laminite, tidal-flat unit locally interrupts the marine limestone sequence at the western (more offshore) end of the Grand Canyon.

The 250-500 m Cambrian sequence appears to consist of more than 30 laterally persistent sedimentation cycles that are grouped into 5 grand cycles. The basal Tapeats Sandstone and the clastic and carbonate tidal flats are not cyclic.

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MICROSTYLOLITES, BEDDING, AND DOLOMITIZATION

Microstylolites are fine dissolution surfaces, with a relief of only 20-40 microns, on which a thin film of silicic-clastic clay and platy silt is concentrated. They commonly form in slightly shaly limestone during secondary (overburden) compaction. Two causes appear to inhibit microstylolite growth: the film concentrate of clay and silt chokes the dissolution surface as a pathway for fluid migration, and acts as a glide plane to relieve stress along the surface.

Microstylolites can accentuate or distort primary sedimentary structures and appear to control the pattern of dolomitization. 1. They commonly accentuate stromatolitic or ripple laminations and outline limestone intraclasts. 2. Thinly-bedded, knobbly, nodular, lumpy, braided or boudinage limestones, characteristic of Paleozoic platform carbonates, appear to result from a microstylolitic induced distortion of originally thin, continuous beds of slightly shaly, pelleted lime muds interbedded with limy (now dolomitic) shale. "Swarms" of subhorizontal, interconnected microstylolites are present throughout both the dolomitic shale interbeds and the dolomitic areas between limestone knobbles. Thin swarms penetrate the sides of limestone knobbles, cutting off clots of limestone. The areas between adjacent knobbles have undergone 20-80% solution thinning, with tension fracturing of the brittle limestone knobbles and flowage along microstylolite surfaces into the area between knobbles. Overburden compaction with microstylolitic dissolution and flowage explains the knobbly bedding. 3. Zoned dolomite rhombs (less than 60 microns) are present in intimate association with microstylolites. In knobbly limestones these rhombs are much coarser than unzoned rhombs scattered throughout the limestone, and are so abundant that they cannot be explained as a simple stylolite solution concentration. Rather, some attribute of the microstylolites, *i.e.*, permeability-controlled fluid migration, composition of concentrate, or differential pressure, provided preferential conditions for dolomitization. Much of the fine-scale, primary or stratigraphic dolomite appears to be a product of preferential dolomitization along microstylolites.

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ABYSSAL SEDIMENT BURROWERS—TRACE FOSSILS IN CARIBBEAN CHALKS AND MARLS, DEEP-SEA DRILLING PROJECT CORES

Cores recovered in the Caribbean Sea on JOIDES Leg 15 exhibit a superb assemblage of biogenic sedimentary structures. They are identified as distinctive trace fossils (ichnogenera) similar to those well-known from land-based stratigraphic sections. They represent the burrowing behavior of benthic animals living contemporaneously with sedimentation.

Some of the best examples are at sites 146 and 149 in the Venezuelan basin. These adjoining sites were drilled in abyssal depths of 3,949 and 3,472 m, respectively, and provide a complete section from Coniacian to Pleistocene. Faunal and sedimentologic evidence from the cores suggests that deposition was abyssal.

The most distinctive biogenic structures are *Zoophycus* (a spiral web), *Teichichnus* (a laminated trough), and *Chondrites* (a regularly branched system). These represent the deep-water trace fossil assemblage of Seilacher, which has been documented in rocks of various ages deposited in bathyal and abyssal frameworks from widespread geographic areas.

Because similar trace fossils are present throughout the Phanerozoic, it is disappointing that they are not recognized in modern deep-sea sediments, and the animals responsible for them have not been identified. One reason is that the traces are accentuated only with time. Our material shows a progressive enhancement of biogenic structures, from vague outlines in the softer Tertiary sediments to increasingly marked contrast and detail downward in the cores. Furthermore, little knowledge exists about modern abyssal burrowers and their burrows, and few cores have been taken for the identification of potential fossil traces.

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ULTRAMORPHOLOGY OF CARBONATE AND SILICATE PHASES ASSOCIATED WITH DEEP-SEA CHERT

Deep-sea diagenesis resulting in chert-nodule formation has been studied by scanning electron microscopy, light microscopy, X-ray diffraction, and electron microprobe analysis of core material recovered by the Deep-Sea Drilling Project (DSDP). Nodules in Tertiary chalk are generally cristobalite-rich, except where metastable silica has converted to quartz. At high magnification, fractures through nodules appear smooth, with little indication of intergranular pore space. Several transition zones may separate chert nodules from unsilicified host rock. For example, in DSDP sample 7/64.1/11/CC, a nodule is surrounded by a weakly silicified chalk zone several centimeters wide, in which interstices are partly filled with 10-micron-diameter cristobalite microspherulites (lepispheres). In a high-silica zone directly adjacent to the nodule, lepispheres are more numerous and exhibit hollow centers. At the chalk-chert boundary, the chalk groundmass has been largely replaced by isotrophic silica, which occludes pore openings but not the hollow centers of the lepispheres. These can be traced for several millimeters into the nodule. Chalcedony within foraminiferal chambers is present in cherts and silicified chalks, but is more common toward the centers of nodules. Fracture surfaces, however, reveal no differences in ultramorphology between groundmasses composed of isotropic silica and those of chalcedonic quartz.

Growth of chert nodules causes dissolution and displacement of most (but not all) of the organic calcite which forms the chalk. Some displaced carbonate in reprecipitated as ultra-fine, euhedral calcite grains within chalk interstices adjacent to nodules. These are probably the supposed calcium-silicate intermediary mineral grains, which some investigators have reported at chert-chalk boundaries. Calcite also may be precipitated as secondary overgrowths on radial prisms of some planktonic foraminiferal tests. This produces characteristic euhedral terminations on inner and outer chamber surfaces.

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SEDIMENTATION ON BALEARIC RISE, A FOUNDERED BLOCK IN WESTERN MEDITERRANEAN

The fan-shaped Balearic rise, southeast of the islands of Mallorca and Menorca, lies at the base of the Emile Baudot escarpment at a depth of 1,600-2,600 m. A sparker, 3.5 Khz profiler, and coring survey reveals that the rise, unlike most deep-sea fans, is almost entirely tectonic in origin. It is a post-Miocene, block-faulted terrane with a thin sediment cover. A large valley, heading between Mallorca and Menorca, follows