

Where Does Oil Come From?



Drop
of Oil

Chapter Two:

In the middle of a sticky Texas July, the mercury is already flirting with 80 degrees around 7:15 a.m. at a Tom Thumb Express in east Dallas. It's a Monday, so there's a steady clip of cars and trucks queuing to fill up before heading to work – maybe a neglected weekend task now turned into a rush errand.



This well-frequented stop near several major highways is one of more than 150,000 fuel stations across the U.S. And, like this location, 85 percent are convenience shops that sell fuel, according to an estimate by the National Association of Convenience Stores.

It markets one of the most vital natural resources known to mankind, yet perhaps one of the most misunderstood – unless you have ties to the oil and gas industry.

We stop a few harried customers to see what they knew about the geologic bonafides of their state's No. 1 industry.

“Where does oil come from?” we ask J.L., a 40-something electrician and handyman, who leans on his late-model Ford pickup while the tank fills up.

“A lot of it comes from here ... some of it's (in) the Middle East,” he replies.

“So, where does that oil come from – historically?”

“Like how far back? It's been around for millions of years ... a lot of years. That what you're talking about?”

J.L. was the fifth customer we approached that morning last summer, but he earns the distinction of even getting remotely near the ballpark of oil's origin story.



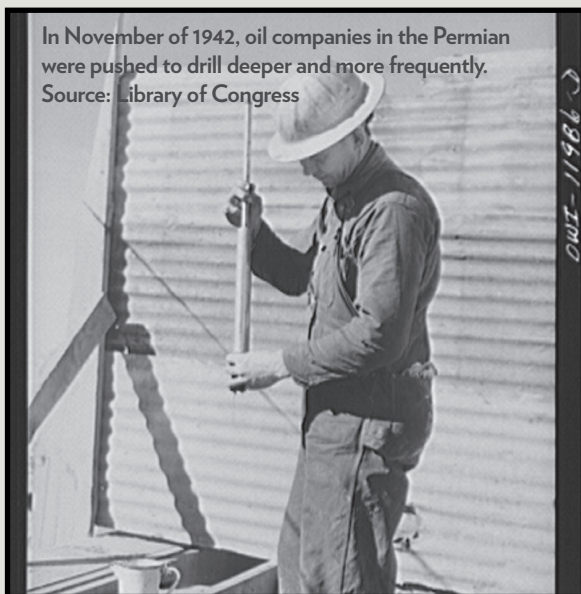


Here's the timeline for the creation of oil in a nutshell:

- The bulk of the oil deposits that exist on Earth today formed during the Mesozoic Era, between 252 million to 66 million years ago. Bookended by two massive extinction periods, Earth was a supercontinent with all landmasses connected – and don't forget T-Rex. The largest lizards ever known roamed the planet.
- 20% of it began forming during our current geological period, the Cenozoic Era, which began roughly 65 million years ago. Meaning “recent life,” the Cenozoic is also called the Age of Mammals.

This last 10% is where the magic happens, and you could technically argue that our company really began in the Permian geologic period – dating 299 million to 251 million years ago.

In November of 1942, oil companies in the Permian were pushed to drill deeper and more frequently.
Source: Library of Congress



But to get there, we have to travel even further back to Precambrian time – hundreds of millions of years before Permian time – where the basin's formation can trace roots to dramatic shifts in the earth's crust, known as **tectonics**.

“Think about it – there are things happening to and on our planet that are really mind-blowing in terms of the scale they operate on, both in the physical size and the time it takes,” says **Nate Ball**, Pioneer's regional geoscience supervisor on the company's Strategic Planning & Field Development team.

Nate's fascination with the planet began as a boy, marveling at the sheer scale and scope of the landmasses and mountainous terrain that towered over humans.

“It takes millions of years for these geological processes to happen and, sometimes, it's really hard to wrap your head around how old the planet is – 4 billion years,” he says in a kind of voice suggesting he hasn't lost some of that childlike wonderment. “That's billion with a 'b,' and that still impresses me today as a grownup.”

