No Free Lunch, Part 1

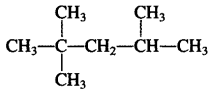
Commentary

The following paper is a critique of the writings of Thomas Gold, written by Jean Laherrere. It is a scientific dialog and contains many technical terms and references which may be nearly unfathomable to the layperson. However, it is a very important discussion because it lays bare many of the errors in Gold's theories. Unfortunately, Thomas Gold is no longer with us to respond to these criticisms. However, this critique has been floating around in one form or another for a few years now, and it is not unreasonable to assume that Thomas Gold was aware of it.

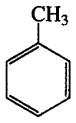
Jean Laherrere has told me that he sent a copy of this critique (along with other materials critical of abiotic theory) to V.A. Krayushkin, the main Russian proponent of abiotic oil, in 2001, shortly before a conference where both men were to present papers. Dr. Krayushkin canceled his appearance and has since gone out of his way to avoid addressing Jean Laherrere's criticism. Jean's comments on the Dneiper-Donets Basin will be presented in the second part of this series. If a scientist cannot or will not defend his theory against fair scientific scrutiny, then his argument is immediately caste into doubt.

For the layperson, before attempting to read this paper it is first necessary to recognize that hydrocarbons are a large and complex family of compounds. At one end of this family, we have single carbon compounds such as Methane (one atom of carbon surrounded by 4 atoms of hydrogen, chemical formula: CH4) and Carbon Dioxide (one carbon atom bonded to two oxygen atoms, chemical formula: CO2). At the other end of this family we have complex hydrocarbons where numerous carbon atoms form linked chains of up to 24 carbon atoms with attached hydrogen and hydroxyl (Oxygen and Hydrogen: OH) combinations, and 6 carbon rings (benzene rings). An example of a complex hydrocarbon with a branched chain is 2,2,4-Trimethylene (isooctane), a component of gasoline with an octane rating of 100. An example of a compound

2,2,4-Trimethylpentane (isooctane)



Toluene



based on a carbon ring is Toluene, another component of gasoline with an octane rating of 120. Petroleum is a mixture of thousands of different complex hydrocarbons, which are classified into useful groups based on their boiling points. Here is a breakdown of various major components of petroleum with their corresponding number of carbon atoms.

Natural gas	C_1–C_4
Petroleum ether	C_5–C_6
Ligroin	C_7
Gasoline	C_6–C_{12}
Kerosene	C_{11}–C_{16}
Heating fuel oil	C_{14}–C_{18}
Lubricating oil	C_{15}–C_{24}

That we are aware of, no scientist has ever argued that simple hydrocarbons such as methane cannot originate inorganically. Methane and carbon dioxide are the major components in the atmosphere of the gas giants of our outer solar system (Saturn, Jupiter, et cetera). And it is believed that the early atmosphere of the Earth consisted mostly of these gases, until they leaked into space. Nor is there much question that simple hydrocarbons could possibly be generated abiotically within the Earth. However, the quantity of methane which might be generated abiotically is likely to be insignificant.

When we move on to more complex hydrocarbons, this becomes another matter. Here we must look at how stable these molecules are at varying combinations of temperature and pressure similar to what is found at depth in the Earth. While some lab experiments have produced somewhat complex hydrocarbons at pressures and temperatures consistent with the upper mantle, they have not explained how these compounds would remain stable as they slowly rose to the crust though zones where pressure was not sufficient to hold them together but where temperatures were still high enough to break them down into methane.

Also, when testing a scientific hypothesis, it is necessary to ascertain whether a phenomenon can be achieved by any mechanism other than that which is central to the hypothesis. If there are other possible mechanisms, then they must be ruled out before any particular test can be claimed to support a certain hypothesis. As Jean Laherrere points out in his critique, Thomas Gold failed time and time again to take other possibilities into account. This results in sloppy science, and it cannot hold up. —D.A.P.

