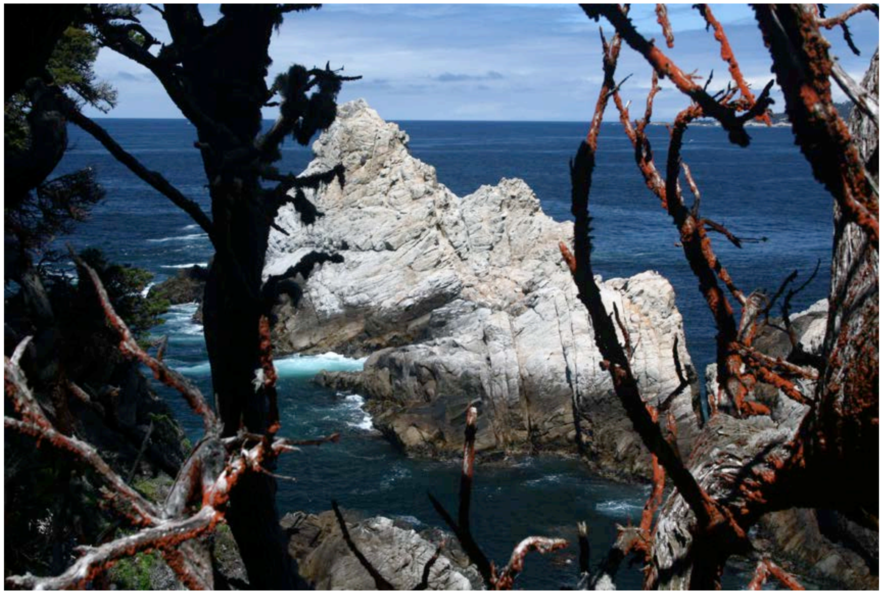
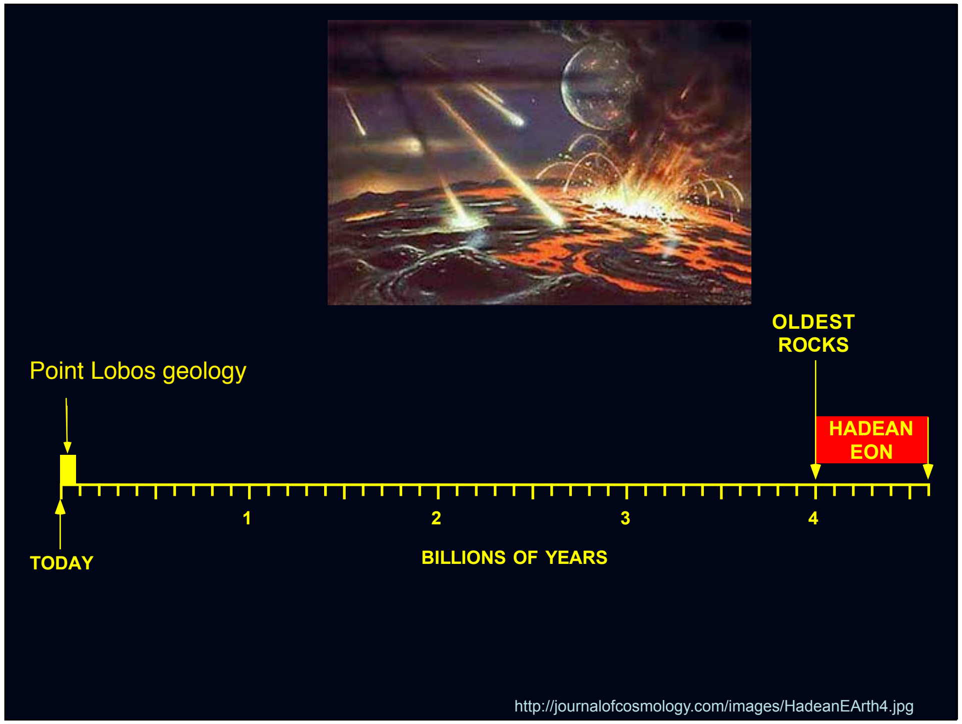
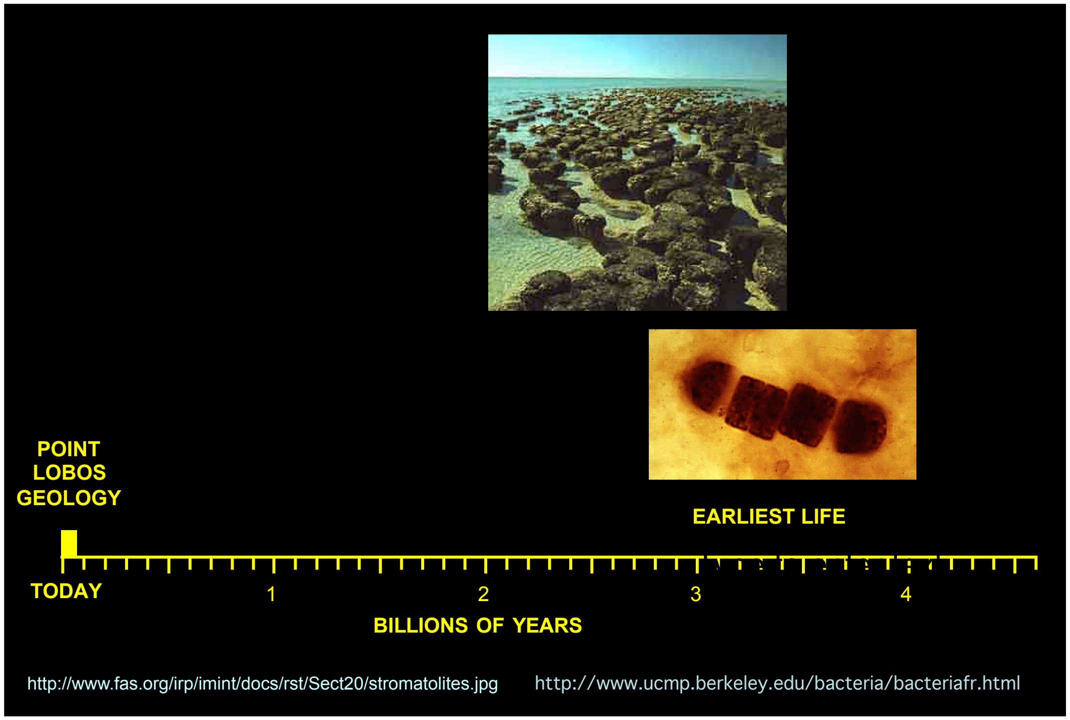
Point Lobos and geologic time

