

equilibrium vapor pressure, and for durations of days to months. Solution compositions were varied to examine the effects of ionic strength,  $Mg^{2+}/Ca^{2+}$  ratio, and  $SO_4^{2-}$  concentration on the direction and/or rate of reaction. The starting solid for these experiments was a stoichiometric and well-ordered synthetic dolomite; several experiments were also seeded with solid reagent-grade calcium carbonate (calcite).

In pure  $CaCl_2$  solution (0.1 M) replacement was complete in less than one week at temperatures of 100° C (212° F) and greater. Replacement was minor after several weeks at 50° C (122° F). Longer term experiments at 50° are still underway. A series of experiments established that dedolomitization only occurs at  $Mg^{2+}/Ca^{2+}$  ratios of less than 1/10 (total ionic strength = 0.1) at all temperatures from 100° to 200° C (212° to 392° F). Because this reaction proceeds far faster than the reverse reaction (dolomitization), we believe this result establishes the most precise calcite/dolomite phase boundary to date. The presence of  $SO_4^{2-}$  was found to strongly inhibit the dedolomitization reaction, even at concentrations far less than in seawater. Seeding the reaction with a small amount of calcite had little effect on the rate of reaction, suggesting that nucleation is not rate-limiting in dedolomitization. Finally, increasing ionic strength from 0.01 up to 0.5 increased the rate of reaction.

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#### Diagenetic Evolution of a Silurian Limestone Reef: Geochemical Documentation of Mixed-Water Dolomitization

Examination of a partially dolomitized Silurian platform reef (Pipe Creek Jr.) indicates that the timing of dolomitization is tightly constrained within the calcite diagenetic sequence. Cathodoluminescence and isotopic analysis of calcite diagenetic components define the diagenetic environment and fluid chemistries at the time of dolomitization.

Abundant syntaxial and fibrous calcite marine cements suggest syndimentary lithification of the reef complex. Multiple episodes of subaerial exposure are recorded both in the petrologic fabric as well as in the geochemical signatures of altered marine components and equant calcite cements. In the upper reef, marine components are corroded, and resulting porosity is partially infilled by red geopetal vadose silts. Resubmergence and continued marine cementation establishes a Silurian timing for this initial episode of exposure.

Evidence for subsequent exposure is contained in the isotopic and cathodoluminescent patterns of later marine cements and overlying equant calcite spars. Marine cement isotopic compositions deviate from an initial marine composition ( $-4.0\text{‰ } \delta^{18}O$ ;  $+2.0\text{‰ } \delta^{13}C$  PDB) along covariant trends that reflect alteration by diagenetic pore waters. Equant calcite cements are restricted to the upper reef and partially occlude primary porosity. These cements exhibit invariant oxygen compositions between  $-7.0$  to  $-8.0\text{‰}$  and variable carbon which shows progressive depletion toward the upper reef. On this basis we interpret these cements as having formed within a shallow meteoric phreatic lens with light carbon derived from soil-gas  $CO_2$  at the exposure surface. Cathodoluminescent patterns and sulfide mineralization indicate progressive reduction of pore waters in the meteoric lens. The latest stage of phreatic cementation records anaerobic fermentation during which the oxygen composition remains unchanged with carbon varying up to  $+7.0\text{‰}$  following precipitation of pyrite.

Dolomitization occurs within this sequence of meteoric phreatic diagenesis. Early zoned meteoric spars, reflecting initial fluctuations in reducing conditions, are corrosively overlain by dolomite. The earliest formed dolomite is luminescent, signifying reduction of manganese, and is overlain by an outer ferroan dolomite. A progressive increase in reducing conditions is further indicated by the reduction of sulfate and concomitant precipitation of pyrite. The heavy carbon equant calcites, which postdate pyrite, suggest anaerobic fermentation during the final stages of phreatic cementation.

