Topographic development was further enhanced by changes in climate and fluvial response during glacial and interglacial periods. Glacial periods were characterized by increased rainfall which resulted in downcutting and erosion of the divides by major rivers. Interglacial periods were characterized by a rise in regional base level accompanied by fluvial aggradation. The net effect has been a reversal of topography in which the Uvalde Gravel, which occupied the bottom of river valleys at the time of deposition, now caps the highest divides. Studies of modern erosion rates indicate that man's activities, mainly agricultural, have greatly increased the rate of landscape evolution.

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Intertidal Cementation: Some Geochemical, Mineralogical, and Petrographic Considerations

The chemistry, mineralogy, and petrography of intertidal cements are dependent on the chemical and physical characteristics of the waters from which they were precipitated—as well as on the biota this water supports. The study of Holocene cementation in Boiler Bay, St. Croix, Virgin Islands, is well suited to illustrate the basic constraints that the chemistry, mineralogy, and petrography of the cements place on any model of beach rock origin. Boiler Bay contains a well-developed beach rock pavement cemented on its western extremity by rhombohedral-bladed, circumgranular magnesian calcite cement, and on its eastern end by acicular, circumgranular aragonite cement. These facts indicate that, although the precipitational fluid was dominantly marine and cementation occurred under phreatic conditions, western beach rock cements were precipitated under a different geochemical regime than were those cements in the east. Pelleted magnesian calcite micrite cements that are characteristic of the seawardmost parts of the beach rock pavements (as well as submarine cements occurring in offshore reefs) were found by scanning electron microscopy to be biologic in origin. Backbeach cemented zones are characterized by low to high magnesian calcite, rhombohedral, equant-to-bladed circumgranular crust cements. This combination of cement mineralogy-petrography indicates fresh to marine, phreatic precipitational conditions in the backbeach area. Cement chemistry, particularly magnesian carbonate content in the calcites and strontium contents of aragonite and calcite, indicates that the beach rocks of western Boiler Bay were precipitated from mixed marine-fresh meteoric waters, and that the eastern Boiler Bay beach rocks were precipitated from normal marine waters with no freshwater influence. Backbeach cements of western Boiler Bay show a complete gradation of cement fabric, mineralogy, and chemistry that would indicate a classic fresh-marine water mixing zone. Hydrogeochemical studies of beach and near-beach interstitial waters confirm that western Boiler Bay is a locus of freshwater influx into the marine system. It would seem, then, that the mineralogy of Boiler Bay beach rock is controlled by fresh-marine water mixing.

Artificial substrate experiments, using the western Boiler Bay observation wells, pinpoint the locus of cementation in this area as being within the fresh-marine water mixing zone near the upper surface of the water table. In addition, these experiments indicate that cement growth can be independent of substrate mineralogy and that organic coatings on cement substrates may ultimately be one of the major controls over initial cementation patterns. Finally, the experimental approach in the intertidal environment may well enhance our understanding of controls over carbonate cementation.

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Jurassic Subsurface Calcite Cementation, Central Gulf of Mexico

Calcite cements of subsurface origin have received increased notice in the past several years, particularly in Jurassic Smackover sequences of the Central Gulf by Moore and Druckman in 1981. Initially, documentation of the subsurface origin of these cements centered about petrographic evidence: fractured grains encased in poikilitic cements as well as pressure dissolved grains covered with cement. Although petrographic data did indicate some burial prior to cement precipitation, burial depth at the time of cementation remained uncertain because of our general lack of knowledge relative to the failure of carbonate grains under confining pressure, elevated temperatures, and changing fluid compositions. Subsequently, study by Klosterman in 1981 and Moore and Druckman in 1982 of the two phase fluid inclusions common to these cements indicated that elevated temperatures (85 to 112°C; 185 to 234°F) and saline brines similar to present Smackover fluids may have been present at the time of cement formation. If indeed the precipitation fluids were similar to present Smackover brines (ten times more saline than seawater with a $\delta^{18}O$ composition near +5), the -6.5 $\delta^{18}O$ composition of most of these cements is compatible with a temperature of 90°C (194°F) because of the strong temperature dependence of oxygen isotope fractionation. Final confirmation of the deep subsurface origin of many of these cements may well rest with their apparent equilibrium with present Smackover brines relative to radiogenic strontium. Most Smackover brines and associated post composition poikilitic calcite cements analyzed to date show an enrichment in radiogenic strontium well above Jurassic seawater values, whereas adjacent grains have radiogenic strontium compositions near that of Jurassic seawaters. Trace element composition of these deep subsurface cements, particularly relative to total strontium, present an enigma. Although present Smackover fluids have a high Sr/Ca ratio (almost four times greater than seawater), the late subsurface cements that have presumably been derived from these fluids have Sr compositions averaging only 200 ppm, well below the values predicted by using Katz et al's 1972 distribution coefficient (1,350 ppm) or Kinsman's 1969 distribution coefficient (3,000 ppm). These discrepancies certainly indicate that kinetic and compositional controls over trace element distribution coefficients must be reassessed for the carbonate system in the subsurface environment.

The most common subsurface cement (demonstrably post compaction, coarse, clear, single unzoned crystals of a poikilitic habit) generally represents a very late stage diagenetic event. A second type subsurface cement, much less common than the first, that generally consists of an interlocked mosaic of coarse crystals, usually fills large sheltered voids, such as gastropod molds, that exhibit a complex iron zonation as seen by staining or cathodoluminescence. Isotopic composition of these zoned calcites consistently show a progressive depletion of $\delta^{18}O$ of some 4 per mil, from center to crystal termination. The lightest composition overlaps the -6.5 $\delta^{18}O$ of the late stage unzoned poikilitic cements described. These calcites, based on petrography and stable isotopic composition, seem to represent an intermediate stage of diagenesis and burial. Dissolution associated with progressive pressure solution during the first stages of burial is the most logical source of the carbonate needed for the calcite precipitation of the zoned cements. A potential source for the carbonate needed to form the late stage poikilitic calcites is deep subsurface calcite

dissolution associated with hydrocarbon maturation-migration.