Discussions on Thomas Gold's papers found on the web

by Jean Laherrere
edited by Dale Allen Pfeiffer

[*Editor's Note—The papers referred to in this article can be found at the following web site: http://people.cornell.edu/pages/tg21/vita.html. Quotes from Gold's papers are italicized, followed by Jean Laherrere's critique.*]

The Deep Hot Biosphere June 1999 http://people.cornell.edu/pages/tg21/index.html
The basic idea that a large amount of microbial life exists in the pore spaces of the rocks down to depths of between 6 and 10 kilometers arose in the following way: natural petroleum almost always contains elevated levels of the chemically inert gas helium and at the same time it contains molecules that are unquestionably of biological origin. How these two different substances meet up in oil has long been a puzzle.
A: There is no problem finding microbial life in sediments (or basement via waters) down to 6-10 km. But that does not mean that petroleum will be generated by these microbes. Every sedimentary basin contains some organic matter, but to generate petroleum requires a certain threshold of organic matter concentration, along with various other important maturation conditions. Helium coming from the mantle can meet

hydrocarbons in reservoirs; being together does not mean that they come both from the same source.

"Drilling deep into the crystalline granite of Sweden between 1986 and 1993 revealed substantial amounts of natural gas and oil. 80 barrels of oil were pumped up from a depth between 5.2 km and 6.7 km."
A: Here failure is transformed into success. Ask the Swedish private investors who put their money (along with the government) in the drilling of two wells, trusting Gold that there should be a gas field in the basement (fractured by an asteroid 368 Ma [*Millions of years*] ago). The American Association of Petroleum Geologists (AAPG) Explorer of a few years ago described seepage of oil in the area coming from sedimentary Silurian rocks. Tar seeping from the granite had been used by the Vikings to seal their ships long ago, and lakes in the Siljan Ring sometimes bubble up methane. Sediments have been stripped away recently by Ice Age glaciers. With oil seepage tracked to nearby sedimentary rocks, it is very likely that these stripped away sediments were also oil rich. Oil migrates in any reservoir up or down, so it is not surprising to find oil in many basement reservoirs. I do not know of any tar seep in granite which is not an overthrust over sediments (as in Glacier National Park in Canada which was the first discovery: 200 m of granite thrust
overlaps a sedimentary basin). The goal was commercial gas and Gold claimed that finding a few barrels of oil is a scientific success.

From **Science Frontiers #69, MAY-JUN 1990:** http://www.science-frontiers.com/sf069/sf069g09.htm
The 72-kilometer-diameter Siljan Ring in central Sweden is generally believed to be of meteoric origin. The granite here has been shattered, perhaps to a depth of 40 kilometers. If Gold's hypothesis about the origin of methane is correct, methane might well be found seeping up through this wound in the earth's outer skin. Further, the shattered granite might prove to be a gigantic reservoir of valuable methane. The Swedes decided to drill.

After three years and the expenditure of $40 million, drilling at the Siljan Ring has been terminated. The drill penetrated to 6.8 kilometers before it got stuck. No significant methane had been found.

From **Science Frontiers #79, JAN-FEB 1992** http://www.science-frontiers.com/sf079/sf079g10.htm (http://www.knowledge.co.uk/frontiers):
Three years ago, at a depth of 6.7 kilometers, the "misguided" Swedish drillers pumped 12 tons of oily sludge from the granite rock. "Just drilling fluids and diesel-oil pumped down from the surface," laughed the experts. This autumn (1991), more oil was struck in a new hole only 2.8 kilometers deep. This time, only water was used to lubricate the drill. How are the skeptics going to explain this? Well, about 20 kilometers away, there are sedimentary rocks; perhaps the oil seeped into the granite from there. Rejecting this interpretation, the drillers are going deeper in hopes of finding primordial methane.

