

Winter 2014

## DOHENY 20,000,000 YEARS AGO

Contributed by DSBI Member, Bob Deshotels

### The Geology around Doheny

In the summer 2014 edition of the South Swell, Rodger More discussed the geology around the Capistrano Valley. The creamy white sandstone cliffs next to Doheny Beach were beginning to be deposited 10 million years ago. The nearby cliff at the Dana Point Headlands has a sudden transition between the Capistrano sandstone and the brownish San Onofre breccia. Breccia (pronounced bretch'-yuh) is composed of angular broken rocks from an earlier era amalgamated with sand and clay. The sharp border between the two types of formation indicates the inactive Dana Cove fault, where the San Onofre Formation was shoved up against the recent Capistrano Formation. The powerful events that created the broken rocks and the distinct border were described by Rodger in the last edition. The San Onofre breccia seen at the point of Dana Point has layers that are 20 million years old. What do scientists know about Doheny 20 million years ago?

[Note that although scientists generally agree about geological history, there is a long-running trend for scientists to think they know more than they really do. Understanding that science changes, I only vouch that the following is the latest scientific consensus.]

### Doheny Beach 20,000,000 years ago

Doheny looked different 20 million years ago. The land we now call Doheny Beach was about 400 miles south of where it is now, and underwater. This change is due to the shifting crust of the earth.

### How did Doheny get here?

For as long as there has been a geological record, the surface of the earth has been shifting. The crust of the earth exists in sections called plates. One of the best known is the Pacific Plate, which currently meets the North American Plate at the San Andreas Fault. The Pacific Plate has been moving northwest relative to the North American Plate at an average rate of about 1.4 inches per year. Although this is slower than your fingernails grow, after millions of years the distance adds up. Twenty million years ago, the land that we now call Doheny Beach was located about 400 miles south, in the middle of what is now Baja California. However, Baja California had not yet formed; it was it was underwater offshore from the west coast of Mexico. It was the slow push of the Pacific Plate, moving atop the North American Plate, that caused the coast to rise above sea level, creating the coastal mountain ranges and the peninsula over millions of years. The coast on which Doheny sits continues to rise today and move north. In the past 10 years, the Pacific Plate has raised the nearby coast about a half-inch, which is about equal to the rise in ocean level over the same period. Geologists predict that in another 20-million years, Doheny will be slowly skidding past San Francisco, heading toward Alaska.

### “Old” is a relative term, especially in geology



There is fossil evidence of simple animals that existed 600 million years ago. Since the time that animal life first developed in the oceans, continents have shifted, the oceans have become saltier, carbon dioxide levels and temperatures have fluctuated. There

have been several meteor impacts and mass extinctions. The greatest disaster was the Permian-Triassic Extinction, perhaps caused by one or more asteroid impacts 252 million years ago. In this extinction, 96% of all marine species were eliminated (including the Trilobites), along with 70% of the land vertebrates. Despite the big changes, some of the same types of creatures that were living in the ocean 600 million years ago can still be seen today along our coast: sponges, corals, anemones, jellyfish, and segmented worms.

### **The rest of the world 20,000,000 years ago**

Twenty million years ago, in the early Miocene epoch, the continents were located in their present relative positions, except that North America was still separated from South



America. The present connection across Central America had not yet developed. However, the undersea portion of Central America was beginning to rise and the mountains of North America were increasing in altitude. The world climate was in transition from the previous warm and humid epoch to a cooler and drier epoch more like the present. Based on analysis of ocean sediments and fossils, the global carbon dioxide (CO<sub>2</sub>) level in the atmosphere was about 1,000 parts-per-million, and falling. For comparison, the present CO<sub>2</sub> level has

recently risen to 280 ppm.

#### **The Miocene Coast**

As the ocean temperatures declined, the climate became drier because the air above the oceans contained less humidity. Ice caps developed in Antarctica and Greenland, but not yet across Siberia, Alaska and Canada.

### **Life on nearby land 20,000,000 years ago**

When Doheny Beach was still underwater in the area that would later become Baja California, the nearest land was the west coast of Mexico. Doheny was riding the Pacific Plate northward, past the coastal mountains of the west coast of Mexico. As you can see in the map, there was not yet a Baja California. In the nearby warm and lush climate on land, life was similar to what we would find today on the warm areas of the U.S. coast, with a few exceptions. Carnivores and hoofed animals had not evolved into present forms. Land animals going through major evolution included cats, wolves, weasels, otters, bears, horses, bison, deer, and antelope.

AND, one exciting thing was happening! Like us today (we surfers and ocean swimmers), some warm-blooded animals had decided to return to the ocean.

### **Sea life in Doheny 20,000,000 years ago**

In the water around Doheny, some land mammals were in the middle of reinventing themselves as sea mammals. Mammals that were adapting to the sea included seals, sea lions, manatees, whales, and dolphins. Other sea mammals developed at the same time, but later vanished into extinction.

