Abiotic Oil: Science or Politics?

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Ugo Bardi offers a simple assessment of the abiotic theory. His logic is so clear and his argument so cogent that even a child could understand it. And the conclusion is inescapable—at least to honest enquiry—abiotic theory is false, or at best irrelevant.
–D.P.

For the past century or so, the biological origin of oil seemed to be the accepted norm. However, there remained a small group of critics who pushed the idea that, instead, oil is generated from inorganic matter within the earth's mantle.

The question might have remained within the limits of a specialized debate among geologists, as it has been until not long ago. However, the recent supply problems have pushed crude oil to the center stage of international news. This interest has sparked a heated debate on the concept of the "production peak" of crude oil. According to the calculations of several experts, oil production may reach a maximum within a few years and start a gradual decline afterwards.

The concept of "oil peak" is strictly linked to a view that sees oil as a finite resource. Several economists never accepted this view, arguing that resource availability is determined by price and not by physical factors. Recently, others have been arguing a more extreme view; that is that oil is not even *physically* limited. According to some versions of the abiotic oil theory, oil is continuously created in the mantle in such amounts that the very concept of "depletion" is to be abandoned and, by consequence, that there will never be an "oil peak".

The debate has become highly politicized and has spilled over from geology journals to the mainstream press and to the forums and mailing lists in the internet. The proponents of the abiotic oil theory are often very aggressive in their arguments. Some of them go so far as to accuse those who claim that oil production is going to peak of pursuing a hidden political agenda designed to provide Bush with a convenient excuse for invading Iraq and the whole Middle East.

Normally, the discussion of abiotic oil oscillates between the scientifically arcane and the politically nasty. Even supposing that the political nastiness can be detected and removed, there remains the problem that the non-specialist in petroleum geology has no hope to wade trough the arcane scientific details of the theory (isotopic ratios, biomarkers, sedimentary layers and all that) without getting lost.

Here, I will try to discuss the origin of oil without going into these details. I will do this by taking a more general approach. Supposing that the abiogenic theory is right, then what are the consequences for us and for the whole biosphere? If we find that the consequences do not correspond to what we see, then we can safely drop the abiotic theory without the need of worrying about having to take a course in advanced geology.

We may also find that the consequences are so small to be irrelevant; in this case also we needn't worry about arcane geological details.

In order to discuss this point, the first task is to be clear about what we are discussing. There are, really, two versions of the abiotic oil theory, the "weak" and the "strong":

- *The "weak" abiotic oil theory:* oil is abiotically formed, but at rates not higher than those that petroleum geologists assume for oil formation according to the conventional theory. (This version has little or no political consequences)

- *The "strong" abiotic theory:* oil is formed at a speed sufficient to replace the oil reservoirs as we deplete them, that is at a rate of something like 10,000 times faster than known in petroleum geology. (This one has strong political implications)

Both versions state that petroleum is formed from the reaction of carbonates with iron oxide and water in the region called "mantle," deep in the earth. Furthermore, it is assumed (see Gold's 1993 paper) that the mantle is such a huge reservoir that the amount of reactants consumed in the reaction hasn't depleted it over a few billion years (this is not unreasonable, since the mantle is indeed huge).

Now, the main consequence of this mechanism is that there is a large amount of hydrocarbons that seep out to the surface from the mantle. Eventually, these hydrocarbons would be metabolized by bacteria and transformed into CO_2. This would have an effect on the temperature of the atmosphere, which is strongly affected by the amount of carbon dioxide (CO_2) in it. The concentration of carbon dioxide in the atmosphere is regulated by at least two biological cycles; the photosynthetic cycle and the silicate weathering cycle. Both these cycles have a built-in negative feedback which keeps (in the long run) the CO_2 within concentrations such that the right range of temperatures for living creatures is maintained (this is the Gaia model).

The abiotic oil—if it existed in large amounts—would wreak havoc with these cycles. In the "weak" abiotic oil version, it may just be that the amount of carbon that seeps out from the mantle is small enough for the biological cycles to cope and still maintain control over the CO_2 concentration. However, in the "strong" version, this is unthinkable. Over billions of years of seepage in the amounts considered, we would be swimming in oil, drowned in oil.

Indeed, it seems that the serious proponents of the abiotic theory all go for the "weak" version. Gold, for instance, never says in his 1993 paper that oil wells are supposed to replenish themselves.[1] As a theory, the weak abiotic one still fails to explain a lot of phenomena, principally (and, I think, terminally) how is it that oil deposits are almost always associated to anoxic periods of high biological sedimentation rate. However, the theory is not completely unthinkable.

At this point, we can arrive at a conclusion. What is the *relevance* of the abiotic theory in practice? The answer is "none". The "strong" version is false, so it is irrelevant by

definition. The "weak" version, instead, would be irrelevant in practice, even if it were true. It would change a number of chapters of geology textbooks, but it would have no effect on the impending oil peak.

To be sure, Gold and others argue that even the weak version has consequences on petroleum prospecting and extraction. Drilling deeper and drilling in areas where people don't usually drill, Gold says, you have a chance to find oil and gas. This is a very, very weak position for two reasons.

First, digging is more expensive the deeper you go, and in practice it is nearly impossible to dig a commercial well deeper than the depth in which wells are drilled nowadays, that is more than 10 km.

Secondly, petroleum geology is an empirical field which has evolved largely by trial and error. Petroleum geologists have learned the hard way where to drill (and where not to drill); in the process they developed a theoretical model that WORKS. It is difficult to believe that generations of smart petroleum geologists missed huge amounts of oil. Gold tried to demonstrate just that, and all that he managed to do was to recover 80 barrels of oil in total, oil that was later shown to be most likely the result of contamination of the drilling mud. Nothing prevents others from trying again, but so far the results are not encouraging.

So, the abiotic oil theory is irrelevant to the debate about peak oil and it would not be worth discussing were it not for its political aspects. If people start with the intention of demonstrating that the concept of "peak oil" was created by a Zionist conspiracy or something like that, anything goes. In this case, however, the debate is no longer a scientific one. Fortunately, as Colin Campbell said, "Oil is ultimately controlled by events in the geological past which are immune to politics."

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[1] Thomas Gold, of Cornell University, has been one of the leading proponents of the abiotic oil theory in the West. The theory, actually, had its origin in the work of a group of Ukrainian and Russian scientists.