

due to reworking of the submerged clastic Beaufort Formation cropping out along the western Arctic coast, and to occurrences of drowned headlands consisting of unconsolidated coarse materials.

Spectrochemical analyses indicate that certain elements and clay minerals in bottom sediments are related to nearby geological formations and that the clay minerals are detrital. This indicates past rigorous physical conditions with negligible chemical activity.

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THE SALT PLUGS OF SOUTHERN IRAN

The distribution of the south Persian salt plugs has encouraged observers in the past to connect these plugs with diagrammatic lines, suggesting deep-seated linear structural weaknesses. Little has been said about the associated anticlines, particularly as to whether or not they reflect the presence of an extensive, deep-seated salt body.

It is suggested in this paper, that the nature of the prominent 'whale-back' anticlines in the salt-plug region of the southern part of the province of Fars reflects the existence of an incompetent layer of salt at depth. Anomalous swings of strike and possible rim synclines give a characteristic pattern to the salt-plug area. This pattern contrasts strongly with an area in N.W. Iran (Lurestan) which, although having similar 'whale-back' anticlines, lacks anomalies of strike, and shows no surface outcrops of salt.

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FLUID-RELEASE MECHANISMS IN COMPACTING MUDROCKS AND THEIR IMPORTANCE IN OIL EXPLORATION

Our current knowledge of clay colloid chemistry and clay mineralogy was applied in an investigation of the mechanisms by which water escapes from muddy sediments. The alteration of montmorillonite to illite after deep burial involves the transfer of large amounts of water from bound positions on montmorillonite to interparticle areas where it has an important bearing on the porosity, permeability, abnormal fluid pressure, and the initial release of hydrocarbons from mudrocks.

In contrast to montmorillonitic deposits, water is compacted out of illitic deposits very soon after burial, before the formation of hydrocarbons comparable to those found in reservoirs. The development of shale source rock requires the initial deposition of a montmorillonitic organic mud, and its subsequent alteration after deep burial to illite. These requirements are of decisive importance in the exploration for oil in new areas.

A considerable reduction in density accompanies the desorption of the last few monomolecular layers of water from montmorillonite during its diagenesis to illite, and the associated volume increase could easily account for the abnormally high fluid pressures so often encountered in drilling operations.

The new compaction theory enables us to give meaningful interpretations to data on the bulk properties of compacting mudrocks.

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ENVIRONMENTAL SIGNIFICANCE OF FOSSIL ALGAE

During the past decade, a great deal of interest has

developed in the use of algae as environmental indicators. As a consequence, many fossils have been identified as algae in the published record and used as the basis for environmental interpretation. Some of these fossils may not be algae and others may be algae without environmental significance. This paper is a plea to paleontologists and geologists to be more critical in their identification and utilization of fossil algae. At the present state of our knowledge concerning these fossils, only a few can be used with any confidence for environmental interpretation.

Algae as a group may inhabit almost any environment. For example, coralline algae in the Recent seas range from the equator to the Arctic Ocean and from the intertidal zone to depths of several hundred feet. Too little is known regarding the distribution of modern genera and species to permit us to attach any environmental significance to the fossil forms.

Probably the most misused forms are the algal stromatolites. Structures of varying origins ranging from caliche to diminutive normal marine bioherms have been called algal stromatolites and interpreted as being intertidal in origin. This practice limits the usefulness of algal stromatolites for environmental interpretation.

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GEOTECHNICAL ASPECTS OF RECENT MARINE SEDIMENTS, OSLOFJORD, NORWAY

Improved fixed-piston and gravity-type, thin-wall corers designed and built at the Norwegian Geotechnical Institute were used to sample localities selected by a sub-bottom, echo-sounding survey in an integrated geochemical, geological, geophysical, and geotechnical investigation of the Oslofjord. Changes in mass physical properties, particularly grain size and bulk density, were correlated with near-surface acoustic reflections from specific sub-bottom strata. Shear strength of the fine-grained, cohesive sediment was measured in the laboratory using the new Norwegian unconfined compression apparatus and the Swedish fall-cone. The latter instrument is of particular value for the scientific study of the strength of soft, Recent marine sediments because of the small amount of material necessary for a valid test. Natural strength was found to be strongly influenced by the remains of polychaete burrows, the extent of which was demonstrated by radiography. Sediment sensitivities generally were medium to very sensitive, but in a few instances were quick. All material had normal fjord pore-water chlorinities (about 19‰), and the quick character of the clay appeared related to an abnormally high content of calcium carbonate. The sediments were underconsolidated above a depth of approximately one meter.

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PRESENT STATUS OF GEOLOGICAL STUDIES IN THE ALASKA RANGE

After more than one-half century of geological study in Alaska, the geology of the Alaska Range remains imperfectly known. This has resulted from emphasis on areas of greater economic potential, such as north of the Brooks Range and Cook Inlet. However, recent geological studies in the eastern Alaska Range by faculty and graduate students at the University of Alaska are now adding substantially to our knowledge of this region.

