

The Effect of Bacterial Degradation on Bituminite Reflectance

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ABSTRACT

Bituminite reflectance is commonly used as a proxy for thermal maturity in characterizing petroleum source rocks. However, this study demonstrates elevated reflectance related to epidiagenetic pyrite precipitation within thermally immature organic-rich marine mudstone. Within bituminite particles (macerals), high reflectance oxidation rims (HROR) (similar to thermally-induced oxidation rims) were observed in close proximity to framboidal pyrites. This variability in bituminite reflectance (BR.o) was not induced via thermal catagenesis, but could however be accounted for by an epidiagenetic process. Labile (reactive) organic matter (OM) enters a bacterial sulfate reduction (BSR) zone where anaerobic bacteria reduces dissolved sulfate to oxidize OM. This process ultimately results in the formation of bacterially-derived framboidal pyrite in close proximity to HROR in bituminite macerals. Although there have been previous reports of elevated BR.o associated with biogenic gas production, no microscopic evidence of such occurrence were reported. This study examines low reflectance bituminite particles with embedded framboidal pyrite and associated HROR.

Through examining a maceral with the framboidal pyrite physically removed, approximately 300 closely spaced reflectance measurements were made. Additional measurements were taken in the form of transects across the maceral, allowing an examination of the relationship between reflectance and distance from the BSR zone. A baseline reflectance value of approximately 0.50%Ro was measured furthest away from the BSR zone with peak values of approximately 0.75%Ro being measured adjacent to the BSR zone. Examination of the measured transects yielded a very rapid drop in reflectance a few microns away from the BSR zone. This demonstrates that the bacterial processes are not uniform on the micron scale and selective of reaction sites. This study also demonstrates the magnitude of variation that can be expected when measuring BR.o which could result in an overestimation of thermal maturity.