The rocks of Point Lobos carry much antiquity in terms of human experience. The oldest rock here, a granodiorite is about 80 million years ago. The sun has risen and set about 29 billion times since this rock crystallized from a molten magma. Yet, this is a but a small part of the time represented by the history of the earth.



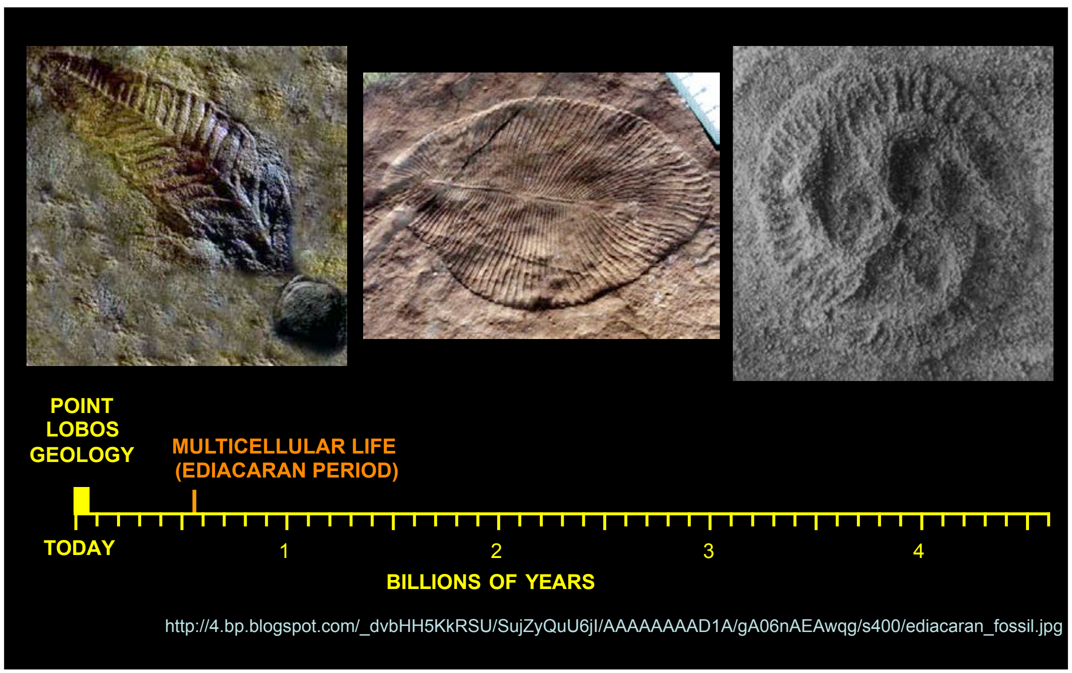


Analysis of radioactive isotopes of meteorites and rocks from the moon consistently indicate that the earth originated about 4.6 billion years ago as the solar nebula, a great rotating cloud of interstellar dust and gas, condensed to form our solar system. The oldest rocks found on our planet have been dated at about 4 billion years. Before that there is no record to indicate the early character of the planet. It is surmised that, during the Hadean Eon (prior to 4 billion years) the earth was bombarded by innumerable meteorites, comets and an occasional planetoid, one of which was large enough to blast a huge chunk of the primitive earth into orbit, where it remains today as the moon.

