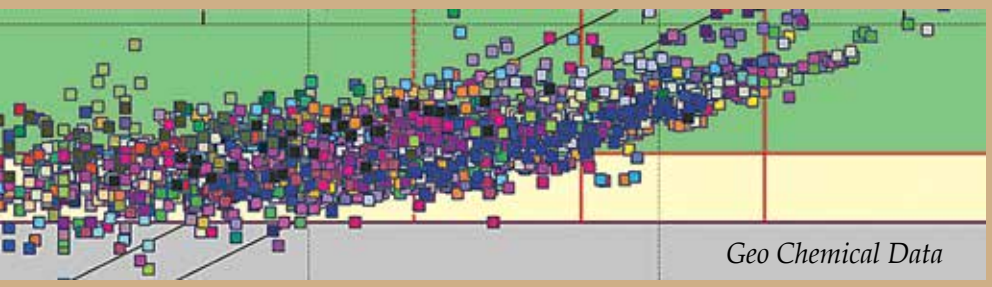
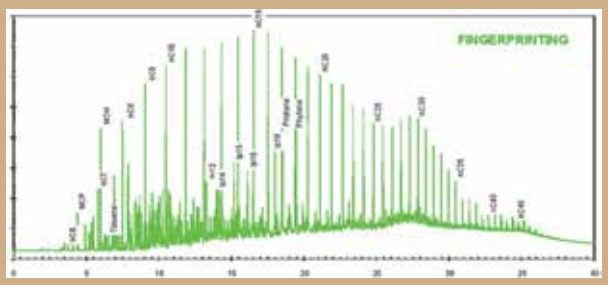
Part 12: Meandering through the Oil Industry

OIL: AN ORIGIN STORY

By Brian Rohrback



Geo Chemical Data



LIQUID SUNSHINE

Ultimately, oil is not a renewable commodity, at least not on the human time scale. It takes mid 10s to low 100s of millions of years to replenish.

Oil is just really old sunshine. In fact, nearly all of our energy really comes from the sun: solar (well, duh), wind (caused by differential heating of the Earth surface), crude oil (explained if you keep reading), coal (by extension), hydroelectric (sun evaporates water, water falls on high points, gets trapped, moves through channels in the dam, voila). Nuclear fusion might be the exception (pretend there is a long discussion here), but even fission (if we ever harness that) simply emulates the sun.

Scientists studied coal formation in the 1700s and determined that coal oils were generated as a function of time and temperature underground. Early in the 1800s, it was suggested that crude oils were also generated as a heating process applied to biological remains, but it took until about the year I was born (in the early 1950s) before this was generally accepted.

But now we know: plants are the primary source of crude oil. Phytoplankton (microscopic plants) supply the precursors to crude oil, although there is a smaller contribution from land plants and microfauna as well. This is all part of the carbon cycle which enables the Earth to sustain life. To get crude oil, you need that source of organic matter, a way to preserve it until geologic forces take over, and enough time and temperature to generate the oil. But, after the oil forms, the compounds in the oil are not stable on the geologic time scale; so, at that time, time is not on your side. How much time do we need?

As it turns out, most of the crude oil found is between 50 and 200 million years old, spanning the Jurassic and the Cretaceous periods and, even

PANGAEA

BEFORE

AFTER

with dinosaurs present, these critters were not a significant contributor to oil generation. This corresponds to the breakup of the last supercontinent, one we refer to as Pangaea. (Note continental drift has created and destroyed several supercontinents in the past; the next one is due to arrive in 200 million years and the Atlantic will be by far the largest ocean – time for the western US to start to learn Chinese from what will be our new neighbor).

The breakup of Pangaea created a lot of shallow oceans that teamed with life creating the pefect environment to source oil.

A Seahawks Analogy

As we are at the end of a football (Go Hawks!) season, the geochemical process is analogous to a timed pass pattern. Contrasting the two:

Seahawks	Geochemical
The ball is snapped	Conditions are ripe for life and micro-organisms (mostly plants) thrive and die
The offensive linemen protect the quarterback	What is now biodetritus settles to the bottom where it is protected from oxidation
The quarterback waits until the time is right and the receiver has run to a position downfield	Burial by additional sediments creates time and temperature sufficient to rearrange into crude oil
The quarterback throws the football	Oil is expelled due to pressure on the source rock
Velocity, spin, direction, and gravity dictate where the ball will arrive in the playing field	Porosity, permeability, pressure differential, and migration conduits dictate the path of the oil
The receiver, if the route is correct and he or she is sufficiently skilled, catches the ball	The reservoir, if along the path and has the ability to store invading fluids, captures the oil
The defender tackles the receiver keeping him from going all the way	An impermeable cap rock has to keep the oil in place and not allow it to proceed to the surface

Editor's Note: If you have been following along, you have now read 12 articles on the "Oil Industry" written by PNR member Brian Rohrback. Here is chance to get to know a little about the man behind the stories!

Field Trip Notes

By Brian Rohrback

The first exploration well I helped manage was offshore Kenya. The country is not noted for being a hotbed of exploration activity, but my company, Cities Service (aka CITGO), bought into a consortium and assumed the operating responsibility. I had convinced management to do the geochemistry work in real time, so we set up an exploration lab in Mombasa, on the coast.

I was sent to supervise the set up and, in a gap prior to drilling, was asked if I needed the helicopter for any reason. Thinking fast, I thought it would be the perfect vehicle to travel up and down the coast looking for evidence of oil seeps. There were stories that locals used tar blobs as fire starters; they thought this had been happening for generations. As I now controlled the destination of a 9-passenger helicopter (the pilot let me taxi and take-off!), I invited two of the lab techs to come and act as translators. Wide eyes ensued as this was not only their first time to escape the ground, but it was the first time they had traveled any real distance outside of the area where they were born. We saw elephants, giraffes, and lots and lots of monkeys en route.

I did collect bits of tar but could get no confirmation from any locals; it seems that the lines of history are blurry, even across generations. So, they were not sure whether they had harvested tar, or it had been their father or grandfather. We did land in an Italian resort; it turned out to be a nudist colony – story for another day. I brought the samples back to the lab, but they all turned out to be leakage from Saudi and Persian Gulf oil tankers, no sign of native oil. The exploration well we drilled didn't strike oil either: bummer.