It is theorized that **seals, sea lions, and walruses** developed from an Enaliactos, a bear-like or badger-like land mammal approximately 23 million years ago. The natural history museums in Los Angeles and San Diego each display fossils of a creature believed to be one in the transition known as Allodesmus. With big eyes and large flippers, it seems to have been adapted to deep diving. The fossils date to around 15 million years ago; one found in

Orange County. Although we do not know exactly what seal ancestors were swimming near Doheny before Allodesmus, we can guess they were still adapting to ocean life.

**Allodesmus -- Ancestral Seal/Sea Lion/Walrus**



**Manatees**, sometimes called sea cows, look like walruses or whales, but they have very different ancestors. Actually, the closest modern relatives of the manatees are elephants and hyraxes. The hyrax is a small (up to 5 pounds), vegetarian, land-dweller that looks like a woodchuck at first glance. Obviously, a lot of evolutionary change has occurred in this branch of mammals. Fossils from Jamaica show that about 50 million years ago, the earliest relatives of the manatee appeared, the Prorastomus and Pezosiren. These semi-aquatic animals looked similar to a pig, ate soft plants, and had a heavy skeleton to assist with diving. By 20 million years ago, the ancestors of manatees had become fully aquatic with front flippers, no visible hind feet, and a large tail for swimming and diving. The LA Natural History Museum has fossils of two 13 million year-old Jordan Sea Cows, which became extinct a little after the fossils were formed. Starting about 20 million years ago, the Jordan sea cow was replaced by the larger Steller's sea cow, which was plentiful in shallow water along the Pacific coast when discovered by Europeans in 1741. The Steller's sea cow was up to 30 feet long with chubby front flippers that made it look like a blubber-filled teddy bear without fur. Unfortunately, this friendly, slow-moving vegetarian was a failure at avoiding humans. Twenty eight-years after first becoming known to Russian whalers, the last Steller's sea cow was butchered for its meat and leather.

**Evolution of the Pacific Manatee**



← Prorastomus



Jordan Sea Cows, Adult and Young ->

**“Desmostylia”** is the scientific name for a mysterious sea mammal known only from two fossils found in Orange County, dating from 10 million to 15 million years ago. The fossil found in Aliso Viejo shows that this area was



under the sea at the time the fossil formed. The Desmostylia looked like a hippo, but was related to elephants and manatees. Nobody is sure whether they were ancestors or descendants of elephants or manatees. The exhibit in the San Diego Natural History Museum mentions that maybe Desmostylia was wiped-out by the chief predator of ocean mammals at the time, the megamouth shark. [See article on the current day megamouth shark in the Winter 2012 South Swell.]

**Whales** began evolving from a mammal that lived near fresh water about 50 million years ago. The original ancestor of hippos and whales was related to deer (an even-toed ungulate), but looked like a small pig. This plant-eating animal waded in fresh water, and apparently jumped into deep water when threatened from land. It had several adaptations for survival in water, including thick skin and heavy bones (to allow it to rest below the water without floating) similar to modern hippos. The head had a whale-like skull and teeth, but no blowhole. Further adaptations to life in water changed this deer-like animal into a meat-eater, with eyes that looked upward like a crocodile, and the ability to swim like an otter. After continued adaptations for better swimming in an ocean environment, protocetids, the first whales, appeared in many different forms around 48 million years ago. The protocetids had blowholes about halfway between their nose and top of the head. They had front and rear flippers, which still had residual hooves. By 41 million years ago, the rear flippers and hip bones were disappearing. By 20 million years ago, toothed whales had begun to develop the



melon-shaped organ in their foreheads that improved underwater hearing. Baleen whales, who strained big gulps of the water through the brush-like baleen in their mouths, began to appear. Some of the modern whales that we recognize today, such as the sperm whale (fossil) in the Los Angeles Museum of Natural History,

seem to have developed about 15 million years ago. Although ancient ***Protocetid: 48 - 35 million years ago*** whales of 20 million years ago had most of the characteristics of modern whales, there is not enough fossil evidence to show all of the steps in the final development of modern whales. Around 20 million years ago, whales had become divided into many types of toothed whales and baleen whales, most of which became extinct a few million years ago.



**Squalodon (toothed whale) - 33 to 14 million years ago**



### **Cetatherium (baleen whale) – about 15 million years ago**

**Dolphins** are part of the toothed whale family. Dolphins, including porpoises, developed from toothed whales around 20 million years ago. An exhibit at the Los Angeles Museum of Natural History shows that beginning 16.3 million years ago, dolphins developed an asymmetrical skull, necessary for the ability to whistle and chirp, which allowed them to navigate by echolocation.

### **Dolphin Echolocation -- Development of the Skull**

Zoologists recognize 87 types of whales in the world today. Modern toothed whales that swim occasionally past Doheny include sperm whales, orcas, false killer whales, and pilot whales, with regular sightings of several types of dolphins. Baleen whales that commonly visit near Doheny every year include gray whales, blue whales, and minke whales, with occasional humpback whales, sei whales, and fin whales.

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