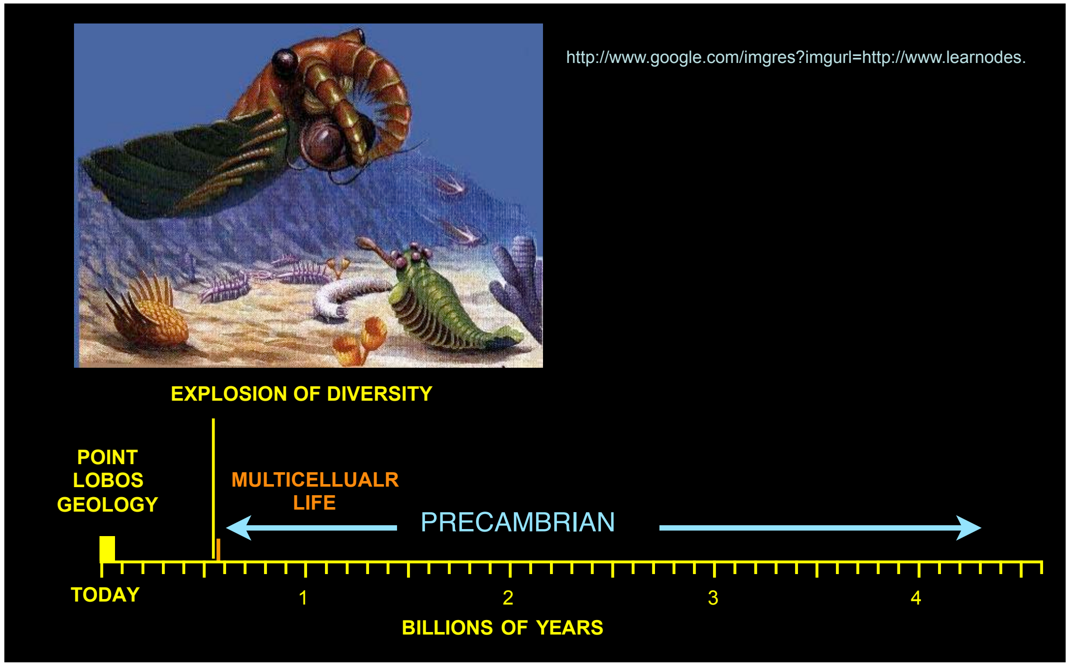


Life on our planet originated very early in its history, probably between 3.4 and 3.6 billion years ago. This early life consisted of simple forms, such as bacteria. These primitive organisms dominated the earth for about 3 billion years.

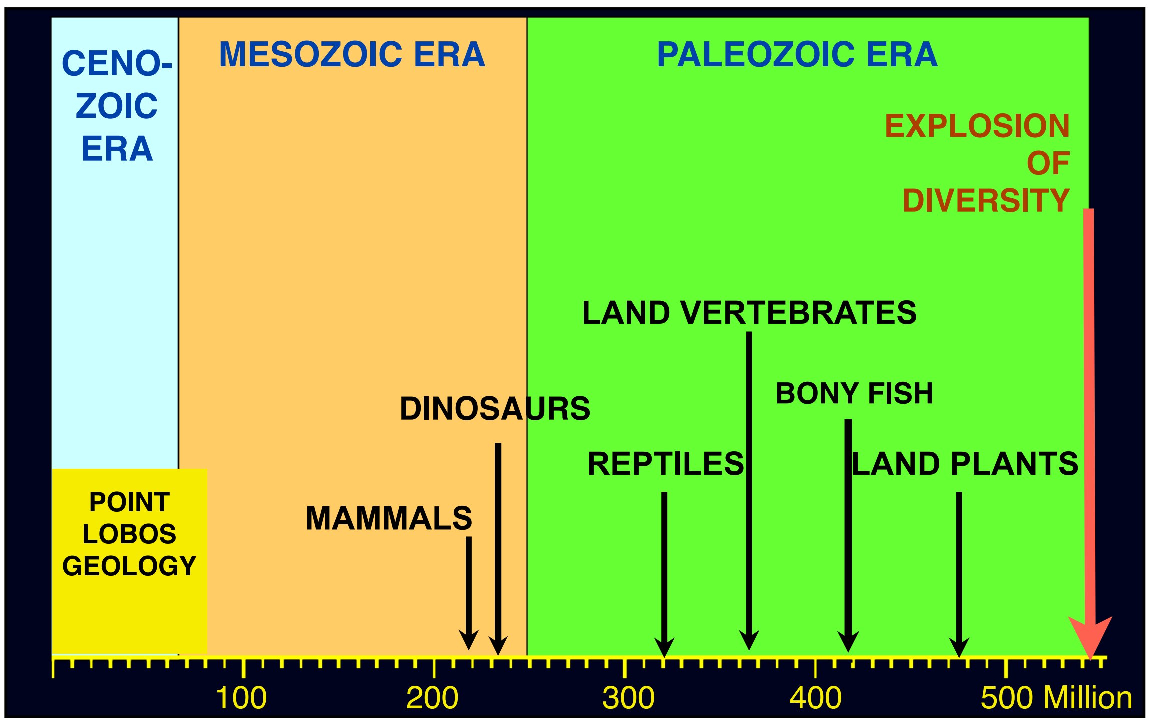
Significant amounts of free oxygen in the atmosphere and the oceans probably developed between 2 and 2.5 billion years ago, as the result of photosynthesis by blue-green bacteria. Strange mounds, called "stromatolites", thought to be produced by these organisms, abound in some sedimentary rocks of this age.