Gas Research Institute report 90/0010:
"Analysis of Drill Core from the Siljan Ring Impact Structure and Related Processes in Shear-Zone" by Valley, John W. & Komor, Steve.
Summary: Sampling was conducted at the Siljan Ring, Sweden on the surface from inside and outside of the ring, from drill cores in pilot holes, and from drill core cuttings in the deep Gravberg hole. Fluid inclusion and carbon isotope data were studied to evaluate implications for the Deep Earth Gas hypothesis. Results indicate that carbon in the calcite may be derived from two sources (organic decay and limestone

dissolution) and is carried downward with variable mixing by groundwater. This suggests that the calcite formation in the Siljan Ring does not require a contribution from mantle methane.

"Drilling into crystalline bedrock is now underway in Russia on a large scale. More than 300 wells have been drilled to a depth of more than 5 km and are productive, as also is the giant White Tiger field offshore Vietnam, mostly producing also from basement rock."
A: Where are the fields found in a crystalline bedrock away from sedimentary basins? There is no drilling on a large scale in bedrock. The Soviet superdeep well in the Kola peninsula in the basement has not progressed beyond 12000 m for more than 10 years. Furthermore, drilling deep wells over 5000 m does not mean drilling in crystalline bedrocks. The White Tiger field in basement (as many others) is perfectly explained with hydrocarbons generated from sedimentary source-rock.

Natural Gas and Oil Thomas Gold January 1997
http://people.cornell.edu/pages/tg21/Natgas.html
"The presence of helium and of numerous trace metals, often in far higher concentrations in petroleum than in its present host rock, has then an explanation in the scavenging action of hydrocarbon fluids on their long way up"
A: Hydrocarbons can migrate down, as very well demonstrated in the Hassi Messaoud field where the Cambrian reservoir was exposed during Hercynian time more than 100 km away from immature Silurian grapholitic shales. Later covered by Triassic sandstones and sealed by thick evaporites, within mature conditions Silurian shales generate oil which migrates through the Triassic sandstones down to the Cambrian reservoirs.

"A 6.6 km deep well drilled in the granite of Sweden shows petroleum and gas, and bacteria that can be cultured, all in the complete absence of any sediments, and hence of any biological debris."
A: what about the oil seepage not far away, and the recently removed sediments?

The Origin of Methane (and Oil) in the Crust of the Earth
Thomas Gold U.S.G.S. Professional Paper 1570, The Future of Energy Gases, 1993
http://people.cornell.edu/pages/tg21/usgs.html

"the well known association of hydrocarbons with helium."
A: The two are associated in some fields, but not all. Helium is rarely found outside hydrocarbon fields as wells are drilled mainly in search of hydrocarbons.

"there perhaps still remain more uncertainties concerning the origin of petroleum than that of any other commonly occurring natural substance. (H.D.Hedberg, 1964)"
A: In 1964, geochemistry for hydrocarbons was at infancy level. Fortunately, since that time there has been great progress in hydrocarbon geochemistry: see Tissot and the IFP Rock-Eval, Welde, Demaison and others. There are few uncertainties remaining about the origin of hydrocarbons.

"The capital fact to note is that petroleum was born in the depths of the Earth, and it is only there that we must seek its origin.!(D. Mendeleev, 1877)"

A: This is not what every oil company is doing, drilling in the depths of the earth. They drill where they are most likely to find hydrocarbons: mainly in sedimentary rocks. The first oil seep in Canada was in basement. Some wells in Canada were drilled in a structural setting where faulted basement rock was overthrust atop younger sediments.

"(1) Petroleum and methane are found frequently in geographic patterns of long lines or arcs, which are related more to deep-seated large-scale structural features of the crust, than to the smaller scale patchwork of the sedimentary deposits"
A: These areas are characterized by rapid sedimentation (as the Gulf of Mexico) and structures favorable for oil entrapment.

