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Specifications for carbonate content quantification in recent marine sediments using Rock-Eval pyrolysis

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The amount of $CaCO_3$ in sediments and/or sedimentary rocks is usually measured by calcimetry while the nature of the carbonates is determined by X-ray diffraction. Recently, a carbonate recognition method based on the results of Rock-Eval pyrolysis was proposed by Pillot et al. in 2014. Rock-Eval pyrolysis is also widely used for the characterization of recent sediments. However, later in 2015 Baudin et al. noticed that some of the characteristics of recent sediments tended to produce different results from those of more classical Rock-Eval analyses, causing bias in interpretations.

In this study, the thermal stability of fossil and recent marine carbonated sediments was analyzed to identify differences in carbonate decomposition and to underline the importance of accounting for them in Rock-Eval analyses. The state of calcite preservation in recent marine sediments and sedimentary rocks at temperatures between 400 °C and 600 °C was characterized using different techniques (calcimetry, XRD, SEM imaging, etc.) for better interpretation of data obtained with Rock-Eval.

Our results highlight a clear difference in the range of calcite decomposition temperatures during Rock-Eval analysis: between 550 °C and 775 °C for bulk clayey hemipelagic sediments versus 650 °C to 840 °C after the same sediments were rinsed to get rid of the salt. During heating, water and hydroxide anions are released from clay minerals and react with salt crystals to form acid vapor. This acid vapor reacts with carbonates to produce CO_2. The chemical decomposition of carbonate starts at temperatures that are lower than the typical range of decomposition temperatures, leading to overestimation of mineral carbon content (overestimation of the S5 peak) and to underestimation of organic carbon content (underestimation of the $S4CO_2$ peak) with the Rock-Eval method. In the absence of clay minerals, such as in recent marine pure carbonate oozes, there is no evidence for this effect. It is therefore essential to prepare and rinse recent clay-rich carbonated sediment samples before Rock-Eval analysis to avoid misinterpretation.