

Homework Assignment 4: Due at the beginning of class 9/28/01

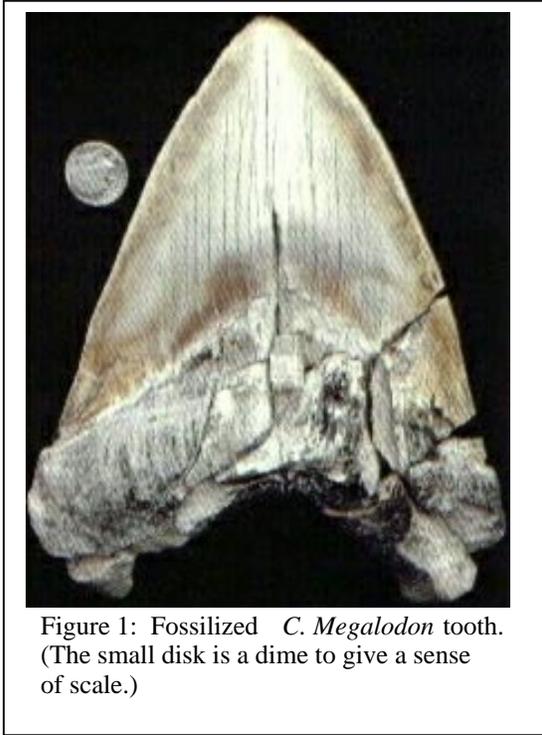


Figure 1: Fossilized *C. Megalodon* tooth. (The small disk is a dime to give a sense of scale.)

The “mega-tooth” shark (*Carcharodon megalodon*) is a giant shark that appears to have lived between 10 and 50 million years ago¹. Much of what we know about this shark comes from fossilized teeth (see Figures 1 and 2²) that have been found in coastal regions of Virginia, North Carolina, South Carolina, Georgia and Florida. Based on the size of these teeth, many scientists believe that *C. megalodon* was approximately the same size as a Greyhound bus³ (see Figure 3⁴).

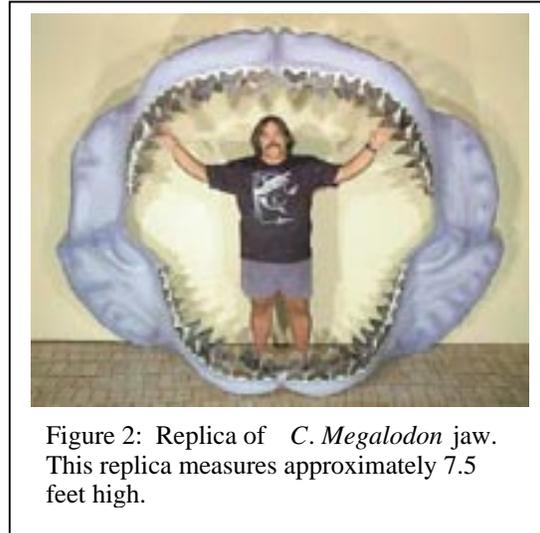


Figure 2: Replica of *C. Megalodon* jaw. This replica measures approximately 7.5 feet high.

One technique for dating fossils is potassium-40 radioisotope dating. In this technique, a sample of rock is chemically analyzed and the percentage of the rock that is potassium-40 determined. Typically for fresh sediment, 2.4% of the sediment is potassium-40. Potassium-40 is a radioactive isotope (half life = 1260 million years) of potassium that decays into the inert gas argon-40. (Questions 1, 2 and 3 refer to the information described here.)

1. What sort of function will do a good job of representing this situation? (Use the age of the rock as the independent variable and the percentage of potassium-40 as the dependent variable.) Be careful to explain your reasoning.

¹ Ellis, R. and McCosker, J. (eds.) (1995) “Great White Shark.” Palo Alto, CA: Stanford University Press.

² Image source for Figures 1 and 2: <http://sharksteeth.com>

³ Gottfried, M.D., L.J.V. Campagno & S.C. Bowman. (1996) Size and skeletal anatomy of the giant “Megatooth” shark *Carcharodon megalodon*. In A.P. Klimley and D.G. Ainley (eds.) *Great White Sharks: The Biology of Carcharodon carcharias*. San Diego, CA: Academic Press.

