diastems are commonly characterized by a hardground which ideally has a bored or abraded surface; holdfasts of sessile organisms or encrusting fauna; and intraclasts derived from the hardground in overlying sediments.

Petrographic examination of Holocene hardground samples from the Persian Gulf and the Bahamas establishes the morphologic habit of contemporaneous interparticle submarine cements. Micritic high-magnesium calcite, fibrous aragonite, fan druses of aragonite, and a graded calcite mosaic (crystal size increases away from nucleation site and crystals exhibit sweeping extinction) are characteristic cements.

Inspection of relict cement morphologies in ancient hardgrounds suggests at least five petrographic criteria for the recognition of synsedimentary cementation: (1) a graded calcite mosaic in which crystals exhibit sweeping extinction; (2) impurities incorporated in blocky calcite which occur in fibrous bundles perpendicular to the site of nucleation; (3) a graded clastic mosaic with incorporated layers of micrite (only on the up side) that parallel the nucleation site; (4) radiaxial fibrous cement; and (5) micritization present only on the upper surface of the hardground horizon with no intergranular penetration of micrite below. Further observations include borings which cut grains; truncated grains at apparent breaks in sedimentation; absence of overlying sediment in grain interstices; intraclasts exhibiting borings and/or encrusting fauna; and obvious absence of compaction of grains.

Because permeability and porosity are greatly reduced along hardgrounds, they may provide effective seals within carbonate reservoirs acting not only as hydrocarbon traps but also as inhibitors to vertical migration of potentially cementing fluids.

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Seismic Stratigraphy Interpretation of Paleocene, Fort Union Formation, Wind River Basin, Wyoming

The integrated use of seismic reflection data and conventional well logs allows a time stratigraphic reconstruction of lithofacies in the Fort Union Formation in the western part of the Wind River basin, a sedimentary and a structural basin formed during the Laramide deformation. During latest Cretaceous through early Eocene time, the basin was infilled with a continuous sequence of alluvial, fluvial, and lacustrine sediments. The Paleocene Fort Union Formation can be divided into two general lithologic units: a lower fluvial unit of sandstone, conglomerate, shale, and carbonaceous shale and an upper unit of fine-grained clastics deposited in and adjacent to Waltman Lake.

Lithofacies in the Fort Union Formation can be recognized on seismic reflection data as lateral variations in the reflection amplitude and continuity. Three major unconformities are recognized within the Fort Union Formation. Two unconformities are indicated by strong reflectors with widespread continuity at the top of the lower Fort Union and about 300 ft (91 m) below the top of the lower Fort Union. A third unconformity is present at about the middle of the upper Fort Union Formation. Mapping of seismic facies with the aid of scattered well control allows the reconstruction of regional depositional settings and lithofacies.

Analysis of the stratigraphic framework of the Fort Union Formation is useful in providing a rationale for future hydrocarbon exploration. Gas production from the Fort Union Formation at Pavillion, Fuller Reservoir, and Frenchie Draw fields is a combination of structural and stratigraphic trapping.

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Carbonate Platform Slopes of Extensional Continental Margins

Carbonate platforms of extensional margins may be grouped into five major categories. *Homoclinal ramps* have gentle slopes into deep water and may have skeletal or ooid/pellet sand shoal complexes that grade without break in slope into deep ramp nodular limestone and thence into pelagic/hemipelagic basin facies. Homoclinal ramps generally lack significant slump and sediment gravity flow deposits in the deeper water facies. *Distally steepened ramps* differ from the above in having a marked increase in slope at the seaward edge of the deep ramp and abundant slumps, slope breccias, and turbidites. However, clasts of shallow platform margin facies are generally absent from breccias. *Rimmed shelves* have linear trends of shelf-edge lime sands and reefs, a marked increase in slope into deep water, and foreslope and slope sands, breccias (with clasts of platform margin rocks), and turbidites, grading seaward into basin margin hemipelagic/pelagic muds. They may be divided into accretionary, bypass, and erosional margins. *Isolated platforms* are broad flat-topped shallow platforms surrounded by deeper water (few hundred meters to 4 km deep). Most are bypass margins but accretionary and erosional margins also occur. Finally, *drowned or open platforms* may develop by rapid submergence of ramps, shelves, or isolated platforms. Platform margin facies are shifted landward and the earlier shallow-water platform is covered with transgressive lags and deeper water blankets of hemipelagic or pelagic facies, or open-marine, whole fossil wackestones. The various platform types may be recognized from continental margin sequences ranging from Proterozoic to Holocene in age.

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Paleoecology of Oligocene Reef Tract, Southwestern Puerto Rico

A well-exposed, late Oligocene, barrier-reef sequence, approximately 60 m thick, outcrops for at least 25 km between Guayanilla and Guanica near the southwestern coast of Puerto Rico. A virtually complete range of reef tract environments, from lagoon to deep fore-reef and basin slope, is present. *Porites-Caulastrea* patch reefs occur in lagoonal miliolid wackestone and packstone, while reef-flat coral shingle is represented by rudaceous grainstones. The reef-crest and reef-front zones are constructed of more than 30 species of hermatypic scleractinian corals. The reef core consists of coral boundstone framework with massive heads in point-to-point contact. The upper fore-reef facies is wackestone with a distinctive assemblage of reef corals, many of which exhibit flattened growth form. Deep fore-reef deposits are packstones of the prolific large foram *Lepidocyclina (E.) undosa,* while deep-basin facies are composed of pelagic mudstones, clays, and chalks which are interbedded with coral-bearing turbidites. The sequence of reef development displays a classic example of community succession from pioneer through intermediate and climax seral stages, with the coral *Porites* occupying a dominant to predominant role.

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