Our Ocean Backyard — *Santa Cruz Sentinel* columns by Gary Griggs, Director, Institute of Marine Sciences, UC Santa Cruz.

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Ocean drilling–asteroids, mass extinctions and the Mediterranean

What began as a far fetched idea 50 years ago, drilling a hole into the seafloor from a floating vessel, was successful and soon opened up an exciting new era of ocean exploration which continues today. The Ocean Drilling Program, by obtaining long cores of sediment and ancient rock from the floors of the world's oceans, has been making discoveries that have challenged old ideas, and brought entirely new concepts to light. Drill ships have evolved and become more sophisticated, enabling scientists to drill in greater water depths and progressively deeper into the seafloor. Hundreds of cores have been obtained over the past 4 decades, in water over 4 miles deep and penetrating as deep as 6000 feet into the ocean floor. Each voyage is normally 2 months long and typically involves dozens of scientists from universities around the world. The United States has provided much of the scientific leadership over the years, and scientists at UCSC have played major roles in organizing and leading the scientific drilling program.

What have we discovered as these voyages have continued to probe the deep ocean floor? Drilling in the Caribbean uncovered proof that an asteroid struck near the Yucatan peninsula 65 million years ago, and not only led to the extinction of 60 to 70% of all plant and animals species on earth, including 90% of all of the plankton in the ocean, but also led to the die out of the dinosaurs. An asteroid the size of Manhattan Island, traveling at about 45,000 miles per hour when it entered the Earth's atmosphere, struck the western Gulf of Mexico. The impact left a crater about 150 miles in diameter as it ejected particulate matter and gases into the atmosphere producing several months of global darkness, which has often been called "nuclear winter". The fossils preserved in the sea floor sediments suggest it may have taken 500,000 years for organisms to recover. We now also know that Chesapeake Bay was created by a similar impact about 35 million years ago.

When the drill ship first entered the Mediterranean Sea in 1970 and begin to bring sediment cores back onto the deck of the ship, scientists were astonished to find hundreds of feet of salt deposits beneath the sea floor. The minerals included gypsum and other salts commonly found when seawater completely evaporates. This presented some problems for oceanographers because the water where the cores were collected was about 6500 feet deep. How do you evaporate the entire

Mediterranean Sea? Dating the seafloor sediments revealed that the salts formed about 5-6 million years ago. The chief scientists on board pieced together a controversial new history for the Mediterranean to explain these bizarre salt deposits.

In order to have salt crystallize or precipitate out of seawater, you need evaporate the seawater such as happens today in tidal flats and tide pools. This required both cutting off inflow of seawater into the Mediterranean by raising the shallow sill at Gibraltar, creating a dam in effect, and also meant that the climate at the time must have been hot and dry enough to evaporate the water trapped in the basin. Over perhaps 1000 years the water progressively evaporated, leaving brackish salt ponds and lakes where hundreds of feet of salt were precipitated out.

Several hundred thousand years later, however, either the Straits of Gibraltar eroded or subsided, or the level of the Atlantic Ocean rose, and water flooded catastrophically back into the Mediterranean again. In a little more than a century, a flow equivalent to 1000 Niagara Falls poured back in and refilled the entire basin. While there are still some differences of opinion about exactly how this all happened, scientific drilling returned the cores that revealed this dramatic series of events that took place 5 to 6 million years ago.