Core and Outcrop Calibration of Upper Cambrian Microbial Textures

Heath Hopson[1], André Droxler[1], Paul Mitch Harris[2]
[1]Rice University; [2]University of Miami

9.29.2020 - 10.1.2020 – AAPG Annual Convention and Exhibition 2020, Online/Virtual

Abstract

Interest in microbial deposits has increased following discoveries of hydrocarbon reservoirs in pre-salt deposits of offshore Brazil and Angola. Systematic core drilling of outcrops in central Texas documents varied microbial textures that vary spatially and temporally within an Upper Cambrian buildup complex, and as such can serve as valuable examples for interpretation elsewhere. These buildups display a core and rind and evolved through three distinct shallow marine growth phases. Initial outcrop characterization revealed the successive growth morphologies, repeatedly identifiable across several separate outcrops. Grounded on these geometries, a three-phase growth model was constructed, entailing a well-defined initial “colonizing” phase, a “vertical aggrading and lateral expanding” phase, and finally a well-defined “capping/demise” phase. Such temporal variations in morphology evidence fluctuations in paleoenvironmental and paleoclimatic conditions, as well as sea level fluctuations during growth. Lateral and vertical transects of shallow cores detail buildup growth by internal structures and microbial fabrics. Nucleating on lenses of flat pebbles, Phase 1 growth results in 3-4 m high buildups defined by a distinct thick, early cemented outer thrombolitic rind. Buildup interiors exhibit amalgamated microbial heads with poorly preserved internal structure enveloped by cm-thin thrombolitic rinds. The buildups grew in high-energy conditions, but without interacting with coeval interbuildup oolitic-bioclastic grainstones. Phase 1 terminated with onlapped terrigenous and calcareous silts (~35% CaCO3). The overlying Phase 2 growth produced buildups up to 8 m thick, characterized by a mutual interaction with interbuildup high-energy oolitic bioclastic grainstones and packstones and lacking a well-developed external rind. Internally, Phase 2 growth consists of vertically aggrading and laterally expanding

stromatolitic columns, each exhibiting cm-thin thrombolitic rinds directly interacting with intercolumn bioclastic grainstones. Phase 3 of growth develops a well-defined, 2-3 m thick thrombolitic rind either crowning the top of Phase 2 or growing as individual buildups on top of Phase 2 buildup flanks and interbuildup sediments. Mixed (≤ 16% $CaCO_3$) silts onlap these large buildups. Cores and thin sections graphically show varied microbial textures that were responsible for growth of the buildups. Thrombolitic fabrics evidence carbonate precipitation induced by microbial colonies. This fabric dominantly consists of original microbial micrite with fossil fragments in an extremely tight framework that hindered diagenesis. Stromatolitic fabrics show alternating laminations of microbially precipitated calcite and amalgamated trapped grainstones. Thin sections exhibit ferroan dolomite replacement and subsequent oxidation of these grains.