and geophysicists which inhibit effective analysis of data as well as development of sound exploration philosophy. Understanding of the nature of the basement and its relation to and influence on sedimentary basins is the first step back to geological health.

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Radiometric Dating of the Bearpaw Sea

Sampling of the bentonites included in the Upper Cretaceous Bearpaw formation of southern Alberta and adjacent areas has provided material for a geochronological investigation of this marine sequence of strata. K-Ar dating of biotite and sanidine included in the bentonites has indicated that the Bearpaw sea invaded most of the southern Alberta Plains 72–73 million years ago. The transgression of the sea was probably rapid and the base of the formation may be isochronous over most of the area, with the possible exception of areas in southern Saskatchewan and northern Montana where the sea might have transgressed somewhat earlier. The regressive upper boundary of the Bearpaw formation is set at 68 million years in the westernmost plains and at 66 million years farther east in the Cypress Hills region. The geochronological picture is compatible with the paleogeography of the Bearpaw.

The bentonites intercalated with the normal sediments represent ashfalls produced by relatively remote volcanic eruptions. Study of the phenocrysts in the sand-size fraction, provided that contamination by detrital material has been negligible, has indicated that most of the bentonites are remarkably uniform in petrologic type and are dominantly andesitic. A source area is suggested in the eastern Cordilleran belt of northern Montana, where strong volcanism throughout most of the Late Cretaceous accompanied the gradual emplacement of the Boulder batholith. The andesitic nature of the Bearpaw bentonites is compatible with granodioritic magmatism in the postulated source area.

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Some Aspects of Recrystallization of Ancient Limestones

Conditions and criteria for "grain growth" in metals are not followed in diagenesis of most sedimentary carbonates; thus the concept should not supersede "recrystallization" as first documented by H. C. Sorby for both petrographers and metallographers. An inclusive term, "neomorphism," is herein proposed to embrace the following isocompositional and replacive processes: inversion, recrystallization (calcite calcite), and strain-recrystallization. Neomorphism and its daughter processes may be aggrading or degrading; the former may be prophyroid (a few crystals growing to replace a passive groundmass) or coalescive (nearly all crystals are consuming or being consumed). In these processes driving forces and physical conditions (porosity, solutions, etc.) vary considerably.

Diagenetic calcite has the following attributes: (1) origin—porefill (P), displacive (D), or neomorphic (N); (2) shape—equant (E), bladed (B), or fibrous (F); (3) dimensions—aphanocrystalline (1) to extremely coarsely crystalline (7); (4) foundation—syntaxial overgrowth (O), crust (C), or random (R). Numerous combinations are possible, expressed symbolically as, for example, $P.E_3$ (porefill, finely crystalline equant spar), or $N.B_5O$ (neomorphic coarsely bladed overgrowth on a trilobite, replacing micrite).

Three phases of neomorphism are discussed. All micritic limestones have undergone porphyroid neomorphism (?), probably from 2μ needles or plates to 2μ subequant polyhedral blocks of calcite (electron microscope work of R. Shoji), involving digestion of the vast majority of original mud particles of similar length but much more slender than the polyhedra.

In some limestones, neomorphism bursts through the "micrite curtain" to form microspar. Normal micrite measures $1\frac{1}{2}$–2μ; a saddle exists at 3–4μ, before another peak frequency at 5–6μ (microsparite). This volumetrically very important type of neomorphism is probably specifically produced by coalescive recrystallization; it results in *uniformly*-sized grains, usually of *simple* loafish form, and is most frequent in limestones with shale interbeds, probably not in brackish environments as has been claimed.

In freakish limestones, diagenesis may go still further, producing pseudospar or fibers largely by porphyroid neomorphism. These may mimic closely the appearance of normal porefill calcite; criteria of grain shape, orientation, uniformity and boundaries are equivocal. The only firmly diagnostic criteria are those based on grosser fabric relations such as transection of allochems, occupation of large areas unsupported by allochems, or presence of undigested inclusions.

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Current Computer Usage by Exploration Geologists

Many geologists are beginning to use the computer to aid in solving some exploration problems.

Key micropaleontological data from several thousand wells penetrating portions of the Tertiary in the Louisiana-Texas Gulf Coast area are stored on magnetic tape for computer usage. Data retrieval programs select wells encountering specified paleo markers and process associated environmental data for preparation of maps showing paleogeography, shorelines, and attitude of ancient seafloors. Too much time is required to justify such map preparation manually.

Correlative tops from electric logs and sample logs are recorded on punched cards or magnetic tape to allow rapid map preparation using the computer in combination with automatic plotting equipment. Current programs include ability to accept normal fault data and restore section on isopachous maps. Fault patterns, combinations of isopach and structure data, and isoliths of sands and combinations of sands can be mapped. Truncation, onlap, shale-out, etc., are indicated on printed results and plotted maps to aid interpretation and contouring.

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Time-Trend Analysis in Paleoecology

Changes in the physical attributes of the rock are compared with differences in the relative abundance of certain fossil species within a vertical sequence of limestone and shale layers. Minor variations in the texture and composition of the rock reflect subtle changes in the depositional environment which had a direct influence on the organization of the faunal community. To plot these relationships, a continuous series of beds within the Richmond group (Upper Ordovician) were quantitatively studied in the field and in thin section.

The major sedimentation trends exhibited by the