



## *Interactive comment on* "The definition of life in the context of its origin" *by* Y. N. Zhuravlev and V. A. Avetisov

## Anonymous Referee #1

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The authors aim at providing a definition of life that would be useful both in considering extant life and the origin of life process. Then, the Origin of Life, considered as a transition state of the evolution from a non-living state to a living state, has to bear most characteristics of living beings. It is argued that definitions of life must account for different levels of organization including the ecological interaction between self-reproducing agents instead of simply defining individual living entities. They analyze the different definitions that have been advanced in the past since no consensus has been reached, with clever comments, for instance, on the insufficient distinction between expressions such as life, living organisms, living, minimal life... Another important issue is that life is considered as a state resulting from a flow of energy and matter utilized by organisms through a network of channels. An alternative definition of life is proposed in conclusion based on a splitting into three manifestations of life as a state, as a structure, and as a process. This definition tries to overcome the difficulty in associating life

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both with a far from equilibrium dissipative system and with an informational content resulting from the evolution process. Many conclusions of the present paper seem to be consistent with the most intelligent definition of life that have been proposed (and especially with that proposed by Ruiz-Mirazo et al.) with the aim of accounting for its emergence. An additional aspect, which may be less easily accepted by the scientific community, is the proposition that the information content of life must not be limited to genetic information. The authors fail in providing a definition of this information content, which is described as resisting to analysis. However, as I understand it, it is obvious for this reviewer that this "information content" is in relation with the self-organization, the self-maintenance and even the "historical evolution" of dissipative structures formed in far from equilibrium systems outside the context of life and its emergence. Then, the emergence of life could be described as the need of material records (genes) as a way to perpetuate self-maintaining dissipative structures. However, a great care has to be used in handling these ideas because genetic information and its biological meanings (ultimately derived from translation) are intimately linked. Moreover, the inheritability of the information coded by genes (responsible for Darwinian evolution) should not be extended to this additional content that is based on the existence of exchange of information between individual agents and may be attributed to a property of the network rather than that of the agents. A comment on this point should be welcome. The choice made by the authors is to avoid analyzing the validity of scenarios proposed for the Origin of Life with respect to the definition they have proposed. But, any reader involved in Origins of Life research will read this paper with his own opinion in mind so that this article may be considered as a validity test for any of these scenarios. Further work by the authors could be devoted to this task. In conclusion, I recommend this paper for publication in Biogeosciences because it might initiate a discussion about the information content of life. A fruitful discussion would however take advantage of a statement on the inheritability of the non-conventional information content.

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