

formed along the base of the slopes. The numerous photographs of ripple-marked sand to depths of 3,500 m, and the observation from deep-diving vehicles of scoured hard rock walls at depths to 1,350 m provide evidence of this activity. The relative importance of turbidity currents and currents of unknown causes is still uncertain. Mass movements undoubtedly are an important contributing cause.

Most submarine canyons are located off relatively large land valleys. In some places, the canyons apparently originated as submerged river valleys, but submarine erosion appears to have played a major role in developing their present configuration. Evidence of more than one cycle of excavation of canyons exists in various places. Apparently canyons have become filled and then reopened by some type of rejuvenation that is not well understood.

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SHELF SEDIMENTS IN ROCK RECORD—A SUMMARY

(No abstract submitted)

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DEVELOPMENTS IN SEISMIC PROCESSING FOR GEOLOGIC INTERPRETATION

Since the introduction in the early 1960s of digital recordings and processing of seismic data, the effectiveness of the seismic method as a petroleum exploration tool has improved substantially by providing better solutions to many problems such as water reverberations and resolution of discrete reflectors. Thus far, the primary emphasis has been on the development and application of new signal-processing techniques through the utilization of communication-theory concepts. With the development of large rapid-access bulk-storage devices and high-resolution on-line display capabilities, the scope of computer processing can be enlarged to include interpretation and the integration of geophysical and geological data.

Continuous interval-velocity information, with an estimated associated error, can now be extracted from seismic data on a routine basis. Examples from field tests show that, in favorable cases, lateral variations in interval velocity of the order of 1% may be detected. In addition to obtaining a major increase in the accuracy of structural information, continuous velocity data provide a means for detecting lithologic and stratigraphic variations. This capability coupled with a means for extracting and displaying quantitative information about reflector amplitude and waveform provides new possibilities for stratigraphic-trap exploration.

Examples from the Gulf of Mexico show how the computer may be utilized to obtain an interpretation of a grid of seismic data with the assistance of an interpreter to make difficult interpretation decisions and to correct the inevitable errors which can occur in the processing sequence. The capability of the computer to deal with and migrate all the relevant data in three dimensions will lead to a more accurate and complete three-dimensional model of the subsurface from seismic data. As this capability is realized, it will become useful to record seismic data on a tighter grid than is done with current practices.

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NEW APPROACH TO CLASSIFICATION OF *Azolla* MEGASPORES SPECIES

Four geologic sections in central Alberta which span the contact between the Paskapoo and Edmonton Formations were measured, described, and sampled for their palynological content. Previous studies, mainly of plant megafossils, vertebrates, and nonmarine invertebrates from units slightly above and below the sampled interval, had confirmed a Tertiary age for the Paskapoo Formation and a Late Cretaceous age for the Edmonton Formation.

Many megaspores of the genus *Azolla* were recovered in every geologic section sampled. Nine species were recorded, eight of which are new and classified according to a new approach based mainly on the nature and structure of the megaspore wall and perispore lamellae. To date, in almost every palynological study, the nature of the "swimming apparatus" has been the primary basis for classification of *Azolla* megaspore species. The "swimming apparatus" is not well defined on every specimen, which limits the application of a classification based on it. Because the method of classification proposed in this study can be used to identify species from mere fragments of the perispore wall, it may prove to be of greater utility in establishing identifications than the system presently in use.

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MULTIVARIATE ANALYSIS OF VARIANCE STUDY OF *Neochonetes granulifer* (OWEN): ITS IMPLICATION WITH RESPECT TO GEOGRAPHIC VARIATION AND EVOLUTION

Twelve characters on the dorsal valve of *Neochonetes granulifer* (Owen) were measured and subjected to multivariate analysis of variance. The specimens were collected from 26 localities which represent seven different geologic units ranging in age from late Desmoinesian to late Wolfcampian. The statistical procedures successfully resolved geographic variation and evolutionary change. They also showed the relations between many measured characters as they evolved. Three-space graphs were constructed, using as axes three discriminant functions which explained 95–98% of the variation. Means projected onto discriminant functions and discriminant functions alone were plotted on these graphs for ease in visualizing relative similarities between sampled populations and influence of the measured characters on the sampled populations. Geographic variation within any one sampled stratigraphic unit was small. The statistical method tended to separate limestone assemblages from shale assemblages. This finding raised the question of whether a population as a continuum or two ecologically controlled populations of the same species were represented by the samples. If, on further investigation the latter is found to be correct, the statistical method employed will have been shown to be a very useful tool for discerning morphologically similar but ecologically different populations of the same species.

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