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Reply to Comment by Marion Wampler on Clauer et al., 2022

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The present reply will strictly and only focus on the general logic of boron and lithium isotopic studies of clay minerals. Our goal was always and still is to obtain coherent interpretations of the crystal chemical changes reflected in different size fractions of clay separates from volcano-clastic sediments, as records of exchanges with changing fluids commonly occurring in hydrocarbon-bearing basins.

The main reason for studying these light elements is that each substitutes in different crystallographic sites of illite-smectite structures. Thus, when smectite layers recrystallize into illite, the changing fluids are theoretically equilibrated with specific crystallographic sites of the minerals as the crystals grow. Measuring isotopic B and Li, as well as other compositions of individual illite layers in a dominant smectite matrix is not possible as it requires an angstrom-level spatial resolution and would not provide enough atoms for statistically significant measurements. However, the study criticized here, and previous ones (referenced in the opposing comment) have shown that it is possible: (1) to measure these light isotopes on nanometric illite-smectite size fractions; (2) to "localize" them in the clay structures by NMR (Clauer et al., 2018); and (3) to trace isotopic signatures showing significant trends lending insights to the evolving fluid compositions as a function of temperature (and time) during burial.

Of course, we agree, and have shown in all our previous studies, that it is necessary to carefully consider all the geologic variables contributing to a mineralogical system that is changing over geologic time. However, we clearly disagree with the statement in the comment that because the interpretation of geochemical data is a 'demanding task', B and Li isotopic data are not valuable contributions to studies on burial diagenesis as recorded by mineral chemistry. The interpretations in the referred paper attempt to consider all possible scenarios influencing mineralogical changes in a dynamic system, all based on existing evidence. The scientific approach of such intimate processes can only improve with more isotopic data generated on carefully selected size fractions of minerals from a well known geologic context!

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