Dilation breccia is a distinct form of nondepositional breccia. It probably occurs in many tectonic provinces.

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Laboratory Simulation of Organic Diagenesis Leading to Oil and Gas Formation

Simulated maturation experiments involving sediments of different source environments give quantitative and kinetic information about generation of petroleum and natural gas. Starting material, temperature, and heating time all play critical roles in determining quantity and type of reaction products. Samples from recent peaty lacustrine and algal mat lagoonal deposits were heated separately in closed systems for 1 to 15,000 hours at temperatures ranging from 35 to 550°C. Reaction products were monitored for both quantity and isotope data. Low molecular weight volatile compounds (C_1-C_5+, H_2, CO_2) and petroleum-range (C_{15}+) hydrocarbons were products.

Petroleum product formation occurs in three stages. A premature stage is characterized by production of volatile hydrocarbons and carbon dioxide but little change in C_{15}+ components. The volatile products are a result of kerogen and humic rearrangements and display marked kinetic isotope effects. In the mature stage, the original biologically related C_{15}+ hydrocarbon fraction is diluted by catagenetically derived products. Methane formed in this stage is derived from C_{15}+ components and is characterized by stable carbon isotopes 15 ppt lighter than the starting material. A postmature stage displays C_2-C_5+ and CO_2 reduction, forming isotopically heavy methane.

Temperature affected the rate of product formation but not the kinetic order governing the reaction or the ultimate production potential for petroleum-like hydrocarbons. Organic source affected both rate of hydrocarbon formation and specific intermediary products of thermal alteration. Peaty organic matter matures more quickly than algal material given the same thermal stress.

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Future Success Factors for Petroleum Geologists or What They Don't Teach in Departments

Educationally, today's graduates in geology are relatively well equipped. Yet, the post-academic success of these geologists relates to factors not in geology curricula or stressed by advisors. Although most supervisors consider technical competence, they base promotions and raises more on qualities of writing, oral presentation, work habits, creativity, initiative, logic, problem analysis, personality, and even appearance, rather than on geologic skills. Management selection often depends on impressions at conferences and brief contacts rather than on geologic aptitude. The formal evaluation system of companies often stresses non-geologic skills. Typical appraisal forms rate quality and quantity of work, initiative, creativity, judgment, relations with people, work habits, effectiveness of supervision, and other performance factors. Frustrations with paperwork and organizational procedures, and the resulting dislike for administrative activities, result from poor non-geologic management skills as much as the problems themselves. Success in pure staff geologic jobs depends on logic, creativity, writing, and speaking ability. In addition to teaching geologic skills, a professor's success depends on his ability to relate to, communicate with, and inspire students.

Solutions to these problems are difficult. Students and young geologists must become aware of these important factors. Curricula should be broadened and strengthened in these areas. Report writing and presentation should be emphasized in geologic course work. Course success should depend more on aptitudes in grammar, organization, logic, and spelling. Companies should include non-geologic factors in their training programs. Societies should include these critical factors, governing future success of members, in their short courses.

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Boundary Problems Between Carboniferous and Permian Systems

Defining the perplexing systemic boundary between the Carboniferous and Permian Systems may be an unresolvable problem. In northwestern Europe, the type Upper Carboniferous rocks are represented by a nonmarine facies, the Permian rocks are represented incompletely by shallow-water, evaporitic, and dolomitic beds. The type Permian sections along the western flank of the Ural Mountains also have shallow-water, evaporitic, and dolomitic beds and red beds. There, Permian beds overlie a series of marine limestone facies comprising abundant and diverse marine faunas, but whose age relations to the nonmarine Upper Carboniferous beds of northwestern Europe are equivocal. During the last 100 years, Soviet geologists have proposed lowering the base of the Permian to various positions in these marine limestones and have tried to locate a natural boundary, as defined by faunal changes. However, any boundary established within this succession will be arbitrary because major evolutionary changes in the different marine fossil groups are not synchronous.

In other parts of the world, Upper Carboniferous and Lower Permian rocks and faunas reflect strong influences of depositional conditions and faunal provinciality. The faunal provinces comprise cold water faunas for much of Gondwanan continents, warm water to tropical water faunas for the Tethys and western Panthalassa, and tropical water faunas for eastern Panthalassa.

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Bed Forms, Facies Association, and Tectono-Stratigraphic Setting of Proterozoic Eolianites, Hornby Bay Group, Northwest Territories, Canada

The Hornby Bay Group is a middle Proterozoic (1.8 to 1.2 b.y. ago), 2.5 km thick succession of terrestrial siliciclastics overlain by marine siliciclastics and carbonates. Deposition initially occurred in isolated intracratonic depocenters. Infilling of rugged basement topography by alluvial fans and braided rivers was followed by deposition of more than 500 m of mature quartzarenite on a low-energy braidplain. Three facies assemblages within this sequence are interpreted as eolian.

Facies A (80 to 200 m thick) interfingers with alluvial fan deposits. It displays low-angle tabular-planar cross-bed sets with wedge-shaped intrasets, ripple cross-lamination perpendicular to foreset dips, and climbing ripples proximal to the fan deposits and large trough cross-beds with wedge intrasets in distal parts of the basin. This facies records deposition in complex transverse bed forms. Facies B consists of lenses up to 40 m thick interlayered with low-energy fluvial deposits. Composed of 3 to 4 single low-angle trough cross-beds with numerous smaller intrasets, it is inferred to represent barchanoid dune deposition. Facies C is characterized by tabular-planar cross-beds, 3 to 4 m thick, interlayered with flat laminated fluvial arenites. It probably formed by migration of solitary transverse dunes across emergent parts of the braidplain. Paleocurrents in all facies are unimodal and parallel to the paleoslope, but commonly show a strong mode perpendicular to the paleoslope. The lack of duricrusts, silcretes, and ephemeral lake deposits suggests a semi-arid to humid paleoclimate.

