnes.)

Figure 9. Once exposed by complete removal of the diatomite around it, the lower jawbone was encased in plaster and burlap. (Photograph courtesy of L. G. Barnes.)

The Monterey Formation is not homogeneous, but consists of varying amounts of biogenic calcite (calcareous nannofossils and foraminifers) and biogenic silica (diatoms and radiolarians) deposited in both laminated beds and in thick, massive beds (Bramlette, 1946). In the Miguelito Mine the exposed section of the

Figure 10. The skull of the fossilized baleen whale in its framed casing of plaster and burlap still at the Miguelito Mine today.

Figure 11. View of the frame and plaster/burlap being built around the whale's skull during its excavation. (Photograph courtesy of L. G. Barnes.)

Monterey Formation (see Figure 3) consists of beds of laminated diatomite up to more than 15 ft (4.8 m) thick separated by thin (less than 1 ft or 0.3 m thick) beds of chert, and by a 3.5 ft (1 m) thick argillaceous diatomite bed just over halfway down the section. This is, of course, hardly surprising, since mining operations would be expected to concentrate on the thickest economic diatomite units, and in the Miguelito Mine there is more than 60 ft (18.5 m) of diatomite exposed, with only the argillaceous diatomite bed and the thin chert units within the mine sequence.

Figure 12. Another view of the plaster and burlap frame built around the skull. Note the purity of the diatomite from which the fossilized whale is being excavated, and the iron staining (darker patch) near the fossil. (Photograph courtesy of L. G. Barnes.)

By definition, diatomite is a light-colored, soft, friable sedimentary rock, consisting chiefly of opaline frustules (ornate, microscopic, box-like cell walls) of once living diatoms, which are unicellular aquatic plants related to algae. However, the diatomite units in the Miguelito Mine, including the lowermost mined unit that contained the fossilized baleen whale, are not as soft and friable in the ground, although the diatomite does crumble easily upon drying out. In thin section the opaline frustules of many fossilized diatoms are readily discernible, but much of the rock also consists of discolored milky amorphous "fluff" that represents opaline silica. This implies that the combination of burial pressure and incipient formation water has resulted in dissolution of some of the opaline frustules and reconstitution of the rock matrix to give it a more coherent bonded mass of opaline silica. This, in turn, partly explains why when the diatomite is struck with a hammer and breaks, it sounds like

Figure 13. The right flipper bones of the fossilized baleen whale in the basement storage area at the National History Museum of Loss Angeles County—humerus (foreground), radius (left) and ulna (right).

