to kaolinite and books of authigenic kaolin are common in the subgraywacke and kaolinitic silty clay. Overgrowths of authigenic quartz are present and act as a cement in the orthoquartzite. Chert is rare in the orthoquartzite but is common in the subgraywacke.

The non-opaque heavy mineral suite consists of tourmaline, zircon, and rutile with a smaller amount of kyanite, staurolite, garnet, and euhedral biotite.

The Eocene sediments of the Texas Gulf Coast were derived from multiple sources and the Simsboro is no exception. Quartz types, chert varieties, K-feldspar, phyllitic rock fragments, and heavy minerals indicate that older sedimentary rocks, low-rank metamorphic rocks, granitic or gneissic rocks, and volcanic ejecta furnished detritus for the Simsboro.

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THE COMPUTER IN GEOLOGY: THE STATE OF THE ART

The past several years have seen a marked expansion in computer applications in geology. Universities, governmental agencies, the oil industry, and the mining industry all share in this activity. Although much work is still research-oriented, increasing effort is being made to extend computer facilities to exploration for oil, gas, and ore. Five aspects of computer utilization are woven through this activity; these are data acquisition, data storage and retrieval, data processing, presentation of results, and use of decision functions as an aid to interpretation.

Data acquisition is represented by new instrumental ways of obtaining data automatically, including remote sensing devices. Storage and retrieval are perhaps best known in the oil industry's activity in developing well-information systems, although much interest also centers on machine handling of scientific bibliographies. Data processing is the most active aspect of machine use, with new computer programs being developed for statistical processing of data, systems analysis, linear programming, and various applications of operations research. Spectacular developments in presentation of map data automatically, and in machine analysis of maps for trends (regionals and residuals), have occurred in the past few years. Development of decision functions (related closely to operations research) is evident, though perhaps less publicized than other aspects of computer utilization.

A major problem in this rapid expansion of computer use is the development of channels for publishing or exchanging computer programs. A center for earth science programs, tentatively called GEOCOMP, is being looked into. This center, whether located in a university, a research organization, or a governmental agency, could issue copies of programs, newsletters on current activities, and perhaps act as a training center for college teachers and geologists in industry. There is no doubt that computer activity in geology, which only a few years ago seemed still to be beyond the horizon, is now actively growing in our midst. Such rapid expansion calls for sound judgment in computer use, inasmuch as indiscriminate applications can produce very large mistakes very rapidly.

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SEDIMENTARY STRUCTURES AND PALEOCURRENTS IN THE LOWER NEW RED SANDSTONE, DEVONSHIRE, ENGLAND

Permo-Triassic redbeds, consisting of mainly breccias and sandstones exceeding 6,000 feet in thickness, are well exposed in coastal cliffs in South Devonshire. They are disposed in semi-circular or elongate basins or cuvettes, margined by ridges of metamorphic rocks which supplied the bulk of the detritus.

The breccias show typical torrential bedding features. Low-angle cross-bedding units, festooned perpendicular to the direction of derivation, are interwoven with generally flat but lenticular beds of breccia and sandstone. Shallow channeling is common, deeper where sandstone is predominant. Mapping of pebble imbrication shows a basically centripetal transportation pattern in the cuvettes, consistent with derivations indicated by cross-bedding, channeling, and fragment composition. Roundness measurements of limestone fragments in the same rocks reveal sub-circular roundness contours increasing in value towards the cuvette centres, and approximately perpendicular to imbrication directions. All features indicate deposition on sub-montane alluvial fans in a semi-arid climate, with converging directions of sediment transport in semi-confined cuvettes.

Sandstones in the upper part of the sequence show clear eolian cross-bedding, with wedge-shaped units and some festoon cross-beds. Attitude measurement indicates deposition by a uni-directional wind from the SSW. Interbedded breccias show truncation and channeling of dune surfaces.

Quicksand injection structures occur in fine-grained silty breccias interbedded with sandstones (distal fan deposits). A saturated sand layer, sealed under an impermeable silty breccia, was mobilized and injected upward through desiccation cracks or other weak spots, forming sand dikes with elongate particles aligned parallel with the walls. Sun-cracked silt layers may show strongly upturned edges on desiccation polygons due to injection (extrusion) of quicksand, which may also be fragmented and dislocated.

Annelid burrows occur in some basal breccias, mostly fine-grained. Where elongate fragments constitute the breccia, the burrow filling shows a distinct internal fabric or "meniscus" particle arrangement. Commonly up to one inch in diameter with circular cross section, in coarser breccias they are ovoid and up to 7 inches wide. These large burrows branch, ascend through strata, and avoid large fragments; together with the consistent meniscus fabric, these features indicate organic origin.

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DEVONIAN PALEOECOLOGY OF NORTHEASTERN ALBERTA

Shallow, epicontinental seas of Middle and Upper Devonian time in Alberta contained abundant microfauna and megafauna which can be used to interpret the environment at the time of deposition. Enough variation exists to differentiate supralittoral, littoral, sublittoral, arid lagoonal, humid lagoonal, and epineritic environments. A series of paleoecological maps for the Middle and Upper Devonian in northeastern Alberta illustrates the detailed paleogeographic history. The transitional boundary between the Givetian and Frasnian stages is explored and a contact postulated that is considerably higher stratigraphically than previously indicated. This paleoecological approach should be equally applicable to similar problems in any area and for almost any geological period.

