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Microfacies and Statistical Analysis of Lower Triassic (Smithian) Microbial-Dominated Teepees and Associated Deposits in the Timpoweap Limestone, basal Moenkopi Formation, in Southwestern Utah

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Lower Triassic (Smithian) anachronistic carbonate deposits comprising the Timpoweap Limestone Member of the Moenkopi Formation are well exposed along a 50 m-long traverse atop the Hurricane Cliffs south of Hurricane, SW Utah. The traverse exposes a series of 11 teepees with dipping flank beds and inter-teepee pond deposits. The teepee cores are approximately 2.3 meters high and spaced approximately 6 meters apart. The base of the teepee zone is planar and horizontal. The upper surface displays up to 1.5 meters of depositional relief prior to filling of inter-teepee ponds. Teepee cores are massive in outcrop and comprised of microbial boundstone with variable abundances of chiefly oncoids and pisoids. Medium-bedded flanking and inter-teepee beds are dominated by non-skeletal grains with lesser amounts of microbial film deposits. Lithofacies were determined using cluster analysis and ordination of point count data (22 attributes) collected from 121 thin sections. Four main sample associations (microfacies A-D)) were derived from the cluster analysis, representing a continuum of depositional processes that include accumulation of seafloor micrite and skeletal grains, formation of ooids, trapping and generation of grains on biofilms, and precipitation of microbial, marine, and meteoric cement. Microfacies A is dominated by microbial micrite and microsparite that display microstromatolitic and microthrombolitic textures. Facies B is characterized by a mix of microbial micrite (biofilms) and non-skeletal grains. Facies C is chiefly non-skeletal grainstone with spar-filled interparticulate pores and minor amounts of microbial micrite. Skeletal wackestone and packstone of Facies D is volumetrically unimportant, but the close association of lamellar siliceous sponges, ammonoids, gastropods, bivalves, echinoid spines, and conodonts (Facies D) with the teepee-forming microbialites (Facies A-C), suggests deposition under normal-marine conditions in shallow subtidal to peritidal settings. Fenestral pores are a common feature in the Timpoweap Limestone ranging from small (about 0.2 mm) equant birdeyes to large and irregular laminoid fenestrae. Pore-filling deposits include microbial crusts, isopachous radial fibrous marine cement, and/or blocky meteoric sparry calcite.

First order distributional trends of 22 carbonate constituents reveal lateral and vertical patterns that distinguish teepee core, flank, and inter-teepee deposits. These trends suggest a quantitative relationship between facies and elevation in ponds and facies evolution of displacive teepee-core

microbialites. These are among the first teepees reported in the burgeoning global literature on Lower Triassic microbialites.