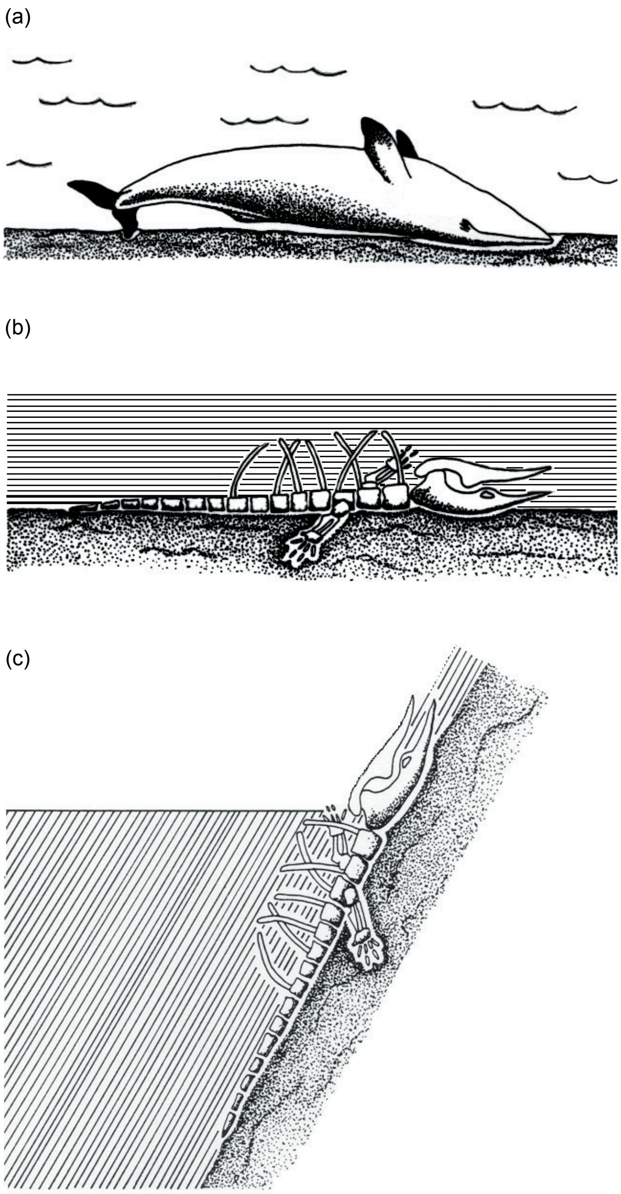

Figure 14. Schematic sequence envisaged for fossilization of the Lompoc baleen whale.
(a) the whale falls to the sea floor on its back as it dies.
(b) the whale's skeleton become entombed in laminated diatomite with its right flipper on its lower jawbone.
(c) the diatomite bed with its enclosed whale fossil is subsequently tilted, in which position the whale fossil was found and excavated in 1976.

the shattering of glass, yet it remains light (density <2 g/cm^3) and porous (>50%).

If the diatomite in the Lompoc area had been more deeply buried, then it may well have been converted to porcellanite, which is a dense siliceous rock that has the texture, dull lustre, hardness, conchoidal fracture, and general appearance of unglazed porcelain. In the coastal section of the Monterey Formation at Point Pedernales just to the west of Lompoc the diatomite units that correlate with those in the Miguelito Mine

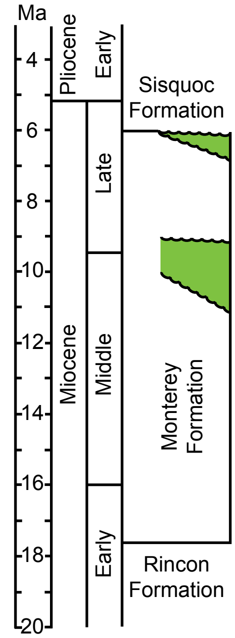

Figure 15. Conventional timescale for the Monterey Formation of California (after Barron, 1986). In some places there is an erosion break within the Monterey Formation at the Middle-Late Miocene transition.

have been classified as porcellanite (Compton, 1991), because the biogenic silica (designated opal-A) has undergone a phase transformation whereby a solution/precipitation mechanism has resulted in the opal-A being recrystallized into cryptocrystalline opal (or opal-CT). As already indicated, this phase transformation of the biogenic opaline silica to cryptocrystalline opal is due to burial diagenesis, and depends on the burial depth of the sediments, the temperature (geothermal gradient) and sediment composition, the transformation temperature increasing with the clay content (Kastner, Keene, & Gieskes, 1977).

Bulk analyses of the porcellanites of the Point Pedernales area indicate significant components of clay (up to 15%), feldspar (up to 20%), pyrite (up to 4%) and organic matter (up to more than 12%), and there are also siliceous mudstones and diatomaceous shales in the sequence (Compton, 1991). The diatomite of the Lompoc area, as seen in thin sections, does not seem to contain such significant quantities of these "contaminants," and the large numbers of diatom frustules, and fragments thereof, indicate that much of the rock is still biogenic silica (opal-A), rather than having undergone transformation to the opal-CT phase of porcellanite. Some cryptocrystalline opal must, however, be present in the matrix to produce the "shattering of glass" sound when the rock is struck (akin to the sound of shattering porcelain), yet the rock's friability when dehydrated affirms its identification as diatomite (porcellanite has a negligible water content).

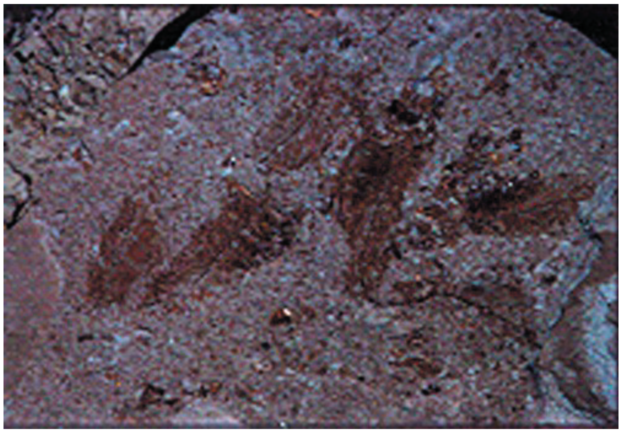

Figure 16. A group of herring fossils *(Xyne grex)* on a lamination surface of the diatomite, Miguelito Mine, Lompoc.