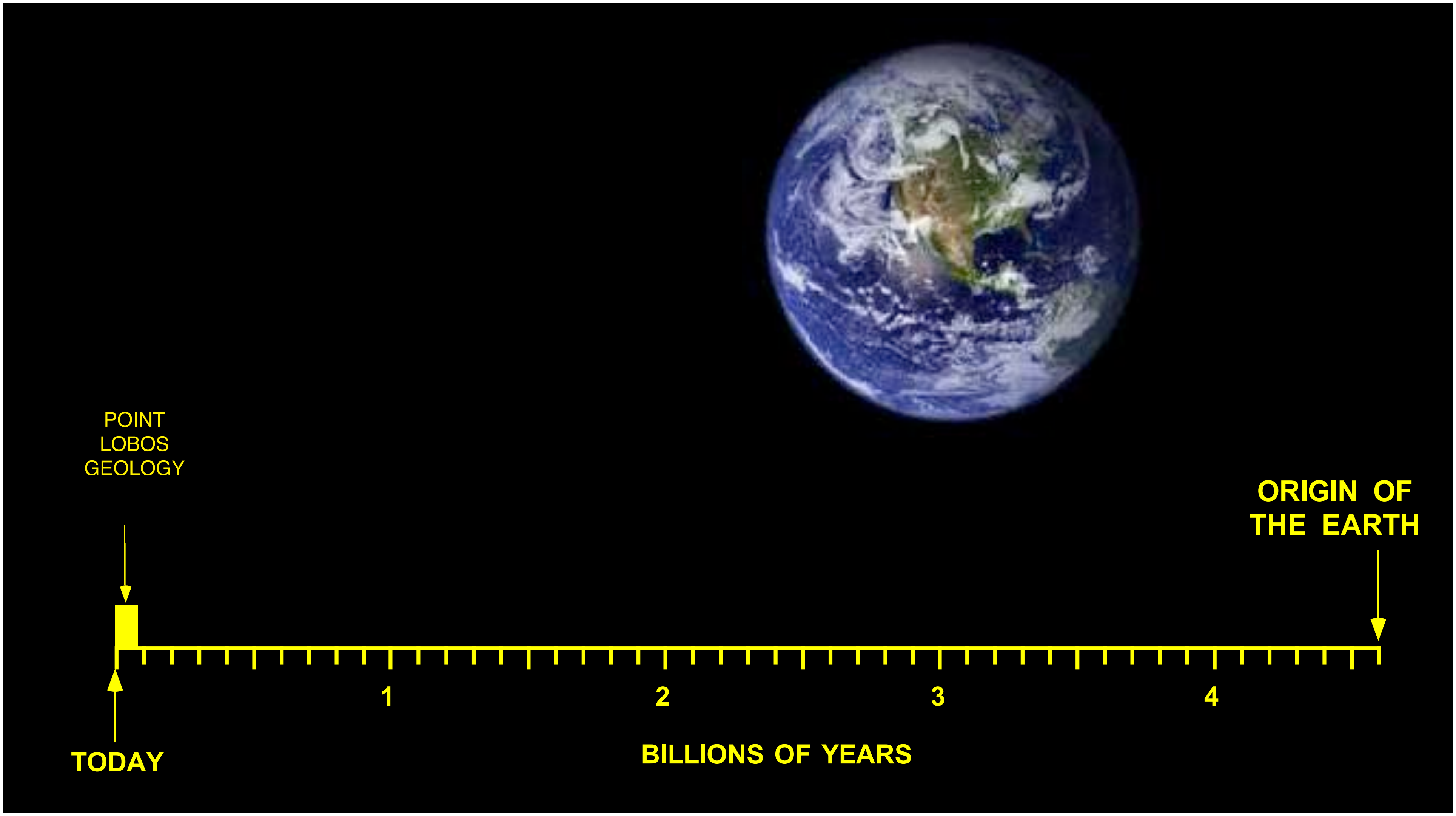
stromatolite



Larger, more complex organisms did not appear on the planet until about 600 million years ago. Rocks that range in age from 542-610 million years (in the Ediacaran Period) contain strange impressions that are generally accepted as representing the first multicellular organisms. These organisms disappeared 542 million years ago with the great explosion of biological diversity on the planet. Within some tens of millions of years virtually all of the phyla (major body plans) are present in the fossil record, and, to our knowledge, none has arisen since. The period of time preceding the explosion of diversity is commonly referred to as the "Precambrian".