"An invasion of an area by hydrocarbon fluids from below could better account for this than the chance of successive deposition."
A: oil does not deposit, it migrates everywhere, up and down

"(4) Methane is found in many locations where a biogenic origin is improbable or where biological deposits seem inadequate: in great ocean rifts in the absence of any substantial sediments; in fissures in igneous and metamorphic rocks, even at great depth; in active volcanic regions, even where there is a minimum of sediments; and there are massive amounts of methane hydrates (methane-water ice combinations) in permafrost and ocean deposits, where it is doubtful that an adequate quantity and distribution of biological source material is present. "
A: Methane belongs to hydrocarbons, but it differs as it can be biogenic or abiotic from chemical reactions. Methane (and ethane) exists in space when life does not exist. For hydrates it is said to be mainly biogenic (see my article in Offshore). Methane is the simplest hydrocarbon, consisting of a single carbon at surrounded by four hydrogen atoms. As such, it is a common occurrence wherever there is carbon & hydrogen. This is not the case with other complex chains of hydrocarbons.

"(5) The hydrocarbon deposits of a large area often show common chemical or isotopic features, quite independent of the varied composition or the geological ages of the formations in which they are found."
A: Of course as oil migrates, its isotopic features are those of the source-rocks as is well known to petroleum geochemists. Correlation between source-rocks and oils are very well documented.

"He (Kudryavtsev (1959) pointed out that oil pools in sedimentary strata are often related to fractures in the basement directly below."
A: Of course, as most of sedimentary structures are correlated to basement features. Sediments move mainly as basements move; this is a function of plate tectonics.

"He stressed that petroleum is present, in large or small quantity, but in all horizons below any petroleum accumulation, apparently totally independent of the varied conditions of formation of these horizons. This statement has since become known as "Kudryavtsev's Rule""

A: This "Kudryatsev's rule" is only known as "keep drilling as long than there is a possible reservoir which can be fed by a possible source-rock." But the capacity of the rig (and economics) halts drilling often before this limit is reached. It is difficult to find reference to this rule anywhere.

"Columns of flames have been seen during the eruptions of some volcanoes, sometimes reaching 500 meters in height, such as during the eruption of Merapi in Sumatra in 1932. (We since know of several other instances.) The eruptions of mud-volcanoes have liberated such quantities of methane, that even the most prolific gas field underneath should have been exhausted long ago"
A: It is unfair to mix real volcanoes coming from the mantle and mud-volcanoes coming from overpressures in sediments as in Bakou area. Methane (not complex hydrocarbons) is present in the mantle.

"Profir'ev (1974) argued that so-called source rocks have no identification that proves their hydrocarbons to be primarily biogenic"
A: This reference is terribly outdated. There is now a thousand times more proof than for abiogenic.

"He [Hubbert] also discounted the hypothesis, often advanced, that the transport and deposition of oil from supposed source rocks to the final reservoir was accomplished by solution in gas:"
A: Most of oil is transported with water from the source-rock to the reservoir: this is why in the reservoir there is oil over water with generally a water-oil contact being horizontal except when there is a strong dynamic aquifer causing a tilting (such as King Hubbert was the first to mention). Hubbert was better known in exploration for his hydrodynamic theory than for his peak.

"There were several voices also outside Russia (or the Soviet Union), who argued for a nonbiogenic origin. Most notable among them was Sir Robert Robinson (1963, 1966) who, like Mendeleev, can be considered among the most distinguished chemists of his day. He studied the chemical make-up of natural petroleums in great detail, and concluded that they were mostly far too hydrogen-rich to be a likely product of the decay of plant debris. Olefins, the unsaturated hydrocarbons, would have been expected to predominate by far in any material that was derived in that way."
A: Geologists have tried to study geochemistry as much as they can before telling something on the origin of oil, geochemists such as Robinson should have studied geology before making statements on the origin of oil. Conclusions should come of a team of geochemists and geologists and not from one side scientist.

"Diamonds are known to have high-pressure inclusions that contain CH4 and heavier hydrocarbons, ... it must therefore have been a hydrocarbon that laid down the diamonds."

A: how much heavier? Up to 4 or 7; this is not enough to speak of complex hydrocarbons. Furthermore, if these hydrocarbons are as rare as diamonds, it is difficult to hope for any field coming from them.