Other Fossils in the Diatomite

While the discovery of the baleen whale fossil in the Miguelito Mine at Lompoc in April 1976 attracted media attention and much excitement due to the fossil's size and apparent rarity, that find has by no means been unique. Indeed, Barnes was reported at the time (April 30, 1976) as revealing that they had

> uncovered four other whale fossils in the quarries here *[at Lompoc]* since March *[1976]*, three baleens and one sperm whale. But none of them were anywhere near the same size. (Anderson, 1976)

In other words, a total of five whale fossils had been found in the Lompoc diatomite units in less than two months, so such fossils are by no means rare. It was also reported that at about the same time another "especially interesting" find was "the skeleton of a small fur seal or sea lion, one of the few known specimens of the species" (Anonymous, 1976a; Reese, 1976). Other fossils also mentioned in these media reports as having been found in the same Lompoc diatomites over the years include fish, seals, saber tooth whales, and birds.

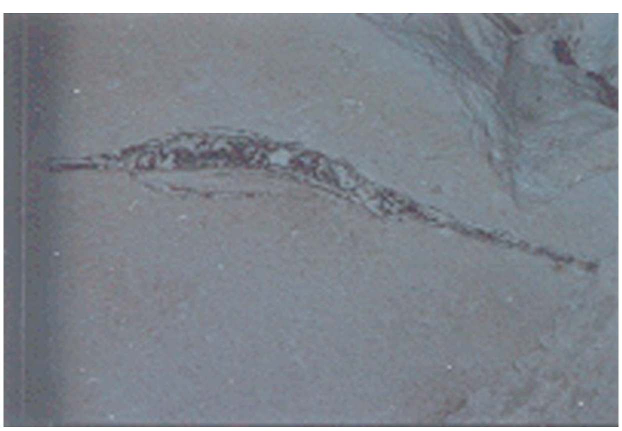

Figure 17. The pipefish *Hippsyngnathus imporcitor* fossilized within diatomite, Miguelito Mine, Lompoc. Classified in the same group as the seahorse, its pouch is clearly seen on its underside.

During our brief visit to the Miguelito Mine, we easily found numerous fish fossils, often as many as four or five in an area of a quarter of a square meter of rock surface, and sometimes there were more underneath on the parting surfaces of the next laminae, only a centimeter or less below. The fish fossils were the cod *Eclipes* and the herring *Xyne grex* (see Figure 16), but we also found the pipefish *Hippsyngnathus imporcitor* (see Figure 17), a relative of the seahorse. Sardine scales were also common, and the occasional "clump" or "string" of fossilized algae. An interesting find was coprolites from sea lions, which included not only mashed-up, incompletely digested food, but also stomach stones. Frequently the fish fossils were in "clusters" of 3, 4, or 5 together, but always only cod together or herring together (see Figure 16 again). It is also worth noting here that it is these same herring that constitute some of the "famous" mass kill reports, such as that described by Ladd, where "more than a billion fish, averaging 6 to 8 in. *[15–20 cm]* in length, died on 4 square miles *[10.4 sq km]* of bay bottom," when referring to beds of herring fossils in the Miocene Monterey Formation shales of California (Ladd, 1959), the very same Monterey Formation to which the Lompoc diatomite units belong.

Deposition of the Diatomite

Since this "controversial" baleen whale fossil was buried in diatomite, it is critical now to investigate the deposition, including the rate, of the diatomite. According to the reigning geological paradigm, uniformitarianism, we need only to look at present-day sedimentary environments to discover how the sedimentary rock units of the geological record were deposited. Consequently, the best model for deposition of diatomite is regarded to be the deposition of diatomaceous oozes on today's ocean floors, and in particular, the diatomaceous sediments in the Gulf of California.