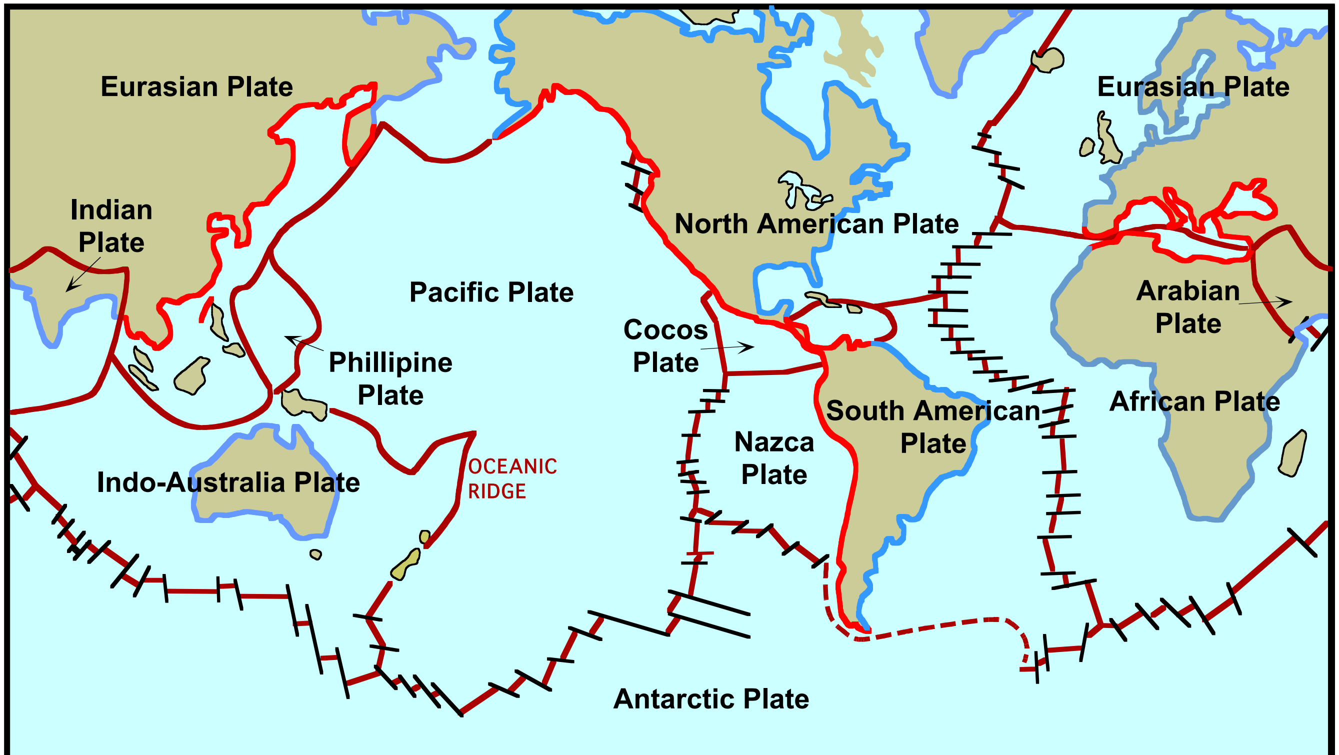


Still to appear on the scene were the first land plants, the first bony fishes, the first amphibians, the first insects, the first reptiles the dinosaurs and the earliest mammals. All of these would occur before the granodiorite at Point Lobos crystallized.



The relatively young age of the rocks at Point Lobos, compared to the age and history of the earth, is no accident. It derives from the structure of the earth's crust and the great plates that compose it (see link to **The Geologic Evolution of Point Lobos).**

The surface of the earth comprises a group of lithospheric plates (the lithosphere is the rigid outer shell of the earth) that are moving relative to one another. The interaction of these plates largely determines the character of the geology in all parts of the world. Continental margins, the boundary between continents and ocean basins may lie within a plate or coincide with boundaries between plates. Where a continental margin lies within a plate (as with the eastern margins of North and South America, most of Africa and all of Australia), it is considered "inactive" (passive). Sediment can accumulate on an inactive margin, but the geologic history tends to be fairly simple. In contrast, where a continental margin coincides with a plate boundary, the geological processes can be very complex. Rock is continually being created and destroyed, and the geologic history of the surviving rocks typically extends only a short time into the past.