Some initial results of these studies are as follows: (1) a pre-Devonian polymetamorphic basement complex, including Precambrian granulite facies gneisses, has been located south of the Denali fault; (2) a stratigraphic interval containing approximately 12,000 feet of greywackes, thin limestones, and associated andesitic volcanics has been mapped and dated paleontologically as upper Mississippian and lower Pennsylvanian in age; and (3) a preliminary study of rugose and tabulate corals representative of the *Lonsdaleiidae*, *Cyathopsidae*, *Hapsiphyllidae*, *Favositidae*, and *Auloporidae* has been made and indicates that many forms are as closely related to Asiatic species as to described North American species.

Heretofore, rocks of Pennsylvanian age were believed to be rare or absent in the Alaska Range. Their presence in geosynclinal accumulations will require modification of existing concepts of the depositional history of this region. Additional paleontological study of these northern faunas may further modify and expand our present poor understanding of the paleogeography and faunal realms of the Carboniferous.

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NEARSHORE SANDS OFF SOUTHEASTERN VIRGINIA

In 1961 and 1962, SCUBA divers examined nearshore sands off southeastern Virginia and collected surface samples and 52 short cores, 2 inches in diameter and up to 4 feet long. The samples were analyzed by standard laboratory procedures.

Two relict populations were recognized: (1) a coarse-grained (median about 1.5 phi) brown sand; and (2) a fine-grained (median about 3.3 phi) gray sand. The brown sand exists principally in linear ridges, whereas the gray sand occupies lower areas between ridges. The two sands are found interbedded in layers up to 10 cm. thick in cores taken from the landward side of a nearshore submarine ridge off False Cape. Though both sand populations have been derived from reworking of older Pleistocene deposits, both contain abundant Recent shell debris.

Ripples covered the bottom continuously from just outside the surf zone outward to the outer limit of effective wave action, which varied from a line about 3 miles offshore in water 28 feet deep after a period of calm weather, to a line more than 9 miles offshore in water 71 feet deep after a moderate storm. Long axes of all active ripples measured were parallel to shore in spite of a 90-degree divergence (NE to SE) in direction of wave approach. Farther offshore ripples occur only on submarine ridges.

Differential impregnation of longitudinally cut core surfaces with epoxy cement revealed numerous primary sedimentary structures, chiefly cross-laminae of both normal and oversteepened dip and burrow structures.

Four stations were occupied in the summers before and after the intense storm of March, 1962. Cores collected here illustrate the principle of shelf sedimentation generally attributed to Barrell (1917) but first propounded by H. C. Sorby (1857) that a slow average rate of vertical accretion is combined with evidence of rapid deposition of individual layers.

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ANALYSIS OF THE SEDIMENTS FROM THE SUBSURFACE OF THE BOGRA AREA, BENGAL BASIN, EAST PAKISTAN

The Bengal Basin, located in East Pakistan and neighboring India, contains a stratigraphic section which can best be described as a basin-delta complex. Formations ranging in age from Gondwana (Upper Paleozoic) to Recent have been studied in cuttings and core samples from two dry tests. The samples were described and some were analyzed either mechanically or chemically.

Conclusions are that both the tectonic and the resulting sedimentary environments varied considerably during the deposition of this section. The older sediments deposited prior to the principal Himalayan orogenies were nonmarine. They differ greatly in lithologic character and in thickness. They were influenced by volcanic activity and continental glaciation. The Sylhet limestone (Eocene) can be interpreted as having originated in a fairly uniform marine environment. The growth of the Himalayas initiated a new and significant source of sediments and fluvial and deltaic agencies of deposition predominated as they do at present.

The Sylhet limestone has yielded gas from several pools and appears to be the most likely, if not the only, possibility for future discoveries of hydrocarbons. However, there may be other marine deposits to the south, closer to or underlying the Bay of Bengal.

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SALT STOCK FAMILIES IN NORTHWESTERN GERMANY

In northern Germany there are more than 200 known salt stocks which are composed of Zechstein salt. Because of favorable geologic conditions, it was possible to reconstruct the historical development of the salt stocks with the aid of reflection seismic surveys. The development of a single salt stock appears to have started with an accumulation of salt, the so-called salt-pillow. At a later stage, the overlying strata broke, allowing the diapir to form. In northern Germany, genetic connections between salt stocks are recognizable. Some of the larger groups of salt stocks are classified as "salt stock families." Such salt stock families consist of a number of salt stocks grouped around the genetically oldest which is said to be the "mother salt stock." The rim synclines of the adjacent salt stocks become younger as their distances from the center increase.

The geological impulse causing the formation of mother salt stocks is supposed to be partly due to tectonics whereas the subsequent wave-front-like growth of the salt stock families took place in a purely halokinetic way, i.e., by the movements of salt under the influence of gravity. The absolute rate of the horizontal wave-front-like flow of the salt over large distances averages about 0.3 mm./year.

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IZA, AN UNUSUAL DIAPIR IN NORTH SPAIN

Interspersed among the gentle fold structures of the Cantabrian Mesozoic basin of northern Spain are at least 12 diapirs with cores of plastic Triassic shales, evaporites, and ophitic igneous rocks exposed at the surface. These occur in an S-shaped belt in a generally east-west direction over a distance of some 130 kilometers (80 miles). The Iza diapir is located in the extreme east portion of the basin at the eastern termination of the diapiric trend.

Surface evidence and seismic work plus the data from four wells drilled on the Iza structure have outlined this unusual diapir. Most diapirs in northern Spain are expressed on the surface as nearly circular depressions