Calvert (1966) reported on the early investigations of the accumulation of diatomaceous silica in the sediments of the Gulf of California and showed that the greatest concentrations of diatom frustules (>26%) and opal (>31%) in the surface sediments on the floor of the Gulf are in the Guaymas Basin area. Production of phytoplankton was also found to be greatest in the same area, with 20,000–600,000 diatom cells per liter of water in the top 50 m of the water column. This implies that the diatom frustules have simply settled to the sea floor directly below the surface waters where the diatoms flourished, rather than being dispersed by the water currents in the Gulf. At an experimentally determined settling velocity of about $1–3\times10^{-3}$ cm/s, Calvert postulated that a frustule would take approximately 1–2 years to settle 1,000 m in still water. Calvert also calculated that the accumulation rate of the biogenous silica in the Gulf of California was approximately 10^{13} g/yr, which in the Guaymas Basin was measured as a sedimentation rate of up to 5 m/1,000yr. With approximately 10^{11} g of dissolved silica being carried into the Gulf each year by rivers, and another 10^{14} g/yr supplied by water exchange between the Gulf and the Pacific Ocean, Calvert concluded that there was thus sufficient silica available in normal Gulf water, in conjunction with upwelling of continuous supplies of nutrients to the surface water zone where the diatoms thrive, to account for the accumulation of the diatomaceous sediments.

Calvert (1996) clearly expressed his uniformitarian bias and motive for his investigations when he said that identification of the processes involved in producing the diatomaceous sediments in the Gulf of California under known environmental conditions would aid in the interpretation of processes and environments of deposition for the planktonic accumulations in the geological column. Yet when he applied the Gulf of California sedimentation model to the diatomites of the Monterey Formation he had to conclude that they "would be produced in a relatively short time." How short? Taking the Lompoc and surrounding area of 100 ml^2 (260 km^2) where the diatomite is at least 500 ft (150 m) thick, he estimated that that volume of diatomite would contain 8×10^{16} g of silica (assuming 100% purity and a grain specific gravity of 2 g/cm^3). At an accumulation rate of 10^{13} g/yr as in the Gulf of California, it would take 800,000 years to produce the Lompoc diatomite at an average rate of 19 cm/1,000 yr. However, such comparisons are not strictly applied, because the fossil dating of the duration of the Monterey Formation (see Figure 15 again) must have precedence. Consequently, Compton (1991) calculated that since the Monterey Formation supposedly spanned nine million years, then the 800 m thickness of Monterey sediments would have accumulated at an average sedimentation rate of 90 m/million years, or a mere 9 cm/1,000 yr. However, since the diatomaceous sediments are concentrated in the Guaymas Basin where the sedimentation rate is up to 5 m/1000 yr, a more realistic uniformitarian application to the Monterey Formation would stress that the 150 m thick Lompoc diatomites may have needed only about 30,000 years to accumulate.

With the visit of the Glomar Challenger to the Gulf of California during Leg 64 of the Deep Sea Drilling Project (DSDP), December 1978–January 1979, piston cores were obtained of the diatomaceous sediments in the Guaymas Basin area (Curray & Moore, 1982). Schrader et al. (1980) described a 152 m deep hole through two alternating sediment types distinguished by primary sedimentary structures, the sequence being divided almost equally between

1. zones comprising rhythmically laminated couplets ("varve"-like rhythmites) of light, pale olive diatom ooze and darker, moderate olive brown muddy diatomaceous ooze, and
2. zones of homogeneous diatomaceous muds to ooze.

In addition, there were sporadic sand layers, turbidites, phosphatic concretions, fish debris, an ash layer, and a dolomitic mudstone.

Rhythmite couplets of the laminated zones are mixtures of biogenic and terrigenous components. The pale olive, light laminae are generally a nearly pure diatom ooze, with 70–80% diatoms and 15–25% terrigenous clay. The dark laminae are a moderate olive brown muddy diatomaceous ooze, with 45–60% terrigenous clay and 15–45% diatom frustules. Laminae are of variable thicknesses, mostly less than 1 mm, and either the light or dark laminae may be thicker. However, the number of dark-light couplets per centimeter was found to be essentially uniform throughout the sequence, 12–15 at the top of the sequence and 12–29 at the bottom, the increase in frequency (and therefore slight thinning of laminae) suggesting compaction of the sediment rather than an increase in the number of couplets supposedly deposited per unit time. In contrast, the homogeneous zones consisted of moderate olive grey diatomaceous mud to muddy ooze with only 10–40% diatoms, but 10–15% foraminifera and calcareous nannofossils, and 40–60% terrigenous clay, which includes quartz and feldspars, while pyrite is a ubiquitous minor constituent.

