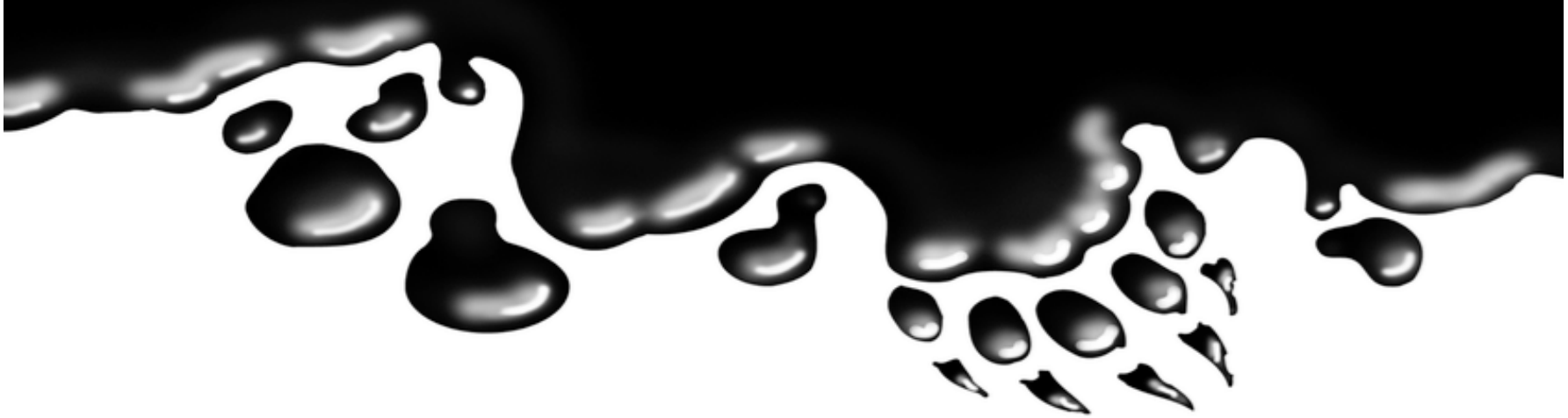
RETURN TO THE ICE AGE:
The La Brea Exploration Guide



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Pleistocene epoch → Last great Ice Age
Started 1.8 million years ago; ended 11,500 years ago

Geologic Time

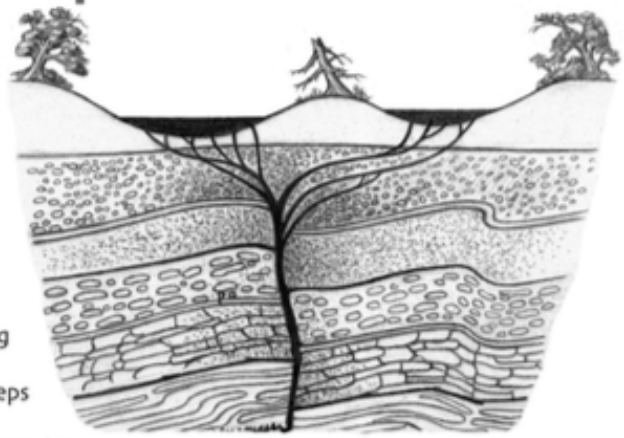
Era	Period	Epoch	Years Ago (Millions)
Cenozoic	Quaternary	Recent	0.01
		Pleistocene	1.8
	Tertiary	Pliocene	5
		Miocene	24
		Oligocene	38
		Eocene	54
		Paleocene	65
Mesozoic	Cretaceous		145
	Jurassic		210
	Triassic		250
Paleozoic	Permian		290
	Carboniferous		365
	Devonian		415
	Silurian		465
	Ordovician		510
	Cambrian		575
Precambrian			

In order to be familiar with the last great Ice Age, one must understand the timeframe in which it occurred. With evidence suggesting that the Earth is 4.5 billion years old, geologists have divided the history of the Earth into units called eras. Within those eras are even smaller units of time called periods and epochs. The most recent era in the history of the Earth is the Cenozoic. Starting some 65 million years ago, the Cenozoic Era continues today. The Rancho La Brea fossil deposits began to form just 40,000 years ago, towards the end of the Pleistocene Epoch. These fossils are very recent compared to other pre-historic life forms. For instance, dinosaurs became extinct about 65 million years before the asphalt deposits or "tar pits" even began to form!