Now that we've roughed

out a timeline to work from, we can finally get to the point: How the first oil deposits on Earth were formed. Again, you'll see how many things needed to click for that to happen – what Pioneer senior geologist **Evan Kelly** calls “the Goldilocks area.”

“Throughout this entire process, a bevy of things have to go just right,” says **Evan**, who got hooked on geology after taking a one-off college course, earned a graduate degree in the subject and started with Pioneer fresh out of school. He knows his material well enough to explain incredibly complex subject material in a relatable way.

Let's start with our
raw ingredients.

Folks, here's a spoiler alert: Although there's a popular (and incorrect) belief that's been knocking around since the early 1900s that oil came from dinosaur fossils, this story isn't *The Land Before Time*.

It actually starts on a much smaller scale, millions of years ago, with the abundant microorganisms, or **zooplankton**, that floated around in warm, shallow waters. This soupy broth kickstarted huge blooms of nutrient-rich algae and other organic plant matter, known as **phytoplankton**.

With relatively short life cycles, these plant organisms died off and sunk to the sea floor, where their remains mixed with clay materials that had channeled through the water column, carried by rivers and streams, and accumulated in layers upon layers over millions and millions of years. If the ingredients in this unique muddy mix were exposed to too much oxygen, however, they decomposed and vanished.



Phytoplankton undersea

As ancient seas dried up, dry basins were left behind. But buried deep beneath these waterless valleys were the diamonds in the rough.

All of that accumulated organic matter covered by millions of tons of sediment began to *lithify*, or turn to sedimentary rock, creating *organic shale*.

Remember, there's no oxygen present, so the temperature of the shale steadily climbs and enters the critical "kitchen phase," as **Evan** dubs it. With increased pressure and temperature, organic elements of the shale can combine to form a waxy byproduct called *kerogen*.

Here's where things get interesting. The kerogen must heat at temperatures between roughly 200 and 300 degrees. There's zero room for error – if the kerogen cooks too hot, you get natural gas, then *graphite*.

But, if the temperature stays just right in this so-called "oil window," the kerogen will transform into *hydrocarbons* – chemicals made of hydrogen and carbon – through a process called *catagenesis*.

These transformed oil molecules eventually begin filling rock pores. Up to two-thirds of these hydrocarbons will be expelled from those source rocks and rise toward the surface, leaving whatever remains untapped. At Pioneer, we use cutting-edge drilling methods to target those hydrocarbons still left in the shale layer.

"You could say the Permian Basin is still in the kitchen," **Evan** says. "For 250 million years, it's been stacked with thousands of feet of organic-rich material and trapped in piles of sandstone and limestone. Around 2009, with the advent of *hydraulic fracturing*, now we can go directly to that source rock and jump the line."

In a later chapter, we'll learn more about how this extraction method touched off the Shale Revolution and remade the U.S. energy industry.



