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Petrography and Diagenesis of Pre-salt Microbialite in the Kwanza Basin, Angola

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Summary

Petrographic and preliminary geochemical analyses have been conducted on a core from the pre-salt microbialite succession of the Kwanza Basin, Angola. The core is characterised by shrubby boundstones and spherulitic grainstones, with several intermediate facies. Magnesian clays are present in small amounts, this may be in part due to later diagenesis. The removal of Mg clays would make some facies classifications non-representative of the unit at the time of deposition. Scanning electron microscopy has also revealed the presence of microbial filaments within the shrubby calcite fabrics, but it is not certain if microbes contributed to calcite precipitation via organomineralization, or if they were merely a passive substrate.
Chert preserves a variety of relict calcite textures. Some silica textures are similar Magadi Type microbial chert. Diagenesis was complex and multi-phase, with evidence of low and high temperature (possibly hydrothermal) fluids.

The Early Cretaceous pre-salt lacustrine carbonates of the South Atlantic form a prolific offshore petroleum play that is proven by discoveries in Brazil and the conjugate Angolan margin. The so-called “microbialite” forms the main reservoir unit in the Brazilian and Angolan pre-salt plays, although to date its biotic vs abiotic origin remains contentious.

Petrographic and preliminary geochemical analyses have been conducted on a core from the pre-salt microbialite succession of the Kwanza Basin, Angola. The core is characterised by (i) shrubby boundstones, likely deposited in shallower waters, (ii) spherulitic grainstones that could have been deposited in slightly deeper settings, and (iii) intermediate shrubby-spherulitic facies that reflect conditions between the two end members. Magnesian clays are present in relatively small amounts; this may in part be due to later diagenesis. The removal of Mg clays would make some facies classifications non-representative of the unit at the time of deposition. All calcite phases are recrystallized to varying degrees, but the shrubs and larger spherulites often preserve an original radiaxial-fibrous crystal structure. Preservation of the fibrous crystal fabric through diagenesis implies that the structures were originally composed of high magnesium calcite. Scanning electron microscopy has also revealed the presence of microbial filaments within the shrubby calcite fabrics, but it is not certain if microbes contributed to calcite precipitation via organomineralization, or if they were merely a passive substrate.

Chert layers often preserve stromatolitic fabrics and shrubby textures. The chert is likely an early diagenetic phase. Fractured, massive chert often displays a pseudo-chalcedonic microfabric with organic inclusions similar to coccoidal bacterial cells found also in Magadi-type chert.

Diagenesis was multi-phase, with early dolomite, quartz and calcite phases present alongside later quartz, dolomite, fluorite and sphalerite. No saddle dolomite was identified; however the presence of sphalerite implies circulation of higher temperature, possibly hydrothermal fluids during later diagenesis.