Foot Note!
If the Earth's history is represented on a 100 foot-long time line, the animals of Rancho La Brea would have lived within 1/100th of an inch (as thin a hair!) from the end of the time line.

Foot Note!
Though asphalt seeps like those at Rancho La Brea are extremely rare, others have been found near Bakersfield, California and as far away as Peru and Iran. However, none have yielded the quantity or diversity of fossils that have been collected from Rancho La Brea.

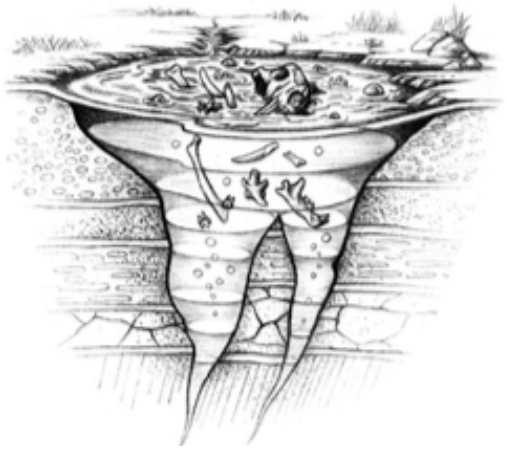
Asphalt Deposits



Millions of years ago, the area of Los Angeles and Rancho La Brea lay beneath the surface of the Pacific Ocean. During this time, marine sedimentary layers formed and in some places these eventually became rich with fossil fuels produced from ancient sea life. When the ocean levels receded some 100,000 years ago, the area of Rancho La Brea became land. New layers of gravel, sand, and clay formed by the erosion of the emergent hills, and settled on top of the much older marine sediments full of oil.

At Rancho La Brea, the crude oil has been seeping out of the ground through conduits and fissures in the coastal plain sediments for the past 40,000 years, the seeps forming pools in low-lying areas.

Fresh sediments from the surrounding hills continued to form new layers of sediments on top of the older ones and asphalt continued to seep to the surface. Over tens of thousands of years, this produced the cone-shaped asphalt deposits found at Rancho La Brea.

