On the origins of prebiotic carbon containing rocks in the early Earth

ARON VECHT

Aron Vecht and Associates, London NW4 2AG, England (phosphors@vecht.com)

In 2007, we suggested that a paradigm shift was required to alter the generally accepted view of the organic origin of the carbon in earliest rocks [1]. To explain the distribution of deposits of methane (as hydrates), natural gas, oil, oil-tars, carbonatites as well as carbonates, we proposed the existence of stable minerals at depth which reacted when exposed to water and/or oxygen nearer the surface. We termed such rocks 'reactive minerals'. We chose carbides as examples e.g. Calcium Carbide or Aluminium Carbide. These would yield acetylene and methane respectively when exposed to water. These would in turn form carbonates under oxidizing conditions, or hydrocarbons and even graphite when exposed to a reducing environment. Under high temperatures carbonates would yield oxides while hydrocarbons would form carbon dioxide. We suggested that the existence of a considerable range of carbon containing compounds found in prebiotic rocks was not consistent with their organic origin.

More recently, evidence has been presented to support our suggestions.

1. The existence of a range of carbonate magma intrusions [2].
2. More detailed studies of ^{13}C to ^{12}C ratio. This was originally assumed to be evidence for the organic origin of carbonate deposits [3], however, more recently this conclusion has been questioned.

The oldest carbon containing rocks showing the existence of living systems is based on Stomatoporoids and Prokarryotic cell structures. These are based on Chlorophyll and DNA systems respectively. Clearly such complicated organic structures must have developed from other organic synthetic systems. Thus Miller-Urey type systems [4] or Fischer-Tropsh catalytic reaction [5] have been proposed. Such complicated processes are unlikely to explain the large carbon containing deposits found with wide distribution. The simple carbon compounds we propose are much more likely to result in the variety and distribution of the range and extent of carbon compounds found on Earth.

The relationship between the earliest organic species and the earliest carbon containing rocks need considerable further study. Many assumptions are made without detailed information. Unfortunately, although detailed isotopic studies of the oldest rocks have been reported, the extent of carbon present (or absent) has so far been overlooked [6].

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Power law behavior in continental crustal heat production and its implications to the thermal regime of the continents

NIMISHA VEDANTI, RAVI P. SRIVASTAVA, O.P. PANDEY AND V.P. DIMRI

National Geophysical Research Institute, Council of Scientific and Industrial Research, Hyderabad- 500606, India (nimisha@ngri.res.in)

The nature and distribution of radiogenic crustal heat production is directly related to the temperature-depth regime in the continental lithosphere. It depends upon the amount of Uranium, Thorium and Potassium present in the rock. It is a primary source of heat flow and contributes to as much as 50% to the observed heat flow at the surface. In the absence of direct sub-surface measurements, number of heat production models have been proposed, which includes widely used exponential model in which heat production diminishes exponentially with depth [1, 2], however this has not been the case. Our detailed study of the fractal behavior in the deep crustal heat production data from some of the prominent continental crustal section across the globe like Kaapvaal craton (south Africa), Baltic shield (Russia) and Dharwar craton (India) etc. exhibits inherent power law behavior in the deep continental heat production data, rather than exponential as has hitherto been believed [3]. This would mean that in case of power law distribution model, decay of heat production with depth within the crust will be slower. Consequently, more heat flow would be generated by heat producing elements within the crust and thus heat flow input from the mantle would be comparatively lower. This would affect rheological behavior of the crust. In comparison to exponential model, power law distribution conforms much better with geological observations and rock types, where metamorphic grade gradually increases with depth till Moho is reached and corresponding lithologies changes from felsic, to mafic. Thus, fractal models can be considered more realistic in defining the decay of heat producing elements with depth within the differentiated crust. Present findings will have significant impact in the estimation of lithospheric temperature-depth distribution.

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