Schrader et al. (1980) admitted that the mechanism for couplet formation was still being debated, but appeared to be related to seasonal patterns in the Gulf as already noted by Calvert. We have already referred to the high organic productivity of the Guaymas Basin, particularly diatoms associated with coastal upwelling of nutrient-rich water triggered by northwesterly winds during the dry season (January through May). This is believed to thus produce the pale olive laminae with an excellently preserved, upwelling diatom assemblage. During the rainy season (July through September) when the winds come from the southeast, the upwelling ceases and terrigenous material is washed into the area by rivers draining the adjacent land areas. Thus the dark laminae are produced with a moderately preserved, different diatom assemblage, an "oceanic" assemblage. However, this simple couplet compositional pattern presumed to be derived by this seasonal pattern (upwelling diatom species dominant in light laminae and oceanic diatom species in dark laminae) although prevalent in the top portion of the sequence, is contradicted deeper down. Nevertheless,

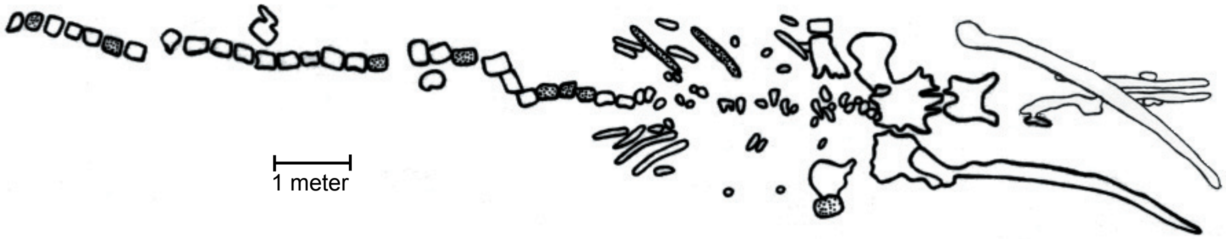

Figure 18. Map of the whale skeleton found on the sea floor, Santa Catalina Basin, offshore from Los Angeles (after Allison et al., 1991).

in a recent detailed study Thunell, Pride, Tappa, & Muller-Karger (1994) directly measured and confirmed the seasonal pattern of biogenic silica fluxes related to the phytoplankton biomass levels, which were controlled by the changes in weather and hydrographic conditions. They also concluded that the sedimentation rate is 0.18cm/yr (1.8m/1,000yr) for the Guaymas Basin and 0.26cm/yr (2.6m/1,000yr) for the nearby Carmen Basin.

The Gulf of California diatomaceous sedimentation, including the rhythmic variations, has become entrenched in uniformitarian thinking as *the* model or modern analogue for formation of the Monterey Formation diatomites and associated diatomaceous units (Armentrout & Schrader, 1981; South, 1995). However, how comparable really are the Monterey Formation diatomites, especially the Lompoc diatomite that entombed the baleen whale fossil, with the Gulf of California diatomaceous sediments? Bramlette (1946, pp. 30–34) noted rhythmic bedding in the Monterey Formation generally, but most beds are 1–2 inches (25–50mm) thick, the thinnest laminae measured in fractions of a millimeter being much less frequent, and Armentrout & Schrader are able to point to apparent similarities in the Gulf of California. Indeed, Bramlette recognized that the rhythmic beds occurred as couplets of organic and clastic layers. Nevertheless, though the Lompoc diatomite is unmistakably laminated, the subtle color differences of the laminae (which are all different thicknesses with no regular pattern apparent) do **not** appear to be the result of *any* significant compositional or microfloral variations, and therefore the Gulf of California diatomaceous sediments and their sedimentation rate are **not** an analogue for formation of the Lompoc diatomite. Indeed, as with other economic/mineable deposits of diatomite, the diatomite beds of the Lompoc area (including that which entombed the baleen whale fossil in the Miguelito Mine) are noted for their relative purity and contain no foraminifera. With a fairly uniform 88.90% silica content (on a dry basis), (*Encyclopaedia Britannica*) not only is calcium carbonate almost entirely lacking (Bramlette, p. 14), but there is virtually no clay (terrigenous) component, all totally different to the supposed Gulf of California analog.

Fossilization of the Whale

So if the formation of the Lompoc diatomite cannot be explained by any modern analog, perhaps the baleen whale fossil entombed within it may give us some clues. After all, it must surely be doubtful whether a baleen whale 24.7–26.6m long, with a "head" therefore as much as 2.3m thick, could become entombed (without being disarticulated) by biogenic silica accumulating around and over it at a rate of 0.18cm/yr (today's Guaymas Basin sedimentation rate), let alone the mere 9cm/1,000yr (0.09mm/yr) suggested by Compton for the Monterey. But the diehard uniformitarians are still convinced that it must have happened that way (South, 1995).