⁴ Image source: <http://hometown.aol.com/rjravalli/index5.html>

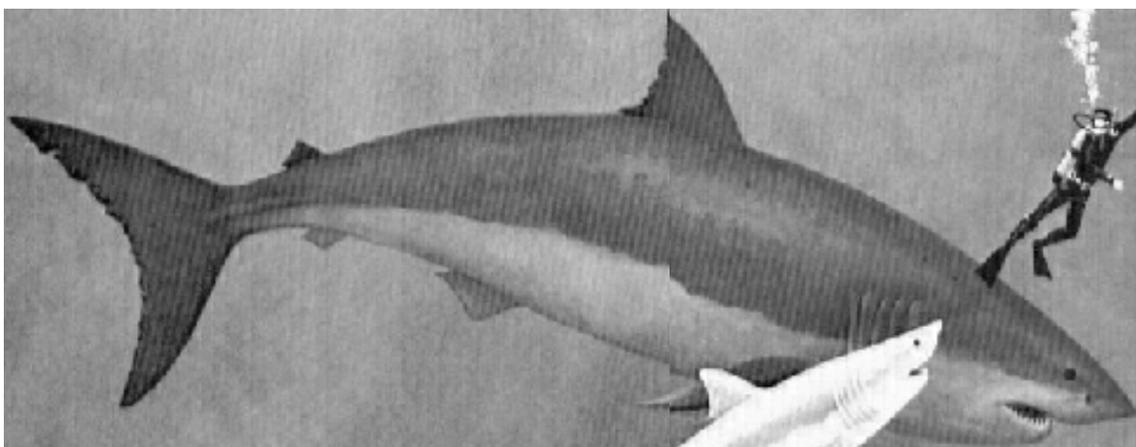


Figure 3: Artist's impression of *C. Megalodon*. A diver and a modern Great White shark are included to give a sense of scale.

2. Find an equation that will give the percentage of a rock sample that is potassium-40 as a function of the age of the rock sample.
3. A *C. megalodon* tooth was found in a quarry in North Carolina. Lab tests determined that 2.38683% of the sediment that the tooth was found was potassium-40. About how old does that make the tooth?



Figure 4: A whale shark and swimmer photographed off the coast of Honduras by underwater cameraman Ernie Bunch.

In recent years, several tantalizing accounts of gigantic sharks have been reported. Monster enthusiasts (some scientists among them) have taken these reports as possible evidence that a few specimens of *C. megalodon* may have survived to the present day.

One of the most credible reports was from the noted author of western novels Zane Grey. Fishing off the New Zealand coast in 1928, Grey reported seeing an "...enormous yellow and green shark with a square head, immense pectoral fins and a few white spots⁵." The creature that Grey saw is almost certainly a whale shark (*Rhincodon typus* - see Figure 4⁶). However, other sightings are not so easy to dismiss.

In 1959, Dr. W. Tschernezky published an analysis⁷ of *C. megalodon* teeth based on the amount of manganese dioxide deposited on the teeth. Two teeth were analyzed and the thickness of the layers of MnO₂ were 1.7mm and 3.7mm thick. Under typical conditions, MnO₂ is deposited on surfaces at a rate of somewhere between 0.15 and 1.4 mm per thousand years⁸. (Questions 3 and 4 use this information.)

3. Find two equations relating the thickness of MnO₂ to the age of the tooth: one that gives the thickness of MnO₂ on a tooth if MnO₂ is deposited at a rate of 0.15 mm per 1000 years, and a second equation that gives the thickness of MnO₂ on a tooth if MnO₂ is deposited at a rate of 1.4 mm per 1000 years.
4. Use your equations (along with the data for the two *C. megalodon* teeth analyzed by Dr. W. Tschernezky) to find a *range* of possible ages for each of the two megalodon teeth. You should clearly explain your reasoning on this problem.

⁵ Roesch, B.S. (1998) "A critical evaluation of the supposed contemporary existence of *Carcharodon megalodon*." *The Cryptozoology Review*, **3**(2): 14-24.

⁶ Image source: <http://www.whaleshark.org/>

⁷ Tschernezky, W. (1959) Age of *Carcharodon megalodon*? *Nature*, Volume 184: 1331-1332.

⁸ Roesch, B.S. (1998) "A critical evaluation of the supposed contemporary existence of *Carcharodon megalodon*." *The Cryptozoology Review*, **3**(2): 14-24.