"it has been argued that hydrocarbons could not come from these deep levels, because they could not survive at temperatures that are reached in the crust at a depth below 20 kilometers (Hunt, 1975); but these discussions in the petroleum literature have not included the effects of pressure."
A: The graph used to back this assertion gives the stability of hydrocarbons (paraffins & aromatics) below 30 km down to 300 km (100 000 bars and 2000°C) but it does not show it at 10 km. What the use of showing hydrocarbons to be stable at 30 km if they are not at 10 km? Furthermore, there are huge amounts of gas in the over-pressured brines of the Gulf of Mexico and the experimental production was a failure. It is not necessary to go so deep to find unconventional resources.

"Everyone now thinks of Arabia, the Persian Gulf, Iran and Iraq as being the oil region of the world. There is no feature that the geology or the topography of this entire large region has in common, and that would give any hint why it would all be oil and gas rich."
A: it is obvious from such statement that Thomas Gold, an astronomer, does not know anything about geochemistry and oil exploration.
The source-rocks of the Arabo-Iranian Mega-Petroleum System (Laherrère J.H., Perrodon A., Demaison G. 1994 "Undiscovered Petroleum Potential" Petroconsultants report -383p - March) are described as follows:
All these source-rocks are almost entirely characterized by type II Kerogen, with often more than 10% TOC and high SPI: 14 t HC/m3 for the Hanifa-Nadrya Upper Jurassic sourcerocks of Saudi Arabia (Demaison and Huizinga 1991). Other Cretaceous source-rocks are of comparable quality. These organic-rich sediments spread over large surfaces, more than 400 km2 for Jurassic formations, and are within the oil window over much of the region. So the amount of hydrocarbons generated is around 5.6 Ttoe = 40 Tboe.

"Yet it is a striking fact that the detailed chemistry of these oils is similar over the whole of this large region (Kent and Warman, 1972)."
A: Of course the chemistry is similar, these oils are from the same source-rocks.

"The island arc of Indonesia, of which Java and Sumatra are the main components, belongs to a much larger pattern of an arc. Along the whole of this arc petroleum is very abundant"
A: Correlation is not causality. Furthermore it is unfair to show only the oilfields on the arc while deleting the oilfields outside the arc (Kalimantan, for example). As said above, rapid sedimentation occurs within an arc and oil deposits occur in rapid sedimentation (as the Gulf of Mexico).

"Yet it has been said by the Russian investigators (Makogan, 1988) that, so far as they could see, in every location on the ocean floor and in the permafrost of the North where the temperature-pressure situation would make methane hydrates stable, they are found"
A: Out of the several thousands boreholes cored at more than 1000 sites of the JOIDES-ODP (Joint Oceanographic Institutions for Deep Earth Sampling-Ocean Drilling

Program), only few cores have recovered more than one foot of hydrates. Many sites with the Bottom Simulating Reflector (BSR) did not find any hydrates, and hydrates were found at sites without BSR (Laherrère 1999[1])

"The helium concentration in a gas is then mainly an indication of the depth from which this gas has come"
A: It must be proved first that the gas contains this helium since the beginning and that the helium is not coming from a different source.

"Yet if helium could flow without a carrier gas, there should be many locations where amounts of helium had accumulated that were similar to the amounts of helium in some gas fields, but now, in the absence of methane or nitrogen, they would be pure helium fields. Such fields would have been discovered, and would be very valuable. Their absence thus certifies the carrier gas concept for helium transport."
A: Pure helium fields should have been found only if they were searched for. Drilling is done looking for hydrocarbons and not for helium, as there is not lead or approach to such deposits.