During submarine investigations of the sea floor in the Santa Catalina Basin off the coast from Los Angeles in 1987–1988, Smith et al., (1989) discovered the intact skeleton of a 20m long, partially buried, blue or fin whale. Subsequently, the investigators reported on their discovery and its significance in more detail (see Figure 18) (Allison et al., 1991). They concluded that the skeleton was actually 18m long, and that in life the blue or fin whale would have been 21m long, approaching the size of the baleen whale fossil at Lompoc. Their investigations suggested that the carcass was deposited at least three years, but no more than 34 years, prior to their discovery of it. Completely skeletonized, the remains were lying in a straight line, the ventral (underneath) surface uppermost, as evidenced by the relative positions of the upper and lower jawbones. In other words, this dead whale settled on the sea floor on its back, the exact same position in which the Lompoc whale was found. The ribs lay symmetrically about the vertebral column, so there was no post-mortem twisting of the carcass. The vertebral column was slightly sinuous, and individual elements had been separated slightly, although the original relative position was largely maintained. At least one of the more posterior vertebrae was out of sequence and lay to one side of the main column (see Figure 18 again). Immediately posterior to the exposed ribs, the vertebrae were disordered with some lying end up.

Allison et al. (1991) also reported that many of the bones were corroded, although the degree of damage was variable. For example, the outer layer of cancellous bone was absent from portions of ribs extending above the sediment-water interface, but the buried parts of the ribs were generally undamaged. Corrosion of vertebrae was more extensive and removal of cancellous bone widespread, especially above the sediment-water interface. Bones lying below the sediment surface, however, were found to be heavily stained by black iron sulphides, with iron precipitation concentrated *within* some bones as a concentric layer approximately 2cm from the outer surface, and the sulphides occurring as fine layers on the inner surfaces of internal bone structures and as infillings of small tubes in the bone. Deterioration was more advanced in bones with a high profile, such as vertebrae and jawbones.

This whale carcass found on the sea floor of the Santa Catalina Basin was at a depth of 1240m where the water pressure is 125atm, the water temperature 4.1°C, and the dissolved oxygen concentration only about 8% of normal marine surface waters. As a result of extensive discussion and appropriate calculations, Allison et al. (1991) concluded that when the whale died it must have sunk very quickly, before the gases generated by decaying flesh could fill the carcass and make it buoyant enough to float and thereby disarticulate. Once it sank, the increased hydrostatic pressure at greater depth presumably prevented the whale carcass from floating, by decreasing the gas volume and increasing the gas solubility, while promoting increased levels of preservation. Since disruption of the skeleton was minimal, the whale carcass must have quickly settled on its back on the sea floor with its soft tissue intact, disruption of some of the bones occurring as the skeleton settled following decay and removal of the supportive soft parts. But even the bones of the carcass had been scavenged.

Another important detail is that a 21m long whale carcass containing approximately 48 tonnes of soft tissue was a food resource that attracted scavengers, while the rotting flesh, and flesh and bone oils, created a reducing environment for chemoautotrophic animals and microbes. Thus Allison, Smith and their colleagues found many of the larger whale bones and nearby patches of sediment covered with white microbial mats composed of large filaments of sulphur-oxidizing bacteria. Two species of clams, numbering more than 50 living individuals and hundreds of shells ranging from 2 to 10cm in length, were found nestled in bone crevices and dotting the surrounding sediments where they lived and hid. Mussels, limpets, and snails were abundant on exposed bone surfaces with densities of more than 100 per square meter, while bivalves and worms were found in small cavities in the skeleton.

The final relevant consideration, if this partially-buried whale skeleton in the present is to be compared with the Lompoc whale fossil as a supposed analog for its burial and fossilisation under slow and gradual conditions, is the depositional environment of the Santa Catalina Basin. Approximately 80% of the sediment is clay of terrigenous origin, the remainder being biogenic. The estimated rate of deposition, based on studies of sediment cores, is 6–11cm/1,000yr, which when recalculated in terms of the actual deposition of the wet, uncompacted sediment that is accumulating on the sea floor (for example, around the whale carcass) translated into a rate of 40–73cm/1,000yr.

