episodic concept it follows that the best way to determine the distribution of sedimentary rocks within a basin is to understand facies relationships and the tectonic setting of the basin. This concept makes good sense and obviously applies to the vast majority of sediments. The weakness of the concept is its inability to explain the "rare event." For these rare events, the episodic-oriented geologist commonly calls on the 1,000 yr storm, the 500-ft (150-m) waves from meteorites, the blanket of dust that extinguishes life.

Our experience, based on seismic stratigraphic studies tied to well and outcrop sections, indicates that yes, sediments are deposited episodically, but they are packaged in genetically related depositional packages or sequences that are shifted back and forth in a predictable global cyclic pattern. We believe this global cyclic pattern is caused by rapidly fluctuating eustatic changes of sea level superimposed on more slowly changing tectonics. Each sequence is composed of all the rocks deposited during a complete cycle of sea level starting with the fall and progressing through the succeeding low, rise, and high before the next fall. We believe orderly cyclic sedimentation caused by eustatic sea level changes is a better explanation for many of the rare events. Deep-marine massive sand fans and debris flows commonly ascribed to 1,000 yr storms or 500-ft (150-m) tidal waves may be explained better by rapidly falling sea level or sea level lows. Rapid rises of sea level and their associated condensed stratigraphic sections offer an alternative explanation for the massive faunal extinction and rare deposits associated with the Cretaceous-Tertiary or Eocene-Oligocene boundaries.

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Comparison of Two Holocene Tidal Flats—Andros Island, Bahamas, and Caicos, British West Indies

Minor climatic and physiographic differences have caused dramatic differences in sedimentation between the tidal flats of Andros, northwestern Bahamas, and Caicos in the southeastern Bahama chain.

Both tidal flats are leeward of large islands and adjacent to broad, shallow platforms that provide carbonate mud to the flats. Each flat forms a sediment wedge 4 m (13 ft) thick (Andros flats are 200 × 30 km, 125 × 19 mi; Caicos, 60 × 10 km, 37 × 6 mi), and each contains an outer channeled flat and an inner algal marsh. Both flats have cementation and protodolomite forming on channel-margin levees and the inner algal marsh.

Differences in rainfall, wind regime and orientation promote important sedimentological differences. Andros receives nearly twice as much rainfall as Caicos; gypsum forms in cemented crusts in Caicos, but not on Andros. Andros receives brief strong pulses of northwest wind following passage of 40 to 60 winter cold fronts per year. The northwest exposure of the margin of the Andros flat thus is flooded several times each year by sediment-laden waters. This flooding focuses on the shore and channel margins, building broad, strongly laminated levees. Caicos flats, in contrast, face south, and neither winter cold fronts nor summer trade winds blow onshore. Levees are poorly developed. Caicos is dominated by brisk easterly trade winds, causing persistent turbidity in nearshore waters. This is dispersed through tidal channels, largely filling interdistributary ponds to a level at which organic-rich intertidal algal mats can flourish. Lower energy conditions on Andros provide insufficient sediment to fill ponds.

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Volcanogenic Alluvial Fan Sedimentation, Puye Formation, New Mexico

The Pliocene Puye Formation of north-central New Mexico represents a rift-filling volcaniclastic alluvial fan sequence developed on the east flank of the Jemez Mountain volcanic pile. This coarse-grained sequence can be separated into two compositionally distinct members that are genetically unrelated. The basal Puye (here referred to as the Totavi Member) consists of a 25-m (82-ft) thick, clast-supported conglomerate with interbedded sandstone lenses. The Totavi is a coarse-grained braided stream deposit composed of reworked Precambrian terrane of the Sangre de Cristo Mountains and mafic lavas of the Taos basin. The sequence displays cross-bedded sandstones and conglomerates, and well-developed clast imbrication and long-axis orientation, which indicate a paleoflow direction to the southwest. The Totavi member is an axial-stream gravel deposit of the Rio Grande rift.