Layers of shale exposed

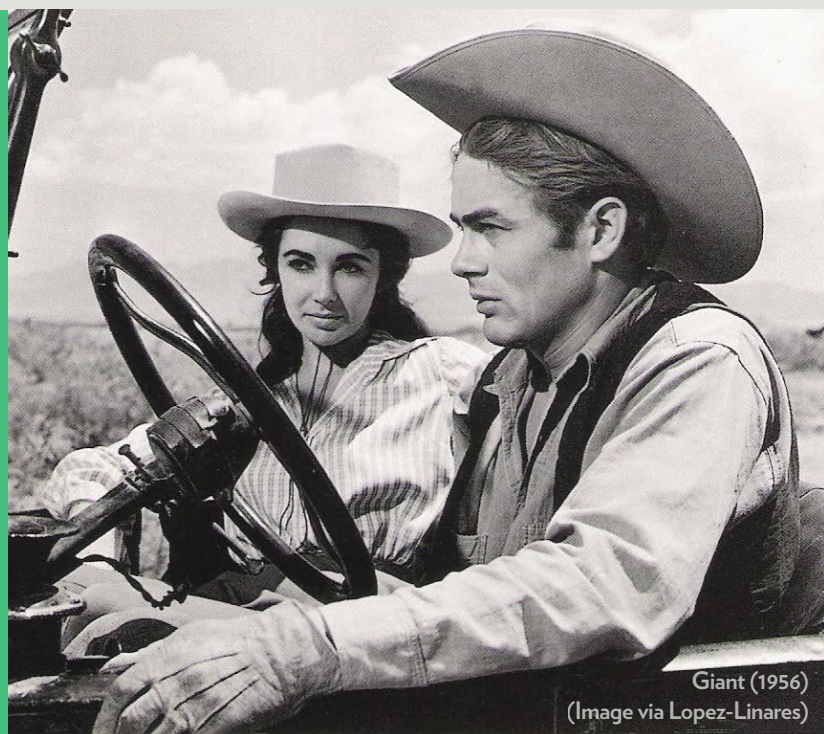
Perhaps just as fascinating

as how oil came into being is when it was first used – and how far back. Approximately 6,000 years ago in the Middle East (present-day Iraq), ancient Babylonians mined asphalt – also known as *bitumen*, or the substance left over after oil has seeped to the surface and evaporated – for brick mortar and waterproofing boats. Even the Bible’s book of Genesis references Noah’s ark being sealed with pitch.

The first known oil wells weren’t drilled in the Middle East or North America. The Chinese were technically the first to pull it off more than 1,500 years ago around 350 A.D., fastening “bits” onto bamboo poles they bored into the earth, reaching depths of 800 feet or more. They used recovered oil and natural gas for light and heat.

Pre-dating the discovery of the New World, Native Americans had already realized the significance of oil. Numerous tribes hewed blades for knives and arrowheads out of it, used it to salve scrapes and burns and incorporated it into elaborate religious ceremonies.

There’s a classic scene in the 1956 movie *Giant* depicting west Texas rancher Jett Rink, played by film legend James Dean, in the seconds after his well finally strikes oil. The prized liquid comes whooshing and bursting from the ground, then shoots sky-high. Jett opens his arms and tilts back his head as the black gold rains on him, then leaps excitedly. In those moments, Jett realizes he’s pulled it off:
He’s tapped a big one.



While it’s just Hollywood fluff, the exhilaration of discovery is quite on point, especially back when the first oil wells were being drilled.

Before the late 1850s, when the frenzy of oil exploration roared to life in America, several notable achievements had already proved its versatility.

Scottish chemist James Young discovered by 1847, for example, that petroleum coal mine seepage could be distilled to make lamp oil, lubricants and paraffin wax. And Canadian geologist Abraham Pineo Gesner beat Young to the punch by a year, distilling coal, oil shale and bitumen in 1846 to produce what he named “kerosene.”

While the first modern oil well was drilled in 1857 in La Brea, Trinidad, Edwin Drake bored the first one in America in sleepy Titusville, Pennsylvania, in 1859. It touched off the first “oil boom,” as starry-eyed converts surged into the state to seek fame and fortune. By 1901, it’s estimated more than 1,500 oil companies had been formed.

The country’s modern oil and gas industry was born, and almost every aspect of American life would change completely. Oil powered a rapidly industrializing society, fueled the nascent automobile and airplane industry and ushered in a previously unimagined freedom of mobility, as people could now reach destinations in hours instead of days.

It also helped fuel Allied planes, warships and tanks during both world wars. In fact, during World War II, about half the world’s oil and gas production came from the Permian Basin, instilling a deep sense of pride and patriotism among oil workers there that’s still evident today, notes the Drilling & Geophysics Society of Dallas.

Keep that rich legacy in mind. It’s something to be proud of – especially these days, when the oil and gas business has become an easy target for critics. The energy industry was – and still is – vital to the world.

“In this very intensely politicized climate, I think people don’t realize the good that we do. Instead, we seem to be the bad guy in a lot of the storylines,” says Pioneer land supervisor **Rebecca English**, who we’ll meet again in a coming chapter. “I think people need to take a second look at that, from the number of people we employ to what we produce. Yes, we drill wells into the ground to produce oil and gas, but I think people forget what oil and gas is used for.

“It’s used for saving people’s lives,” **Rebecca** says. “I mean, it sounds so dramatic, but it’s the truth, and I think we’re underrated in that regard.”



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