Environments and Dynamics of Clastic Sediment Dispersal Across Cambrian of Grand Canyon

The transgressive Grand Canyon Cambrian contains basal fluvial sands (Tapeats Sandstone) and overlying shallow marine sands and shales (Bright Angel Shale) in which textures and structures permit a detailed reconstruction of clastic sediment dispersal across a broad cratonic margin.

Dominantly trough cross-bedded basal Tapeats Sandstone, containing buried regolith in bed-rock depressions, a low-variance, unimodal paleocurrent trend down the regional paleoslope, and well to moderately sorted medium to coarse-grained sands, records pre-vegetation bed-load fluvial sedimentation. Bed-load sands (>200 mμ) mature from arkosic to orthoquartzitic within 5 to 10 m of the base. Finer, suspension-transported sands remain subarkosic through the entire 250 to 500 m of Cambrian section implying rapid dispersal.

The Bright Angel Shale is composed of shallowing upward sedimentary cycles 1 to 6 m thick. Lower parts of the cycles are thinly interbedded fine sand and shale layers whose sedimentary structures and textures record level-bottom storm resuspension, dispersal, and deposition (sand layers) alternating with quiescent periods of finer silt and clay dispersal and accumulation. Bed-load transported sands are absent. Sand bed thickness up to a maximum (5 to 20 cm) represents variation in storm intensities with maximum thicknesses controlled by water depth, which limits volume in suspension.

Upper parts of cycles are cross-laminated fine sands with glauconite and U-shaped or vertical burrows. These represent shoaling phases with increased bottom agitation, decreased sedimentation rate, and winnowing bypass of silts and clays. Organism structures, tadpole ripples, and rare mud cracks record shallowing.

Cycle caps are 1 to 20-cm thick layers of medium to very coarse quartz sand, hematitic ooids, phosphatic, and dolomite cemented clasts that record phases of emergence and complete bypass of all suspension load.

Recently recognized dunes 3 to 5 m in height provided bed load dispersal at the close of sedimentation cycles. Structures and textures suggest dunes are eolian.

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Holocene Tepees and Stromatolites from Southern Australia and Their Paleohydrologic Significance

Along the southern coastline of South Australia, coastal salinas were created by the stabilization of the late Pleistocene-Holocene sea approximately 6,000 y.b.p. In these isolated seepage depressions stromatolites (millimeter laminated), algal tufas, tepees, and other fenestral crusts and mounds constitute a marginal aragonite facies. The fenestral limestone crusts 10 to 30 cm thick) are underlain by a highly porous, open boxwork limestone.

During late winter and spring the water table is high in the calcreted, Pleistocene calcarenite dunes which surround and underlie the salinas. Consequently the hydraulic gradient between the dune and the salina is steep; meteoric-influenced ground water seeps into the salina margin. Waters driven by this ground water head seep into the boxwork beneath the crusts and are confined by this crust aquitard. The pressure causes the crust to expand and become slightly concave. During the late summer and autumn, the dune water table and associated hydraulic gradient are lower by the processes of evapotranspiration. Concentration of the salina waters and lowering of the salina water level causes a lowering of the

crust. This lowering is coincident with passive and neomorphic precipitation of aragonite on and within the crust. The alternate lifting and falling of the crust in conjunction with aragonite deposition during the falling stage cause a seasonal increment in crust size. As the crust is laterally confined by the calcreted dunes, overthrusting of the crust occurs and tepees are formed.

Millimeter layered indurated stromatolites, growing millimeter laminated algal mats and poorly laminated algal tufas (including *Conophyton*-like tufas) all form in this schizohaline zone. The breaking of the crust along megapolygonal overthrust zones creates zones of pressured ground water upwelling that commonly control the three-dimensional distribution of stromatolites and tufas. In some marginal zones of Marion Lake stromatolites are only found atop tepee crests. All finely laminated stromatolites probably grew up to the ambient water level.

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Casablanca Field, Offshore Spain—Paleogeomorphic Trap

The Casablanca field, the largest of four producing fields in the Spanish Mediterranean, is located about 50 km south of Tarragona. Using the Halbouty classification in AAPG *Memoir 16,* the field is a "paleogeomorphic trap."

The field is producing 18,000 BOPD from two wells in an "early production phase." The crude has an API gravity of 33.7°, sulfur content of 0.2%, and a GOR of 155 cf/bbl. Full field production of about 35,000 to 40,000 BOPD will start in 1983 after a platform is installed.

The reservoir is a weathered and fractured Upper Jurassic