Now for Allison et al. (1991) to claim that this whale skeleton was intact and not disarticulated—while true in a relative sense when compared to other whales that die, float, rot, and fall apart in the oceans today—is nevertheless misleading. Their map of the skeleton (see Figure 18 again) clearly shows that not only have the vertebrae been moved, but a long portion of the lower jawbone had been separated from its socket joint and twisted. A useful comparison can also be made with the skeleton of the 21.3m long fin whale on display in the National History Museum of Los Angeles County, since Allison et al. suggested that this carcass they found was that of a 21m long fin whale (or a blue whale). Allison et al.'s drawing of the skeleton does not of course provide the third dimension, nor do they give details in their description, so we can only estimate the "thickness" of the skeleton, for example, in the crucial head area. The thickness of the combined skull and lower jawbone of the museum's 21.3m long fin whale is approximately 1.8m (see Figure 19), so the original thickness of the whale carcass in the head area must have been about the same. However, given the likelihood of collapse and "flattening" of the whale's skeleton as the soft

Figure 19. View of the skull and lower jawbone of the fin whale on display in the Natural History Museum of Los Angeles County. This whale is similar to the Lompoc baleen whale and this photograph gives some perspective to the thickness of diatomite that would be needed to bury the whale skeleton.

tissue rotted and was removed, the thickness of the skeleton in the head-lower jawbone area, may have been reduced to about 1 m. The point of all of this is, that even allowing for the most optimistic deposition rate of 73 cm/1,000 yr of wet, uncompacted sediment, it would take more than 1,350 years to completely cover the whale skeleton (and much longer if compaction occurred concurrently), during which time continued corrosion of the bones, microbial activity and the work of the scavengers must surely bring about progressive disintegration of the skeleton, particularly above the sediment-water interface. In other words, the rate of burial is far too slow to fossilize the complete intact skeleton, and therefore the short term preservation and partial burial of this Santa Catalina Basin whale carcass cannot be the slow and gradual analog for the processes that fossilized the Lompoc whale.

However, there is other compelling evidence that also mandates this conclusion. First, the Lompoc whale was buried in diatomite with negligible terrigenous clay content, whereas the Santa Catalina whale is being buried in a sediment consisting of 80% terrigenous clay. Second, if the Lompoc whale was buried on a sea floor environment after the manner of the Santa Catalina whale, then where are the fossilized clams, mussels, limpets, snails, bivalves, worms, and bacteria that should have been buried with the whale skeleton? To the contrary, in the Lompoc diatomite we find cod, herring, pipefish, sea lions, and birds, *none* of which are sea floor bottom dwellers, unlike the Santa Catalina assemblage which are all bottom dwellers. Indeed, the Lompoc assemblage represents a catastrophically buried death assemblage, *not* the progressive burial of a habitat (even if it's one associated with a whale skeleton), as is the case in the Santa Catalina Basin. Third, there was no corrosion of the fossilized Lompoc whale bones reported by the excavators, and we definitely saw no corrosion of the ulna, radius, and humerus of the right flipper when we inspected them in the basement of the museum. There were iron oxides around the bones and staining the diatomite when the bones were uncovered, as is evident in photographs taken at the time (the darker patches in Figures 7, 8, and 9), but this appears to have been the result of chemical reactions surrounding the bones after deposition of the surrounding diatomite, that is, after burial of the whale carcass, because the bone surfaces are intact (non-corroded). Thus the Lompoc whale must have been catastrophically buried, the carcass having been entombed whole before scavengers could attack the bones, unlike the slow and gradual burial of the Santa Catalina whale carcass that has left the bones corroded.

Thus present processes operating in the Guaymas and Santa Catalina Basins cannot explain either deposition of the Lompoc diatomite or fossilization of the Lompoc whale respectively—the present is not the key to the past. Given that the evidence is only consistent with catastrophic burial of the Lompoc whale, this implies catastrophic deposition of the Lompoc diatomite. While not polystrate in a vertical sense, as misunderstood thus far by many creationists, this Lompoc whale is nevertheless still polystrate in a horizontal sense because the fossilized whale bones "pass through" many diatomite laminae. What requires explanation, therefore, is how the diatomite was deposited catastrophically, complete with laminae.