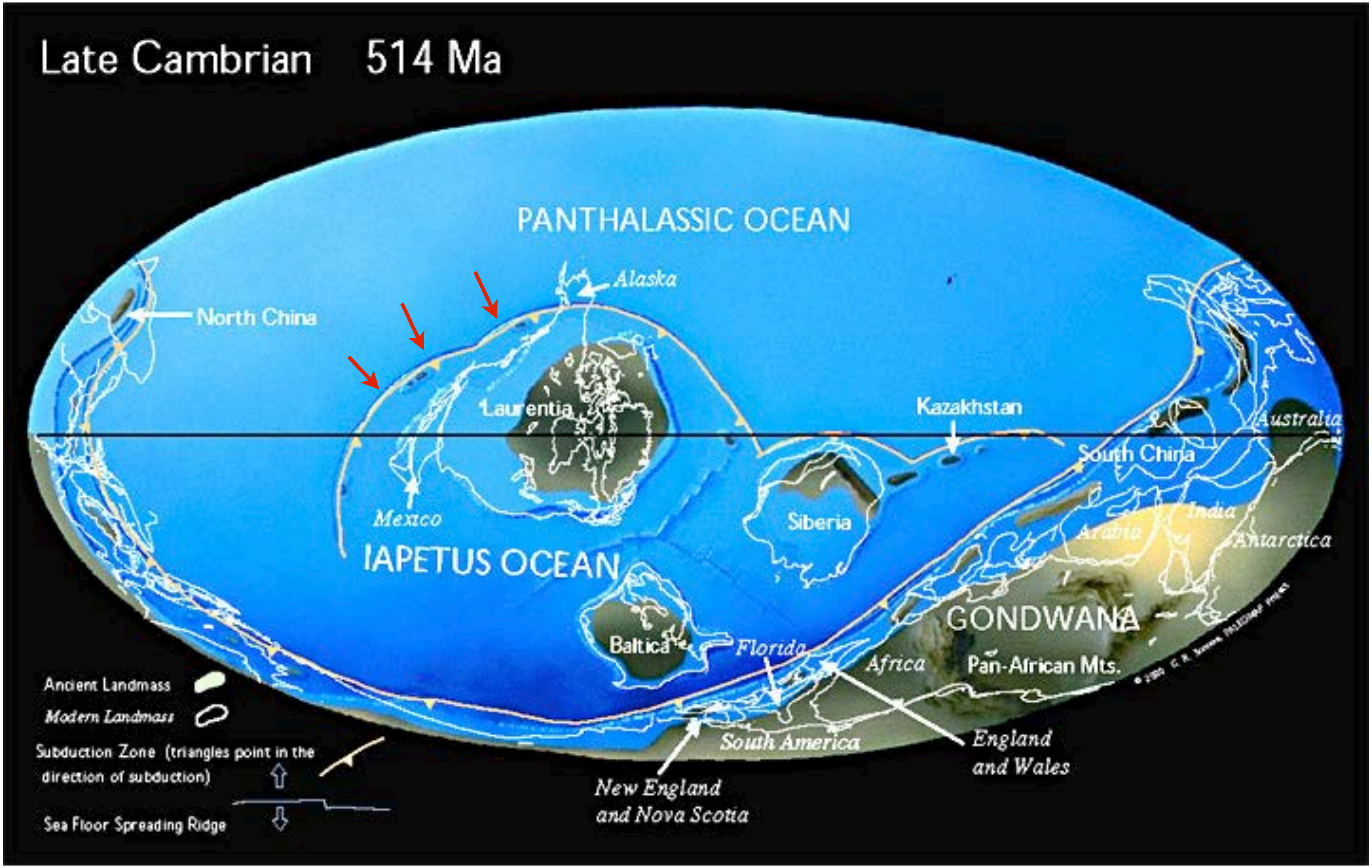


MAJOR LITHOSPHERIC PLATES OF THE WORLD

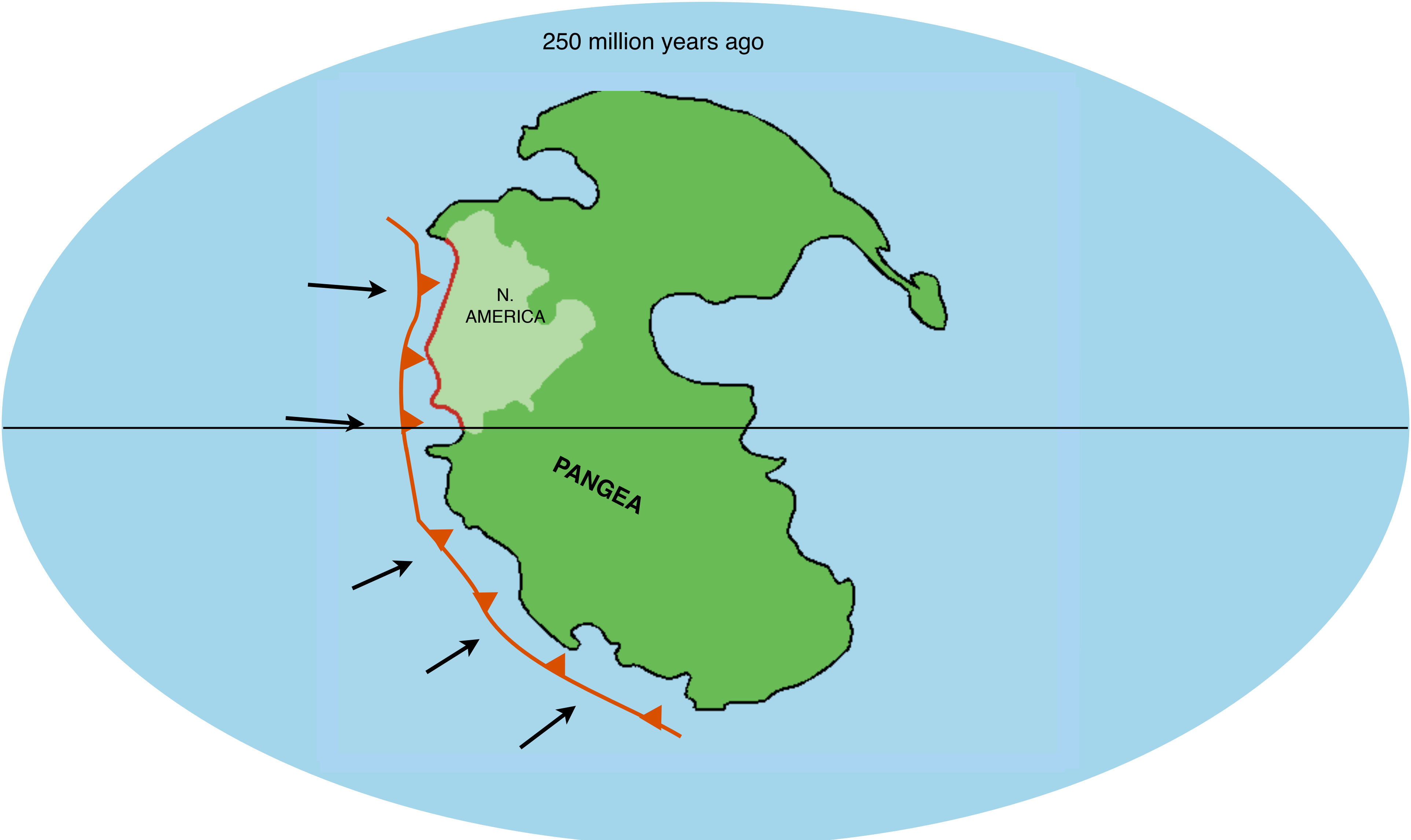
INACTIVE (PASSIVE) CONTINENTAL MARGINS (BLUE)
ACTIVE CONTINENTAL MARGINS (RED)