"During the episodes of the Krakatoa eruption below the sea surface, a large region of flames above the water were observed, in this case of course in the complete absence of any confusing sprays of lava. But even at quiet times some volcanoes emit enough combustible gases to burn above the lava lake. There are strong indications that small amounts of gases coming out of volcanoes at quiet times are largely oxidized, while in violent eruptions the unoxidized gases--hydrogen and methane--are prominent."
A: most volcanic gases are water, and at high pressure water dissolve large quantities of methane (see Bingham's solubility curve (Laherrère 1999); at 6000 m water depth, water dissolves 150 times more methane than at surface—hydrates contain 150 times the volume of methane compared to the volume of hydrates). It is obvious that volcanoes occur at tectonic subduction zones, and the waters come from the sediments where methane is present everywhere. Deep waters can contain a lot of methane and volcanoes discharge these waters and methane coming from sediments or the mantle. So much for the flares in real volcanoes (also in mud volcanoes!)

*"**Results in Sweden** It is with this consideration in mind that I persuaded the Swedish Government to study the region of a giant meteoritic impact crater, the "Siljan Ring" in Central Sweden. An impact that left a circular formation 44 kilometers in diameter would undoubtedly have fractured the rock to great depth, and one might therefore have expected this to be a particularly favorable location for finding upwelling hydrocarbons. It was quickly ascertained that just the area of the Siljan structure was quite anomalously rich in soil methane and other light hydrocarbons, that many ordinary water wells produced copious amounts of gas and that a number of stone quarries in the area had oil seeping out of the rocks and making oil pools in the ground. It is true that the stone quarries were in the sedimentary rock which fills a ring shaped depression, but those sediments are nowhere deeper than 300 meters. Oil seepage generated after 360 million years from such a small quantity of sediments seemed improbable"*

A: The age of the source-rock is not the age of generation. The two wells recovered 80 barrels, which is a very small proportion of the seepage known for centuries on surface. So the origin of the oil from these sediments should not been excluded as it was by Gold.

"Some biological molecules, steranes, were found to be from the same set and in closely similar ratios as had been seen in the surface seepage oils… and this strengthened the case that the two oils had a common origin "
A: Of course they come from the same source rocks: they should have been compared to the sedimentary source rock which is known to be the source of the seepages. Oils migrate with waters to any porosity, either in a sedimentary rock or in a fractured basement.

Can There Be Two Independent Sources of Commercial Hydrocarbon Deposits, One Derived from Biological Materials, the Other from Primordial Carbon and Hydrogen, Incorporated into the Earth at its Formation? Thomas Gold November 1996 http://people.cornell.edu/pages/tg21/origins.html
"For the second, the primordial origin of commercial hydrocarbons, we have the comparison with the abundance of similar hydrocarbons on many other planetary bodies, also in interplanetary grains, in comets, and also in the interstellar gas clouds thought to be similar to the cloud that formed the solar system. We also see abundance of methane in the volcanic ocean vents where there are no substantial biological sediments"
A: methane does not represent all hydrocarbons; it can come from simple chemical reaction. Its solubility with water increases drastically with pressure.

"1.) Nickel and vanadium porphyrins are found in varying proportions, but in all petroleum deposits. An explanation that on every occasion in all oils the original metal atoms had been exchanged for just nickel and vanadium from the rocks in their surroundings, seems extremely improbable."
A: why not, as oil moves with waters coming from everywhere, waters from sediments and from the mantle.

"The overall hydrocarbon composition corresponds to the equilibrium state at temperatures 1,300 to 1,500 °C and pressures of 20 to 40 kb. The estimate is that this is the condition in the upper mantle at depths of 60 to 160 km. (This information comes primarily from the publications of two chemists and thermodynamicists from the Ukraine, G.E. Boiko and E.B. Chekaliuk, over the years from 1950 to 1982, I have found no other reference to these in the U.S., British, German or French literature.) "
A: No more reference after 1982 in Russian papers, and none in the rest of the world, may mean that it is considered as wrong

On the Association of Petroleum with Helium and with Biological Molecules Thomas Gold July 1992 http://people.cornell.edu/pages/tg21/assoc.html
"The only circumstance I could see that would account for the hydrocarbon-helium association, was that the hydrocarbons have ascended from deep levels far below any sediments, from materials similar to those of carbonaceous chondrite meteorites, which were a major component of the materials that formed the Earth"

A: why not the simplest explanation: that helium comes from a different origin. Gold has forgotten about Occam's Razor.