The eolianites are distinguished from fluvial sediments by: (1) tabular-planar and trough cross-beds bounded by low-angle to horizontal planar surfaces, the cross-beds being composed internally of wedge-shaped intrasets that dip in the direction of the megaset foresets; (2) ripple cross-lamination perpendicular to the megaset foreset dip; and (3) large-scale cross-beds. An eolian origin is substantiated by association with braided river facies, dissimilarity of cross stratification compared to established fluvial facies models, and the tectonic setting.

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Reflection Seismic Surveys for Basin and Range Geothermal Areas—An Assessment

Several state-of-the-art reflection seismic surveys have been completed in high-temperature geothermal areas of the northern Basin and Range province. The survey data have been made public through the Department of Energy/Division of Geothermal Energy Industry Coupled and Exploration Technology programs. Data were studied for the Stillwater, Dixie Valley, Beowawe, San Emidio, and Soda Lake resource areas.

Reflection quality, and hence usefulness of the reflection method, can be highly variable in the complex basin and range environment. Certainly survey design and proper processing are required to enhance the quality of the data. The most severe geologic condition appears to be the presence of surface, or near surface, layered volcanic rocks. These result in strong early reflections, substantial ringing and poor energy penetration to depth, as at Beowawe. In areas of thick alluvial cover, or Tertiary gravels and lake bed sedimentation (San Emidio, Soda Lake, Stillwater), data quality is often sufficient to map basin border faults and major displacements on volcanic or bedrock surfaces beneath 2,000 to 4,000 ft (609 to 1,219 m) of cover. Faulting is indicated primarily by the systematic termination of coherent reflections. Diffraction patterns are sometimes recognized but commonly obscured by the complex faulting and lithologic variations. The identification of a given reflector across major structures and accurate time-to-depth conversion are difficult interpretational problems. Excellent data quality at Stillwater and Dixie Valley should contribute to the development of these resources.

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Roosevelt Hot Springs, Utah Geothermal Resource —Integrated Case Study

The Roosevelt Hot Springs geothermal resource is located along the western margin of the Mineral Mountains, approximately 19 km northeast of Milford, in southwestern Utah. To date, seven producing wells have been drilled by Phillips Petroleum Co. and Thermal Power Co. Construction will soon begin on the first stage of a 120-megawatt power plant.

Detailed geologic mapping and the study of well logs and drill cuttings indicate that the geothermal reservoir is a fracture-controlled, liquid-dominated system. The host rocks of the reservoir are Precambrian metamorphic rocks and various Tertiary intrusives. The reservoir is mainly localized between the range front and an alluvial covered horst block, along which fluids have migrated to the surface forming an elongate north-trending dome of siliceous sinter. The reservoir is an area of high heat flow (over 1,000 mW/sq mi) and low near-surface electrical resistivity (less than 10 ohm-m). Aeromagnetic, gravity, and reflection seismic data help define the geologic structure within and around the alluvium covered reservoir. Trace element geochemistry shows that arsenic, lithium, and mercury are enriched along fluid pathways of the geothermal system. Mercury concentrations greater than 20 ppb occur only at temperatures less than 225°C and reflect the present thermal configuration of the field.

The system was efficiently explored using detailed geologic mapping in combination with thermal gradient studies and dipole-dipole resistivity.

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Biostratigraphy of Monterey Formation, Palos Verde Hills, Southern California

Three members comprise the Monterey Formation in the Palos Verdes Hills: the Altamira Shale, The Valmonte Diatomite, and the Malaga Mudstone. Following the diatom zonation of Barron (in press), the middle to upper Altamira Shale ranges from Subzone b of the *Denticulopsis lauta* Zone through Subzone b of the *Denticulopsis hustedtii-D. lauta* Zone (14.5 to 12 m.y.B.P.), the Valmonte Diatomite ranges from Subzone b of the *D. hustedtii-D. lauta* Zone into the lower *Thalassiosira antiqua* Zone (13 to 8 m.y.B.P.), and the Malaga Mudstone ranges from the lower *T. antiqua* Zone into the lower *Thalassiosira oestrupii* Zone (8 to 4 m.y.B.P.), transgressing the Miocene-Pliocene boundary (5 m.y.B.P.). The overlap of up to one million years along the Altamira-Valmonte contact is not surprising since this contact is characterized by a diagenetic change of Opal-A to Opal-CT at most sites.

The age distribution of outcrops reflects northwest-southeast-trending anticlinorium structure of the Palos Verdes Hills, but local sections are discontinuous and deformed due to slumping, folding, and faulting during Pliocene uplift of the hills. This is best seen at Malaga Cove where folds, faults, and slumps are visible along the sea cliffs, and a short hiatus marks the Valmonte-Malaga contact.

The siliceous biostratigraphy of the Palos Verdes Hills correlates to that of the Monterey Formation at Newport Bay. However, the correlation of the siliceous zonation to the benthic foraminiferal stages (assigned by Woodring et al, and Warren) differs for the two areas.

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Dune Size in Paleodeserts of Colorado Plateau

Where dunes migrate during deposition, they move upward (climb) with respect to the generalized depositional surface. Sediment deposited on each lee slope and not eroded during passage of a following trough is left behind as a cross-stratified