Method Development for Rapid Evaluation of Sulfur Content and $\delta^{34}S$ Value in Sedimentary Rocks

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Sulfur (S) content and its isotopic values ($\delta^{34}S$) in sedimentary rocks is used to reconstruct paleoenvironment conditions of sediment deposition. However, S analysis in the rocks is highly complex and labor intensive. Here, a rapid (hours) and simple method for S quantification and $\delta^{34}S$ value determination of kerogen and pyrite in sedimentary rock was developed by coupling a RockEval (RE) analyzer to MC-ICPMS. A collection of 14 thermally immature sedimentary rocks, with varying composition, were pyrolyzed and the residual was combusted by the RE. Quantitative separation of the S fractions was achieved by an empirical relation between the relative amount of pyrolysis organic-S to total organic-S, and the Tmax-S value (the temperature of the organic-S peak maximum). Determination of $\delta^{34}S$ values with a precision of ± 0.2‰ and accuracy of ± 1‰ was achieved for pyrite-S, and the $\delta^{34}S$ of the organic-S can be determined by means of isotopic mass balance. Hence, this new method simplifies the lab work without compromising on accuracy. Moreover, we found that the new variable Tmax-S is correlated to $\delta^{34}S$ values of the organic-S, pyrite-S and the difference between them. The isotopic distribution between organic-S and pyrite-S and Tmax-S set by the sum of natural conditions and processes during sediment deposition and later in diagenesis and catagenesis processes. Hence, Tmax-S combined with the $\delta^{34}S$ values of pyrite-S and organic-S are proposed as a new proxy for paleo-environmental conditions, which can be achieved, using our new method, rapidly and accurately.