laminar crusts with pisolites. Fractures are filled by micritic laminae, microspar, spar, and terra rossa.

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Estimating Unconformity Thicknesses from Vitrinite Reflectance Data

Combining variations of vitrinite reflectance with depth and burial history information enables estimation of the paleoheat flux-time derivative, β. In the presence of an unconformity, the residual r.m.s. fit of the paleoheat flux to the observed data is significantly improved when the unconformity thickness (h) is allowed to be a free variable. A best unconformity thickness that minimizes the residual r.m.s. fit to β can be determined, providing a new method of determining simultaneously paleoheat flux and unconformity thickness.

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Seismic Expression of Catastrophic Slope Failure: Lower Cretaceous Torok Formation, North Slope of Alaska

Seismic geometries in the deep marine Torok Formation illustrate that catastrophic slope failure involving both slope and basin-plain sediments occurred during Early Cretaceous time on the North Slope of Alaska. The magnitude of the failure emphasizes the importance of slumping and sliding as processes of mass transport of sediment in the deep marine environment.

Torok sandstones and shales were deposited on continental slopes, basin plains, and submarine fans. Fluvial-deltaic sands and shales of the Nanushuk Group are the time-equivalent shelf deposits. The Nanushuk-Torok relationship is expressed seismically as offlapping reflectors that record shelf-edge progradation. Slumps and slides are common on Torok slopes where gradients of up to 10° are documented.

The largest such feature, located near Harrison Bay, is 1,500 mi^2 in area and 2,000 ft thick. The disturbed zone is lobate in plan view, wedge shaped in cross section, and thins basinward from a dramatic scarp deeply incised into Torok foreset beds. Seismically, the slide is expressed as a series of remnants of undisturbed or rotated glide blocks that strike parallel with the slump scarp and are encased in chaotically bedded slump debris. Geometric similarities to the Turnagain Heights slide (Anchorage, 1964) suggest block gliding as the mechanism of slope failure.

Because the Torok was initially sand-poor, wells drilled through glide blocks and slump debris encountered predominantly shale. Understanding similar seismic geometries in other slope systems will aid in their evaluation as hydrocarbon traps. Favorable reservoir and trap scenarios include turbidite sands in remnant blocks trapped against slump fill and younger turbidite sands ponded behind remnant topography.

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Low to Intermediate Subsurface Temperatures Calculated by Chemical Geothermometers

The concentrations of silica and proportions of sodium, potassium, lithium, calcium, and magnesium in water from hot springs and geothermal wells have been combined into 14 chemical geothermometers that are used successfully to estimate the subsurface temperatures of the reservoir rocks. Modified versions of these 14 geothermometers and a new chemical geothermometer, based on the concentrations of magnesium and lithium, were used to estimate the subsurface temperatures (40°C-200°C) of more than 200 formation-water samples from about 30 oil and gas fields located in coastal Texas and Louisiana, Central Valley, California, and North Slope, Alaska. The new Mg-Li geothermometer, which can be used to estimate subsurface temperatures as high as 350°C, is given by:

$$t = (1{,}900/(4.67 + \log[(C_{Mg})^{0.5}/C_{Li}]) - 273$$

where t is temperature (°C) and C is the concentration (mg/L) of the subscripted cation.

Quartz, Mg-Li, Na-K-Ca-Mg, and Na-Li geothermometers give concordant subsurface temperatures that are within 10°C of the measured values for reservoir temperatures higher than about 70°C. Mg-Li, Na-Li, chalcedony, and Na-K geothermometers give the best results for reservoir temperatures from 40°C to 70°C. Subsurface temperatures calculated by chemical geothermometers are at least as reliable as those obtained by conventional methods. Chemical and conventional methods should be used together where reliable temperature data are required.

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Sketching Cross Sections with a Portable Microcomputer

Computer applications have been carried to the field long ago by geophysicists and their "dog houses." The advent of inexpensive battery-powered microcomputers promises to allow the field geologist to participate in this application. The field geologist may record data directly onto a computer-readable medium and calculate statistics or plot a cross section. A program for routine plotting of cross sections in the field has been developed and field-tested. The program proved to be useful to 30 computer-illiterate geologists on a 6-week mapping project in New Mexico. The program allows the user to control vertical exaggeration and displays the correct apparent dip along the chosen line of section. Cubic-spline interpolation is used to plot both topography and folded bedding planes. The program executes in Pascal on an Apple IIc in a few seconds.

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Regional Cement Stratigraphy and Diagenetic History of Waulsortian Limestones, Eastern Midlands, Republic of Ireland

The Lower Carboniferous Waulsortian Limestones, eastern Midlands, Republic of Ireland, contain 7 distinct luminescent zones in clear calcite cements that overlie inclusion-rich, marine cements in cavities and also fill fractures and aragonite-skeleton molds. The luminescent sequence, which records precipitation from increasingly reducing pore waters, is regionally and stratigraphically consistent over an interval more than 1,200 ft thick. Zone 1 cements are nonluminescent; zone 2 cements are brightly luminescent; and zones 3-7 cements are ferroan with a moderate to dull luminescence. Zone 1 cements (mean $-2.6‰\ \delta^{18}O/+3.3‰\ \delta^{13}C$ PDB) are slightly depleted in oxygen relative to radiaxial-fibrous cements (mean $-1.8‰\delta^{18}O/+3.5‰\delta^{13}C$ PDB) which have a composition that reflects Lower Carboniferous seawater. Zone 4 cements (mean $-4.1‰\delta^{18}O/+3.1‰\delta^{13}C$ PDB) are depleted in oxygen relative to zone 1, whereas zone 5 cements (mean $-11.8‰\delta^{18}O/+1.1\delta^{13}C$ PDB) are extremely depleted in oxygen and somewhat in carbon.

Locally intense dolomitization includes 2 regionally extensive generations of ferroan saddle dolomite. Petrographic relationships demonstrate these dolomite generations were replaced by zone 5 cement. Sulfide mineralization, principally pyrite and sphalerite, occurred after the precipitation of zone 5 cement.

Much of diagenesis occurred during a brief period in the Lower Carboniferous. Zones 1-6 and saddle dolomites are contained in Chadian (upper Osagean), shallow-marine facies overlying the Waulsortian. Fractures filled by zone 5 cements are truncated at the margins of Waulsortian clasts contained in a conglomerate overlying an early Arundian (early Meramecian) unconformity.

In the proposed model, marine pore waters were displaced by oxidizing meteoric waters, which became reducing with shallow burial. Warm brines were introduced during later stages of diagenesis and were involved in late calcite cementation (zone 4?-7), saddle dolomitization and sulfide mineralization.

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Algeria: Structural Evolution and Hydrocarbon Potential of a Complicated Tectonic Province

During most of the pre-Carboniferous, Algeria was part of a stable foreland platform on which a thick clastic sequence was deposited. Caledonian tectonics were primarily epeirogenic, but they established structural alignments that were further reinforced by the much stronger movements of the Carboniferous Hercynian orogeny.

In northern and eastern Algeria, a variable basal sandstone and a thick sequence of Triassic and Lower Jurassic evaporites were deposited over