Use of different geothermometry methods on fossiliferous Proterozoic sediments to constrain thermal maturity of microfossils and sedimentary basins (DRCongo, Mauritania & Australia)

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ABSTRACT

Evaluate the thermal maturity of old sedimentary basins containing microfossils is crucial to reconstruct early life evolution on Earth. Here, we investigate carbonaceous shale samples containing exquisitely preserved organic-walled microfossil assemblages from three Proterozoic shallow marine sedimentary sequences: the Mbuji-Mayi Supergroup (Democratic Republic of Congo, Congo Basin), the Atar/El Mreïti Group (Mauritania, Taoudeni Basin) and the Kanpa Formation (Australia, Officer Basin). By comparison with Raman geothermometry, solid bitumen reflectance, illite crystallinity and Thermal Alteration Index, we evaluate and validate the use of Raman reflectance on Proterozoic carbonaceous material and especially for poorly-ordered carbonaceous material. We show that extracted kerogen (microfossils and amorphous organic material) is more accurate to estimate the thermal maturity of low-grade temperature Proterozoic sequences than kerogen in thin section. All the techniques provide consistent range of temperatures except for Raman geothermometry, giving slightly higher estimates. Raman reflectance appears to be a fast and robust tool to evaluate the thermal maturity of poorly-organized carbonaceous material from Proterozoic rocks and by extension could be used to assess the thermal evolution of a sedimentary successions.

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