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DOLOMITIZATION OF RECENT AND PLIO-PLEISTOCENE SEDIMENTS BY MARINE EVAPORITE WATERS ON BONAIRE, NETHERLANDS ANTILLES

The carbonate rocks and sediments on the island of Bonaire in the Netherlands Antilles contain interesting examples of early dolomitization. A large flat area of Recent supratidal sedimentation exists on the south end of Bonaire, and in this area evaporation of sea water is depositing calcium carbonate and gypsum, which produces dense brines having large Mg/Ca ratios. Dolomite is found in most of the Recent supratidal sediments, and carbon-14 dates on the dolomite establish that the time since dolomitization has been less than 2,200 years. Textural evidence indicates that some of the dolomite was formed by replacing lime sediments.

The dense brines produced by evaporation tend to flow downwards into the permeable sediments, and an analysis of the chemistry and hydrology of a hypersaline lake chosen for detailed study shows that downward drainage of brine having a Mg/Ca ratio of about 30 must be happening today. Examination of marine Plio-Pleistocene rocks on the north end of Bonaire shows large areas of dolomitization whose boundaries cut across the bedding. The field evidence is consistent with the hypothesis that this dolomite has been produced by the flow of dense brines from a supratidal area. The time required to produce the estimated volume of dolomite found in the Plio-Pleistocene rocks would be of the order of 10^5 years.

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PETROGRAPHY OF THE SOUTHESK-CAIRN CARBONATE COMPLEX, WESTERN ALBERTA, CANADA

Regional and petrographic studies suggest that a specialized reef association was responsible for the build-up of the carbonate mass. Although dolomitization has preferentially affected certain formational members, some original textures and rock constituents may be recognized.

At the Mount Dalhousie type section, the complex has divided into lower Cairn and overlying Southesk formations. The coarsely crystalline, light gray dolomites of the Peechee member, Southesk formation, were originally medium and coarse calcarenites with some areas of algal-stabilized sediment. The whole is suggestive of a depositional environment with strong currents and local sheltered areas. Where dolomitization is incomplete, there is a preference for replacement of intergranular sparry calcite. It is suggested that this is an early diagenetic event that took place prior to complete infilling of porosity by calcite precipitation.

The Arcs member, in contrast, consists dominantly of microcrystalline calcite with eyes of clear sparry calcite (dismicrite and birdseye limestone), with sporadically distributed areas of calcarenite and layered algal limestone. Comminuted skeletal remains are abundant, although locally, delicate undamaged ostracod shells occur; the latter partly infilled with microcrystalline calcite constitute geopetal fabrics and indicate quiet microenvironments where the fine calcite or aragonite particles settled out. A relatively quiet environment is postulated during deposition of most of this member, with algal-stabilized areas building up locally to further restrict circulation. The algal material was in turn frequently torn up, presumably during storms, and incorporated as intercalated calcarenites in the predominantly microcrystalline rock sequence of the Arcs member.

The overlying Ronde member, composed of calcarenite, microcrystalline limestone, silty limestone, silty dolomite and siltstone, probably accumulated under unsettled conditions. Globular stromatoporoids appear to have been characteristic of turbulent reef-margin areas and colonial corals of rather deeper and turbid environments. The sedimentary record terminates at an unconformity beneath the overlying Sassenach formation.

Viewed as a whole, the carbonate complex has been extensively dolomitized. Various types of dolostone have been mapped and studied with a view to equating them with limestone facies, establishing a reef model and interpreting the dolomitized sequence.

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CRITICAL ANALYSIS OF THE GLADSTONE-DALE RULE AND ITS CONSTANTS

The Gladstone-Dale rule, which is an empirical attempt to relate chemical composition, refractive indices, and density, was applied to minerals by Larsen in 1934. In 1956, Jaffe offered some corrections and additions to Larsen's original constants.

While applying the Gladstone-Dale relationship to some tellurites and selenites this writer found that Larsen's constants for TeO_2 and SeO_2 required revision. Furthermore, the value of these constants, as well as those for many other oxide components, varied widely, depending on the particular compounds used to calculate them.

Values of k for various oxide components are given here, using Larsen's form of the Gladstone-Dale equation:

$$\frac{n-1}{d} = k_1\frac{p_1}{100} + k_2\frac{p_2}{100} + \cdots k_n\frac{p_n}{100}.$$

In this equation, n is the average index of refraction, d is the density, k is the specific refractive energy for a particular oxide component, and p is the weight percentage of the component.

Oxide	*Larsen's k*	*Aver.*	*k—This Study Range*	*No. of Compounds*
Cs_2O	.124	.120	.116–.122	3
CaO	.225	.225	.213–.239	7
CoO	.184	.182	.167–.206	4
CuO	.191	.182	.173–.201	8
ZnO	.153	.160	.139–.179	4
BaO	.127	.128	.123–.132	6
PbO	.137	.144	.125–.169	7
SeO_2	.147	.196	——	1
TeO_2	.200	.193	.181–.206	4

Users of the Gladstone-Dale relationship should realize that wide differences between calculated and observed refractive indices and densities may be caused by the variation in k values.

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TECHNIQUES OF EXPLORATION FOR BURIED LANDSCAPES

Hydrocarbon traps are customarily subdivided into two main classes: structural and stratigraphic. A third important class, hitherto not considered separately, includes hydrocarbons trapped in buried hills, ancient valleys, fossil reefs, and other primarily geomorphological phenomena. These are referred to as paleogeomorphic traps. The analysis of and prospecting for this type of trap must proceed along purely geomorphological lines of reasoning.

Paleogeomorphology covers all geomorphic phenomena recognized in subsurface geology; i.e., all