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Increase in bituminite reflectance due to diagenetic bacterial degradation in the Late Cretaceous Second White Specks Formation, Alberta, Canada

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Abstract

The Cenomanian-Turonian Second White Specks Formation of the Colorado Group is a prolific source rock and being increasingly evaluated as an economically valuable unconventional resource play. Recent access to new analytical technologies has opened up the possibility of building upon existing studies and increasing our understanding of its organic matter composition and its evolution. This study closely examined bituminite macerals from the Second White Specks Formation in samples taken at 1m intervals between 1008.00m and 1020.50m depth from 102/07-12-042-21W4/00. Samples are immature at approximately 0.50% BR_o.

Within bituminite particles, “halos” of high reflectance bituminite (similar to thermally-induced “oxidation rims”) were visible in close proximity to framboidal pyrites. This variability in bituminite reflectance (BR_o) within the Second White Specks was not induced via thermal catagenesis, but could however be accounted for by diagenetic process. This process involves the labile (reactive) organic matter (OM) entering a zone of bacterial sulfate reduction (BSR). In this zone, anaerobic bacteria reduces dissolved sulfate to oxidize OM as shown by oxidation rims in proximity to the occurrence of BSR. This process ultimately results in the formation of bacterially-derived framboidal pyrite. Although there has been a previous report of elevated BR_o associated with biogenic gas production in the regional scale, there was no microscopic evidence of such occurrence reported. This study examines low reflectance bituminite particles with embedded framboidal pyrite and associated oxidation rims showing elevated BR_o.

Through examining a maceral with the pyrite aggregate 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 pyrite. A baseline reflectance value of approximately 0.50%BR_o was measured furthest away from the pyrite with peak values of approximately 0.75%BR_o being measured adjacent to the pyrite site. Examination of the measured transects yielded a very rapid drop in reflectance a few microns away from the site of the removed pyrite framboid. 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 within the Second White Specks Formation.