Modified from Tilling, Heller and Wright (1987) and Hamilton (1976)

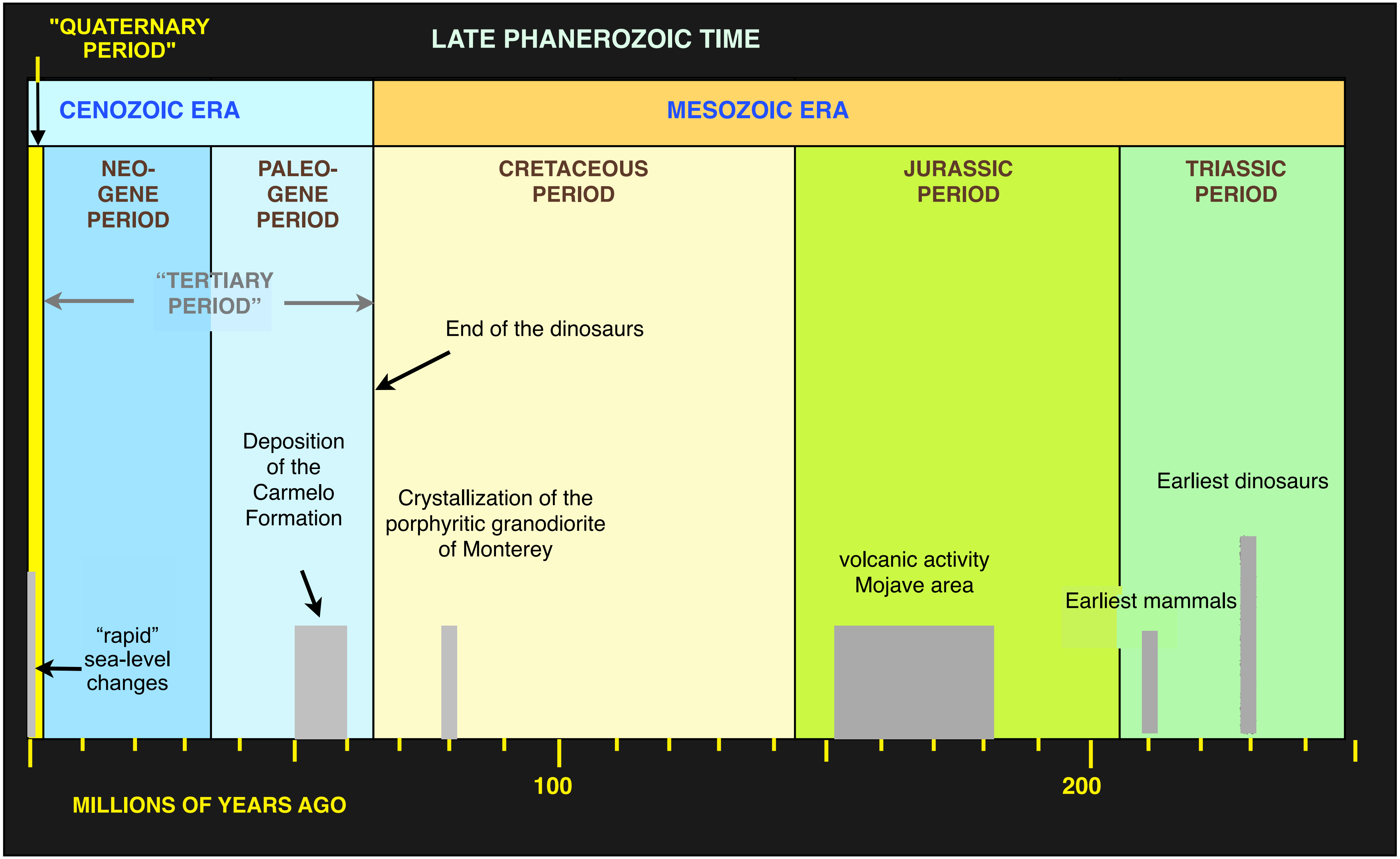
The western margin of North America has been the battleground between great plates of the earth's crust for hundreds of millions of years. Reconstructions by Scotese (see following figures) show that this margin coincided with a subduction zone as far back in time as the Cambrian Period, more than 500 million years ago). It continued to be an active margin of the supercontinent, Pangea, 250 million years ago, and after Pangea separated into the continents we know today, remained an active margin. The geology of California reflects this history.



Distribution of continents and oceans 514 million years ago. Red arrows added to indicate the relative motion of the oceanic crust. The western margin of what will become the North American Continent (Laurentia, red arrows) coincides with a plate boundary as it has through the entire Phanerozoic Eon. From: Plate tectonic maps and Continental drift animations by C. R. Scotese, PALEOMAP Project (www.scotese.com).

