j36 Oil and gas < kerogen; Titusville, PA >

The film "One Million Years BC" featuring Raquel Welch fed the popular misconception that cavepeople, the first of which did exist then, lived alongside dinosaurs[1] although the last dinosaur went extinct 65 million years ago, and a popular misconception for the source of fossil fuel was fed by the Sinclair green apatosaurus (brontosaurus) trademark registered in 1932: "highlighting its unique association with the age of the dinosaur—an age representative of the beginning of the formation of crude oil"[2] although the first dinosaurs appeared 225 million years ago and oil seeping out of basal Mississippian strata will have migrated there from where micro-organisms that did contribute died before 360 million years ago. —HR

Kerogen-rich clays (sapropels) experimentally heated in the absence of oxygen expel oil that is compositionally similar to natural oils. Petroleum is a messy mixture of liquid (oil), volatile (natural gas), and organic alteration products.[3] In source-rock sediments buried to more than 1 km and at temperatures above 50ºC, its generation begins by the cleavage of weak non-covalent bonds in kerogen to form a macromolecular bitumen phase, followed by cleavage (cracking) of covalent bonds in bitumen to form liquid oil and natural gas.[4] During maturation, migration and trapping, water and minerals, such as anhydrite and hematite, can be reactants, clays can be catalysts,[5] and organic-inorganic interactions can create or destroy sediment porosity.[6] The "petroleum window" is up to 160ºC above which only natural gas is a stable product. Below 80ºC, anaerobic microorganisms biodegrade petroleum to leave heavy oils (tars) and produce methane—a valuable by-product of this natural system that Ian M. Head and others in 2003 suggest could be exploited. They also point out that: "The world's oil reserves are dominated by biodegraded heavy and super-heavy oils in the super-giant tar sands common in shallow reservoirs on the flanks of foreland basins."[7] Two examples: *The Eastern Venezuelan Basin Reservoirs*[8] These were charged in the Neogene from Upper Cretaceous marine source rocks from up to 200 km away in the foreland basin depocentre (area of maximum thickness) formed when was the Interior range. *The Western Canada Basin*[9] Comprised of Lower Cretaceous Mannville Group sandstones that onlap onto subcropping Paleozoic carbonates, it was charged at the inception of the Laramide orogeny development of the Rocky Mountain Fold and Thrust Belt 112±5.3 million years ago from pre-Cretaceous source rocks.[10]

In eastern North America, Paleozoic sediments are exposed where erosion cuts across their strata that are flexed up to the west through now Ohio, Kentucky, and Tennessee, along the northeast axial trend of the Cincinnati Arch. This arch was rising throughout the Paleozoic as is evidenced by the lessening of the number of disconformities and thickening of Paleozoic strata to its east to where is the more complete sequence in the Appalachian Basin. The Permian (uppermost strata) here are its trademark red-sandstones. To the south occur Permian marine mudstones and limestones (dolostones). The beginning Permian is marked in marine limestones by the first appearance of "rice rock": the fusulinid foram *Pseudoschwagerina beedei* in North America and *Sphaeroschwagerina fusiformis* in Europe.[11] Stratigraphically lower are the strata of the Carboniferous, named so in Europe for its coal measures. In N. America, coals measures are called *cyclothems*. These are confined to the Upper Carboniferous and the formation and time is called the *Pennsylvanian*. The Lower Carboniferous in N. America, is without coals and the formation and time is called the *Mississippian*. The uppermost Mississippian strata are of shallow-water limestones (abundant remains of crinoids, wave-agitation produced oolithic limestones, and calcareous-algae produced lime mudstones). Towards the base are some strata of siltstones and silica- or calcium carbonate-cemented quartz sandstones. The first appearance of the conodont *Siphonodella sulcata* or *S. duplicata* marks the beginning of the Mississippian. The sandstones are often with "pools" of gas and oil that has migrated from underlying black-shale source rocks in older Paleozoic foredeep (miogeoclinal) strata that accumulated on Laurentia. Natural seeps of this oil occur along Oil Creek, just south of Titusville, Venango County, PA. There Colonel Edwin Drake's borehole-drill struck oil at a depth of 69.5 feet in August 1859, marking the birth of the commercial oil industry.[12] ❑