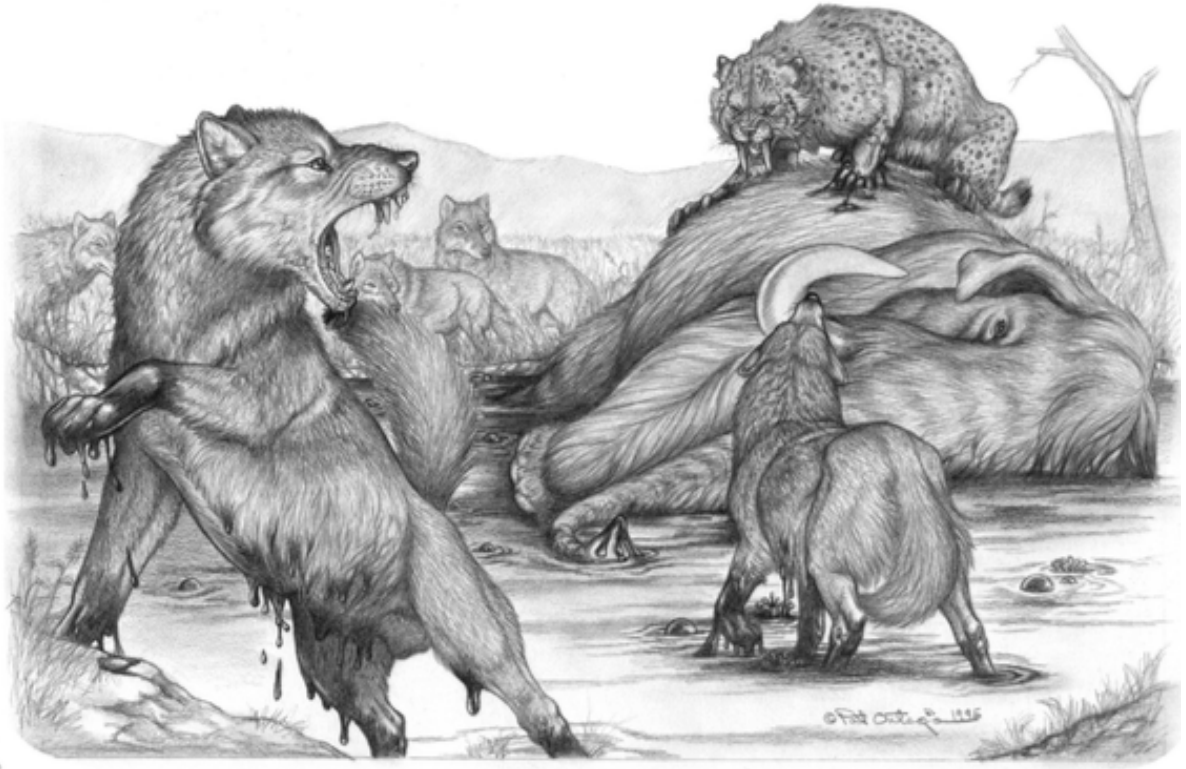


Foot Note!
Commonly called the "tar pits," the liquids that seep out of the ground at Rancho La Brea are actually comprised of asphalt, not tar. Tar is a commercial by-product made by the distillation of woody materials, such as coal or peat, while asphalt is a naturally formed substance comprised of hydrocarbon molecules.

Entrapment Events

With its numerous asphalt seeps, Rancho La Brea was a hazardous place for animals to roam. This was especially true during the warmer seasons. As the semi-solid asphalt turned softer and stickier, leaves, dust, and water would cover the surface and partially obscure it from view.

Wandering animals would often pass by and unknowingly venture into the camouflaged asphalt. If the conditions were right, the animals might become trapped like a fly caught on flypaper. The stranded animal would be easy prey for the many carnivores that lived here.



Not likely to pass on a free meal, a pack of dire wolves or a sabertoothed cat would attack the mired animal and even each other. After an intense struggle over the helpless prey, some of the attacking predators would become trapped as well. In turn, scavengers would eat those animals and also risk entrapment.

Foot Note!
Entrapment was not a daily event. If only 10 large mammals became trapped in the asphalt every 10 years, it would more than account for the millions of bones recovered from the asphalt!

Fossil Burial & Preservation

The unusually high quality of fossil preservation at Rancho La Brea occurred because the bones were buried rapidly by the asphalt and sediments. That is not to say that the bones were buried overnight, but they were seldom exposed to elements for an extended length of time. Those that were exposed to natural processes like erosion, for an extended amount of time usually failed to be preserved as fossils.

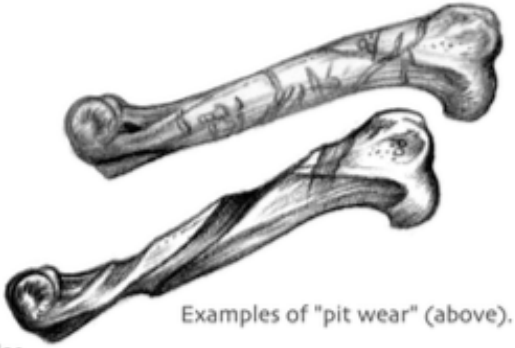
After the animal remains decayed, the bones became saturated with asphalt and partially or wholly submerged in the seep. After partial burial, winter and spring rains would wash down fresh sediments that mingled with further seepage. It is this cycle, repeated for tens of thousands of years, which contributed to the formation and composition of the fossil deposits.

Foot Note!
Animal tissues and organs such as flesh, hair, cartilage, claws, and feathers have not been recovered from Rancho La Brea. Several types of bacteria helped decompose these materials before complete burial within the asphalt and sediment layers occurred.