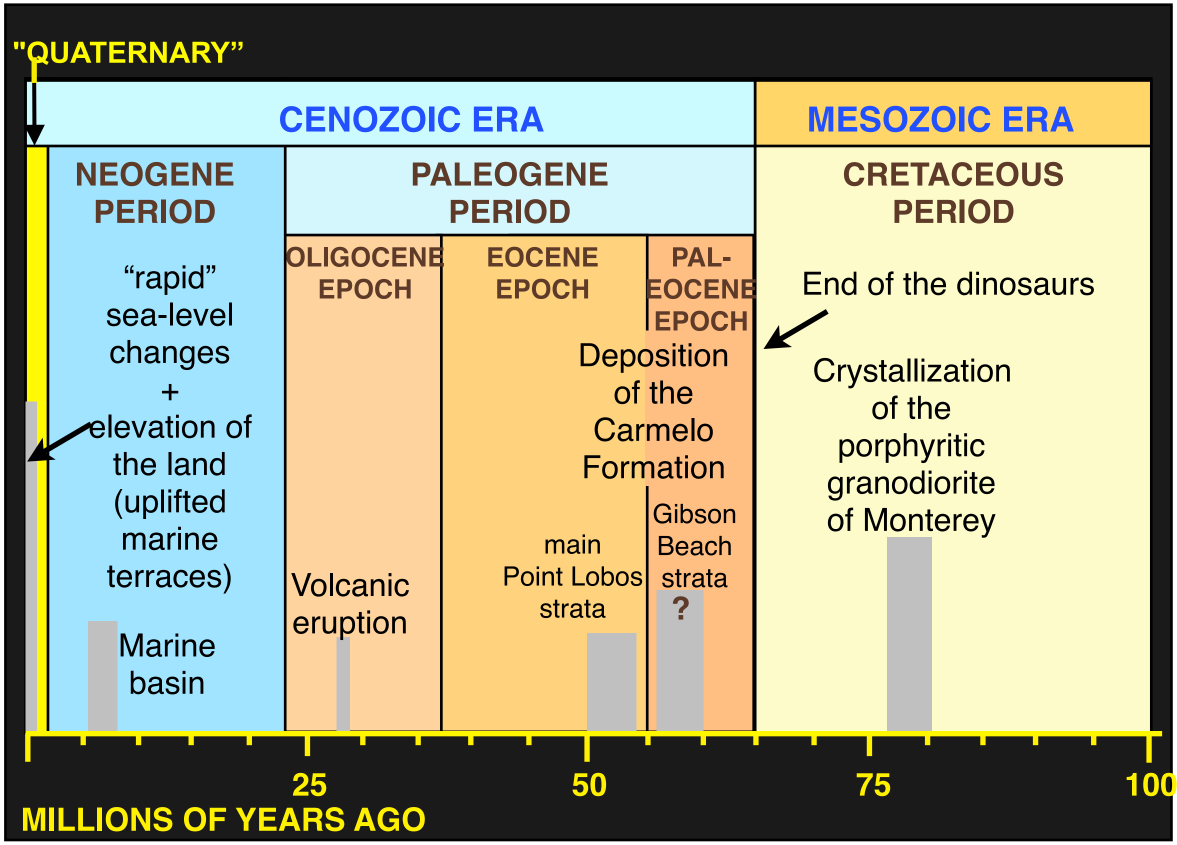


The super continent, Pangea , 250 million years ago (adapted from Scotese, 1997). The entire western margin (including the North American margin) is considered to coincide with a subduction Zone.



Most of the pebbles in the Carmelo Formation likely derived from volcanic rocks of Jurassic age in the Mojave region and other parts of southern California. Some of the pebbles in the Carmelo have been chemically linked to a Jurassic rock called the Sidewinder Volcanic series that crops out in the Mojave Desert. The Carmelo Formation accumulated in a submarine canyon off an ancient shoreline that existed then in Southern California, probably outboard of todays Mojave Desert (see section on "Assembling Point Lobos").

The geologic history of Point Lobos is largely confined to the last 80 or so million years, beginning with the crystallization of the porphyritic granodiorite of Monterey. The Carmelo Formation may have accumulated at 2 different times. The Gibson Beach strata contains fossils considered specific to the Paleocene Epoch, whereas the few fossils found in the main body of the Carmelo Formation at Point Lobos are indicative of deposition during the lower Eocene. Although Oligocene volcanic rocks are not present at Point Lobos, they crop out 1.5-2.5 miles to the northwest at either end of Carmel Beach. This "basaltic andesite" probably blanketed the area where Point Lobos is now when it erupted 27 million years ago.



The Miocene and Pliocene Epochs of the Neogene Period are not shown in the figure to the right; their boundary is placed at 5.332 million years ago. In the middle Miocene, the land in this area subsided and a large coastal marine embayment passed into a deep marine basin in which the diatomaceous shale of the Monterey Formation accumulated. Like the Oligocene volcanics, these diatomaceous shales must have covered the site of present-day Point Lobos in the fairly recent geologic past, but have been removed by erosion. A combination of sea-level change and elevation of the land, in the last few hundred thousand years, produced the physiographic stair-steps defined by the uplifted marine terraces here.

The final chapter to the story of the rocks at Point Lobos is written today as powerful storm waves change the shape of the coast within the time frame of human memory.

Ed Clifton
September, 2013