Reproduction of diatoms is by division, which occurs at such a rate that it is estimated that one diatom could produce 10^{10} (10 billion) descendants in 30 days under the most favorable conditions (*Encyclopaedia Britannica*). The key ingredient for diatom growth is, of course, an abundant supply of silica in the water, which the diatoms extract in order to form their frustules, so what is required is a continuous sustained supply of copious quantities of dissolved silica. In conventional thinking the chief source of silica in ocean waters is from river inflow carrying silica from weathering and erosion of the continents. However, the major likely source under catastrophic conditions would be volcanic activity, discounted in conventional uniformitarian thinking (Calvert, 1966, pp. 592–593). Yet Bramlette reported:

> Pyroclastic material occurs in much of the Monterey Formation. It consists of unaltered vitric ash or tuff beds, partially altered tuffaceous beds, and the more thoroughly altered tuffaceous material known as bentonite, composed largely of the clay mineral montmorillonite (Bramlette, 1946, p. 22).
>
> Numerous beds of nearly pure volcanic ash occur in the Monterey Formation … Most of the beds are from less than an inch to a few inches, or at most a few feet, in thickness, though in a few areas there are some of much greater thickness (Bramlette, p. 23).

Furthermore, volcanic ash beds do occur in the Lompoc area (Figure 3), and Bramlette reported the composition of one of these vitric ash beds, "one of the most nearly pure and fresh," which was clearly rhyolitic, with a silica content of 72.11% (Bramlette, p. 24). Additionally, there is always the possibility that the chert beds with the diatomite are largely composed of silica directly precipitated from volcanic waters. Thus a link between the Lompoc diatomite beds and volcanic activity can be firmly established.

In the biblical framework of earth history the Monterey Formation and its diatomite beds would be regarded by most as being deposited during the post-Flood era in a local catastrophic event. Prodigious outpourings of silica-rich volcanic fluids would have provided ideal conditions for gigantic blooms of diatoms to flourish in the shallow waters adjacent to the then western U.S. coastline. To sustain maximum diatom productivity and ensure repeated growth of gigantic blooms to supply the enormous quantity of frustules needed to make the diatomite beds, it is feasible to envisage onshore currents sweeping the diatoms away from the area of the volcanic activity, driven in part by the volcanic disturbance. Under these conditions it is not surprising that various fish and whales were swept along in such currents of water choked with diatoms and were thus subsequently entombed catastrophically as a death assemblage in the mass of frustules as they settled out. It should be noted that it has been demonstrated, both in a recent small catastrophic event (Austin, 1986), and in the laboratory (Berthault, 1988, 1990; Julien, Lan, & Berthault, 1994), how a continuous fast-flowing current carrying a heterogranular mixture of sediments will invariably produce a laminated deposit, even with the different grain sizes alternating between adjacent laminae. Since it is postulated that these Monterey Formation diatomites and associated sediments were deposited in a post-Flood local catastrophe, the elapsed time for accumulation of the whole sequence is not restricted to days or weeks within the Flood year, but could have been in the order of several years, which allows time for the production of the incredible number of diatoms whose frustules now compose the thick diatomite and diatomaceous strata.

Conclusions

Contrary to some reports that have circulated, the 80–90 ft (24–27 m) long fossilized baleen whale found in April 1976 in an inclined position in a diatomite unit in the Miguelito Mine at Lompoc, California, was **not** buried while standing on its tail. An on-site investigation has revealed that the diatomite unit which entombed the whale is also inclined at the same angle, the whale having been buried in the diatomite while both were in the horizontal position, and subsequent earth movements having tilted both. Nevertheless, this whale fossil still bears testimony to its catastrophic burial, and thus the catastrophic deposition of the enclosing diatomite.

The current uniformitarian (slow and gradual) model for diatomite deposition, as seen in the Guaymas Basin of the Gulf of California, is not capable of explaining the purity of the Lompoc diatomite, nor is the gradual burial of a whale carcass found in the Santa Catalina Basin an analog for fossilization of the Lompoc whale. Not only is the Santa Catalina whale carcass being buried in a non comparable type of sediment (terrigenous clay instead of diatomite), but the deposition rate is too slow to avoid corrosion and scavenging of the bones, both of which are absent from the Lompoc whale bones. Indeed, the fish, sea lions, birds, and other whales fossilized in the diatomite with the baleen whale at Lompoc represent a death assemblage totally different from the habitat assemblage of clams, mussels, limpets, bivalves, and worms being slowly buried in clay with the Santa Catalina whale.

Only a catastrophic model is consistent with all the evidence. The demonstrated association of rhyolitic volcanism with the diatomites of the Monterey Formation is consistent with prodigious outpourings of silica-rich volcanic waters providing the ideal conditions for sustaining maximum diatom productivity in gigantic blooms. Rapidly carried away by water currents from the area of volcanic activity where the diatoms flourished, the mass of diatom frustules choked other marine life and catastrophically buried it. As a post-Flood local catastrophe there was ample time available for the sustained diatom production required by the volume of the resultant diatomite beds.

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