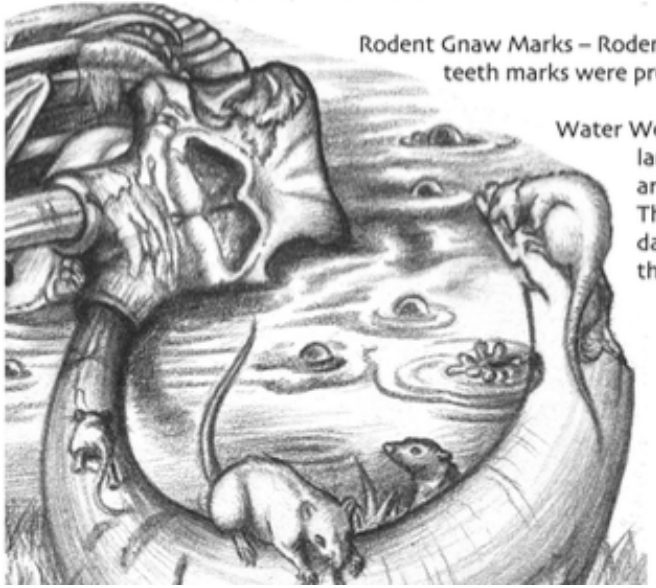
Conditions of Fossilization

Bones that were preserved by the asphalt are stained in different shades of brown. Even though the asphalt is an amazing preservative for bones, the fossils of Rancho La Brea are not always perfectly preserved. Because the bones took between several weeks and two years to be completely buried in the asphalt seeps, the bone surfaces may show:

Surface Weathering –Bones were often subjected to physical processes while on the surface. These included heat, cold, wind and rain.



Examples of "pit wear" (above).



Rodent Gnaw Marks – Rodents gnawed on the bones while on the surface, and their teeth marks were preserved on the fossils.

Water Wear – Because of the climate during the last Ice Age, larger streams and rivers were year-round in the Los Angeles area. The bones of animals that died near these streams sometimes eventually ended up in the water. The bones would then tumble downstream, bouncing off rocks and the streambed, creating the type of damage called water wear. While traveling downstream, the bones would sometimes become stuck in the asphalt that had seeped into the streambed.

Pit Wear – Bones that have rubbed against a rock or one another within the asphalt display a condition called "pit wear." Caused by earthquakes or by animals trampling on the bones stuck in the asphalt, this condition takes the form of holes and long grooves cut in the bones.

Foot Note!
The fossils at Rancho La Brea are preserved so well that it is possible to detect healed bone fractures and subsequent infections, as well as degenerative forms of osteoarthritis and other bone diseases.

Microfossils & The Pleistocene Climate

One of the most incredible aspects of Rancho La Brea is the variety of its fossil record. The asphalt has not only preserved animal bones, but also plants, insects, and other smaller-sized specimens that are too small to be seen with the naked eye. These small objects are called microfossils. At Rancho La Brea, microfossils include freshwater shells and small animal bones that are usually identified with the aid of a magnifying glass or a microscope. These small fossils give scientists the most complete look at the environment of the Los Angeles area 40,000 years ago.

The reconstruction of the Pleistocene climate begins with microfossils. For instance, plant material is the best indicator of weather. The fossil record includes wood, leaves, cones, and seeds. The presence of chaparral-type plant life along with coastal redwood and other canyon-dwelling trees suggests that the Pleistocene climate of Los Angeles was not drastically different from the present day. In fact, the best available evidence points to a climate similar to coastal Monterey or San Francisco, California. This climate is slightly more humid and cooler than one typically associated with the present day environment of the Los Angeles area. It is a common misconception that all Ice Age climates included glaciers and ice sheets covering the landscape. This type of landscape was far away from Rancho La Brea and was nearest in the Sierra Nevada Mountains.

An enlarged (x3) view of microfossils (above).
For the actual size see the illustration at the bottom left of the page.

Foot Note!

Although microfossils can be very small and difficult to identify, the trained eye can easily identify deer mouse teeth from those of other rodents of the same size!

Microfossils (actual size).

The Los Angeles Basin 25,000 years ago (below).