Because dolomitization is bracketed by events of meteoric phreatic cementation and diagenesis, and its chemical evolution mimics the progressive reduction of the pore-water system, we suggest a mechanism of meteoric-marine water mixing to account for partial dolomitization of the Pipe Creek Jr. reef. This does not, however, imply a similar mechanism for the pervasive dolomitization of adjacent shelf reefs. Rather, this study emphasizes the complex early diagenetic history of shelf sequences with implications for late Silurian sea level fluctuations.

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#### A Community Model for Coalbed Methane Utilization

The University of Alabama at Tuscaloosa provides a model for community utilization of coalbed methane and energy independence. A feasibility study for coalbed methane development has been completed through a grant from the U. S. Department of Energy. The total resource available beneath the 760-acre (310-ha.) campus is estimated to be nearly 10 bcf. The Mary Lee Coal Group alone contains more than 3.4 mcf of gas, assuming 75% recovery.

As a result of an economic analysis, two exploration/research wells have been completed to depths of 2,289 and 2,760 ft (698 and 841 m) respectively.

The university is currently in the process of unitizing with Bryce and Partlow Hospitals. The combined acreage is approximately 2,000 acres (800 ha.). It is anticipated that coalbed methane could meet the gas demands of all three facilities for many decades. The methane will be used for space heating, domestic hot water, and for compressed natural gas (CNG) to operate the university's vehicle fleet.

Recently the university, along with Southern Company Services, Kaneb Services, and the Gas Research Institute, has embarked on a demonstration project to evaluate the feasibility of using coalbed methane as a primary fuel source for a fuel-cell power plant. A 40-kW fuel cell will be utilized to provide both electricity and hot water for the student recreation building.

These coalbed methane utilization activities should provide planning information for communities located over coal lands to develop independent resources and provide long term energy alternatives.

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#### Tide-Dominated Delta Model for Coal-Bearing Wilcox Strata in South Texas

Coal-bearing Wilcox strata near Uvalde in south Texas are the deposits of a tide-dominated delta. The delta of the Klang and Langat Rivers, Malaysia, provides a modern analog for these strata. Five facies have been identified from a study of core and well logs: (1) lignite, (2) underclay, (3) interbedded sand and mud with lenticular, wavy, and flaser bedding, (4) ripple-laminated or cross-bedded sand, and (5) greenish, very strongly bioturbated sand. On the Klang-Langat delta, the modern equivalents of these facies are (1) peat formed in freshwater swamps, (2) root horizons developed beneath the peat (3) interbedded sand and mud deposited on tidal flats, (4) channel sands, and (5) shallow marine sand and mud.

Tidal flat deposits are the most abundant type of sediment on the Klang-Langat delta and in the coal-bearing Wilcox strata. The tidal flats of the modern delta are crossed by small tidal creeks and by larger tidal streams. The tidal channels are cut into tidal flat sediments and separate peat-forming areas. Channel sands in the Wilcox are cut into tidal flat deposits and form washouts in the lignite. Two types of channel-fill sand are present in the Wilcox, sands 5-15 ft (1.5-4.5 m) thick and sands more than 30 ft (9 m) thick. The thinner sands, deposits of small tidal creeks, have sharp, erosive bases, fine upward and pass into interbedded sand and mud. The thicker sands have sharp tops as well as sharp bases and show no grain-size trends; they are fills of larger tidal streams.

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#### Depositional Environments, Conodont Biostratigraphy, and Porosity Diagenesis of Montoya Group (Upper Ordovician), Sacramento Mountains, South-Central Mexico

Intensely dolomitized and siliceous marine carbonates comprise Upper Ordovician strata in the Sacramento Mountains, New Mexico. Pray subdivided these units into lower Montoya, upper Montoya, and Valmont formations. These strata are more appropriately designated the Montoya Group which includes 3 formations: Second Value, Aleman, and Cutter.

The subrounded, medium to coarse-grained sandstone rests disconformably on the Lower Ordovician El Paso Formation. This thin sand (Cable Canyon Member of the Second Value Formation) represents a