Eye-witness Accounts of Several Major Earthquakes Thomas Gold 1987
http://people.cornell.edu/pages/tg21/eyewit.html
Earthquakes disturb soil which contains gas (as marsh gas) and most of the gas reports during earthquakes do not bring much. As for prediction, I read about radon study not mentioned by Gold.

The Deep, Hot Biosphere Thomas Gold July 1992
http://people.cornell.edu/pages/tg21/DHB.html
"The large quantities of methane hydrates (methane-water ices) found in many areas of the ocean floor, and thought to contain more methane than all other known methane deposits (5,6), suggest a widely distributed methane supply from below."
A: This is based on comparing the amount of carbon in the dispersed methane in the oceanic sediments with unreliable high concentration (in fact about 1% of the porosity for the last survey in the Blake Ridge) to the recoverable fossil reserves (for oil & gas less than 1% of the generated hydrocarbons). The comparison with the amount of carbon in fossil fuel is completely different. It is not Gold's fault: he just repeats incorrect statements.

"While drilling to a depth of 6.7 kilometers in an ancient meteorite impact crater called the "Siljan Ring", and the oil was largely a simple, light, hydrogen saturated petroleum, completely different from plant oils"
A: In a paper above, Gold said that this oil is similar to the oil seepage, which has been known for centuries, coming from a sedimentary source-rock
"It may be that we shall find a simple general rule to apply: that microbial life exists in all the locations where microbes can survive;"
A: no objection

Metal Ores and Hydrocarbons Thomas Gold June 1994
http://people.cornell.edu/pages/tg21/metal.html
"2.) Which fluids have the capability to take into solution such substances as heavy metals or metal compounds? At high pressures and temperatures many metals will form organometallics, that means molecules that combine metal atoms with such elements as carbon and hydrogen, possibly with some nitrogen and oxygen also. Most organometallic compounds are soluble in hydrocarbon oils. Such oils, being forced through the rocks, will have a chance to combine with metals in the rocks to make organometallic compounds. In turn those that are soluble in the oils can then be transported by that same flow. This will be so also for many metals that have very low solubilities in aqueous liquids. 3.) What process can be so selective that it will deposit one metal ore in one location and another often nearby? What liquid stream will just leach out copper from the rocks, while another nearby stream will leach out zinc? Or why platinum here and gold there? The hydrocarbon flow. "
A: Good point. But if it is so, metal deposits should be found only in places where there were hydrocarbons, and this is not the case.

"In the drilling in the Siljan Ring structure in Sweden, large quantities of magnetite were found. Some twelve tons of a mix of very fine grained magnetite and natural petroleum were pumped up from one wellbore,"
A: It is reported that only 80 barrels of oil were recovered and that "oil-based drilling fluid had been in use for several months."

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[1] **Oceanic Hydrates, an Elusive Resource,** Laherrère, Jean. *Offshore*, August 1999 and September 1999. "The Deep Sea Drilling Program (DSDP), which was extended in 1985 as the Ocean Drilling Program (ODP), stimulated an interest in hydrates. Russian research suggested that they could occur at a depth of a few hundred meters below the seabed in deep water areas. Geophysicists simultaneously identified what was known as the Bottom Simulating Reflector (BSR) on deepwater seismic surveys (Markl 1970, Shipley 1979). It was soon assumed that the BSR marked the occurrence of hydrates, trapping freegas below, and several Joides sites were designed to investigate them. These sites were planned by universities not oilmen, although the latter were called in to advise on safety on the PPSP panel (I was one of them during the first half of the 80s). A total of 625 sites were drilled by the Glomar Challenger between 1963 and 1983 under the auspices of the DSDP, (see Figure 1), but it was ruled not to drill through the BSR to avoid any blow out."