The Totavi member is conformably overlain by a 100+ m (330+ ft) thick volcanogenic alluvial fan deposit here referred to as the San Ildefonso Member. This member represents the eroded and reworked detritus of the growing silicic volcanic complex of the Jemez Mountains. The San Ildefonso Member consists of four major interstratified lithofacies associations. These include: (1) clast-supported, massive and horizontally stratified conglomerates, with interbedded sandstones; (2) matrix-supported conglomerates; (3) laminated claystones and mudstones; and (4) primary pyroclastic deposits of both silicic and mafic composition. The clast-supported conglomerates and interbedded sandstones are typical coarse-grained, braided-stream deposits representing longitudinal bar and minor transverse bar accumulations. Internal stratification and clast imbrication points to an easterly flow direction.

The matrix-supported units display a complete spectrum of types from clast-rich (debris flows) to clast-poor (mudflow) varieties. These deposits are sediment gravity flows developed in response to steep slopes, abundant unconsolidated volcanic detritus, and excessive loading by water uptake. A number of debris flows and mudflows are underlain by primary volcanic airfall material and were undoubtedly initiated by volcanism.

The laminated claystones and mudstones are lacustrine deposits that resulted from temporary damming of the alluvial fan and ancestral Rio Grande drainage systems. The San Ildelfonso Member contains at least 7 primary silicic air fall ash beds and 3 basaltic ash beds. These not only provide a time framework for sedimentation but can be used to delineate lateral facies changes.

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Coorong Dolomites (South Australia) and Models of Ancient Coorong-Style Dolomites

The Coorong Dolomites and associated magnesian and calcian carbonate muds form sporadic deposits over a 90 × 200 km (56 × 125 mi) area of coastal dune strand plain in southeastern South Australia. They are deposited wherever the Pleistocene dune surface intersects the water table. A reconstruction based on the hydrological setting of the Coorong is a facies mosaic model. It includes the ideas that: (a) dolomite and magnesian carbonate deposition was widespread and associated with resurging continental groundwater; and (b) although widespread, the actual volume of "primary" dolomite is insignificant compared to the total volume of lacustrine and other carbonate sediment.

The lacustrine sediment in the interdunal depressions builds up to the highest level attained by the water surface, equivalent to the outcropping water table. The upper portion of these carbonate muds often contains one, sometimes two, indurated crusts. Such crusts contain subtle, small-scale structures called extrusion tepees. These tepees form as layers of mud are injected from below into megapolygonal cracks in the crust. Successive layers of mud are cemented to the sides of the crack as the lake desiccates each summer. Ongoing episodes of injection and cementation expand the crust volume until it overthrusts into large-scale tepee structures.

An ancient "Coorong-type" dolomite is a shallowing upward mudstone sequence which shows increasing evidence of subaerial exposure in the upper levels of the cycle. The lower portion of the cycle is a relatively thick, organic rich, laminated, calcitic mudstone (2–3 m, 7–10 ft, thick). This passes up into a lighter, highly bioturbated and pelleted dolomudstone (1-2 m, 3-7 ft, thick). The upper zone is characterized by crusts containing extrusion tepees, intraclast breccias, and siliceous cements. The succession is capped by a well-developed palaeosol with portions of the uppermost zones sometimes showing evidence of dedolomitization.

One should be wary of the idea that ancient Coorong-type dolomites are never associated with evaporites. In the modern Coorong lakes, gypsum and halite grow as an ephemeral phase in the near surface and surface muds during late summer. The same crystals are dissolved out by winter rains, and their molds destroyed by bioturbation and the thixotropic nature of fresh dolomite mud. In Precambrian analogs, the lack of bioturbation could lead to the retention of some evaporite pseudomorphs. Also the modern hydrology of the Coorong is highly compartmentalized. A laminated gypsarenite sequence at least 2 m (7 ft) thick is