The understanding of these subsurface cements helps decipher the diagenetic history of carbonate rock sequences during progressive burial and can be particularly helpful in timing hydrocarbon migration.

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Development and Infilling of the South Pass Shelf-Edge Failure Bowl, Offshore Mississippi Delta

The South Pass shelf-edge failure complex, which extends from the continental shelf edge to the Mississippi fan, is one of several expressions of late Pleistocene seafloor failure identified off the Mississippi River delta. The headward portion of this feature lies within a 240 km^2 (93 mi^2) study area located 22 km (14 mi) south of South Pass. Water depths within the area range from 50 to 400 m (165 to 1,300 ft). High-resolution sparker and Acoustipulse seismic data have been correlated with borehole information and radiocarbon dates to document the failure and subsequent infilling of the headward bowl of this massive feature.

Radiocarbon dating of the sediments cut by the failure feature suggest that it was formed 25,000 to 20,000 years ago. The buried failure surface represents the evacuation of a slab of sediments approximately 200 m (660 ft) thick with a volume of 40 km^3 (9.5 mi^3) from within the study area. Dating of the post-failure sediments indicates that the infilling process was essentially complete by 15,000 y.B.P.

Seismic stratigraphic techniques, and lithologic and geotechnical borehole data were used to subdivide the evacuation and infilling into seven stages. These stages are represented by four surfaces of unconformity and the sediment packages they enclose. Sea level, morphology of the depositional surface, contemporaneous structure, sediment accumulation rate, depositional source, and erosion controlled the duration and development of these stages.

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Lake-Margin Deposition in Ensialic Rift Basins—The Miocene Chalk Hills Formation of the Southwestern Snake River Plain

Over 120 m (400 ft) of terrigenous sediment within the Miocene Chalk Hills Formation was deposited in proximal to distal fluvial to lacustrine settings during extensional tectonism along the southwestern Snake River Plain. spectacular exposures of basin-fill facies along deep tributary gorges allow for detailed reconstruction of major sedimentary environments along this extensional basin margin.

Vertically, Chalk Hills sediments comprise a transgressive sequence of fluvial-floodplain, marginal lacustrine, and deep lake systems which progressively onlap basin-margin silicic volcanics. Fluvial-floodplain facies, deposited in and along large, slightly sinuous rivers, consist of trough-cross-bedded boulder gravel to coarse sand paleochannels which incise floodplain fine sands and muddy silts. These pass basinward and vertically into coarse, marginal lake facies, commonly exhibiting tabular cross-sets in excess of 18 m (60 ft) in thickness, with individual inclined units reaching 1 m (3.3 ft) in thickness. These constructional units are characterized by dips to the northeast of 15 to 22°. Closely spaced sections demonstrate that most well-developed foreset-topset couplets have great extent along the basin margin, and were probably deposited as lateral benches which repeatedly developed along interfluvial headlands. Coarse sediment supplied from one or more fluvial sources along the lake margin was winnowed by waves on shallow bench platforms prior to deposition on steep basinward-dipping bench slopes. In addition, localized Gilbert-type deltas may have been responsible for lobate cross-set sequences which are laterally restricted in comparison to the tabular cross-sets which characterize bench sequences. Marginal lake facies in turn grade basinward and upward vertically into deep lake silts and muds which were deposited during continued lake transgression over steep lake margin volcanics. These units are commonly horizontally bedded or massive.

Unlike lacustrine systems deposited in broad compressional intermontaine basins, facies within the Chalk Hills Formation of the southwestern Snake River Plain exhibit abrupt lateral and vertical changes, recording both spatial narrowness and temporal instability of fluvial-lacustrine transitional environments in extensional rift basin settings. The unique relationships exhibited by these sediments, resulting from tectonic instability, may be characteristic of many rift-valley lacustrine systems.

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Radiolarians in Plankton Samples from Ice-Covered Antarctic Waters

Plankton tows taken within the Antarctic sea ice in late October through November 1981, as part of the US-USSR Weddell Polynya Expedition contain numerous varieties of polycystine and tripylean radiolarians. Fifteen tows at nine sites sampled the zooplankton at specific intervals within the water column along a north-south transect extending over 300 km (190 mi) within the ice.

Although chlorophyll A levels were relatively low (≤ 0.1 mg/m^3) in samples taken under the ice, the total number of polycystine and tripylean radiolarians per cubic meter of filtered seawater ranged from 20 to 50% of that reported from open-ocean sites. At several of the ice stations, the number of radiolarians per cubic meter of filtered seawater was similar to that recorded at the ice edge, even though ice-edge chlorophyll levels were 100% higher than levels at sites in the ice. The relatively high number of radiolarians found under the ice is even more unusual considering that the region has been completely ice-covered for a minimum of 4 months prior to sampling.

Although most species were found living above and below the thermocline/halocline, specific species such as *Spongotrochus glacialis* Popofsky and *Lithelius nautiloides* Popofsky were most abundant in tows which sampled the water column above this oceanographic boundary. Comparison of this plankton-tow data with that from Antarctic surface-sediment samples shows, that with few exceptions, the relative abundances of specific polycystine species in the water column are comparable to those found in the surface sediments.

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Extending Present Coal Reserves with Self-Bursting Coal Pellets

A new scheme is proposed which would extend our present reserves of coal by making use of what is now a waste product.