

## ***Interactive comment on “An inverse method to relate organic carbon reactivity to isotope composition from serial oxidation” by Jordon D. Hemingway et al.***

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Received and published: 3 September 2017

Hemingway et al. have offered an inverse model to extract the reactivity of organic matter (OM) and relate it to the isotopic composition via data obtained from a record of thermal decomposition of that organic matter. This is a technique that has been used with respect to petroleum formation and there exists published literature for that application. The present paper hopes to extend the method to the degradation of OM sampled in low-temperature aquatic systems.

The mathematics of the model appear to be solid (better than my own efforts in this area), including the use of a Lagrange multiplier to add constraints to the model solu-

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tion. I do not think that the paper can be faulted on this account; nevertheless, I have two strong reservations.

Firstly, microbial enzymatic degradation of OM is not the same process as thermal decomposition. Microbes use enzymes to breakdown OM in order to increase the rate of this reaction. According to a very broad interpretation of transition-state theory, that result is obtained by altering the decay (reaction) mechanism so as to lower the activation energy of the reaction. The authors' thermal method is also based on activation energy, but on the activation energy for a thermal decomposition reaction. Thus the microbial and the thermal activation energies are not guaranteed to be the same or even comparable. Assigning the thermally derived results to the microbial situation is not, at this time, experimentally justified.

Secondly, only two samples were tested with the method, and one, OM from a marine sediment, failed the test of the model assumptions. I am unaware of any other papers that have applied this technique to aquatic "low-temperature" sediments. That represents meager testing of the applicability of the model. The low-temperature geochemical community does not at this stage know if the method is useful, and the theory has significantly overstepped the acceptance of the methodology itself.

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Interactive comment on Biogeosciences Discuss., <https://doi.org/10.5194/bg-2017-344>, 2017.

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