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Contour Mapping Using A Microcomputer—Techniques for Improvement

There are 3 basic steps to contouring by microcomputer: control-point data analysis, generating a regular grid of estimated values, and contouring. Because each of these steps requires a significant amount of time and computer resource, techniques have been developed to improve grid parameter selection, speed gridding, and edit computer-generated contour maps. Grid cell size is a critical parameter used during the gridding stage of computer mapping and must be selected with consideration given to control-point distribution. A histogram showing control points per grid cell is a simple graphical presentation that illustrates before gridding is actually performed the effectiveness of the selected grid increment in producing the desirable grid characteristics of having one control point per grid cell. Gridding is accomplished in 2 steps at every node: gathering the control points for estimating, and actual calculation. Using collection and estimating techniques such as nearest-neighbor searches and inverse-distance moving weighted averaging, several thousand nodes can be calculated in a few minutes. Often, the generated grid (contour map) is satisfactory with exceptions in 1 or 2 areas. Using an interactive computer technique known as contour editing, geologic knowledge and experience can be infused into the map. When editing contour, the computer mapper indicates the way the contours should behave. The entered values are then used to calculate back to the grid nodes (without regridding the whole map area) so that when the grid is recontoured, the contours mimic the contour revisions.

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Facies and Paleogeography of Middle Silurian Bisher and Lilley Formations, Adams County, Ohio

Six facies are recognized in the conformable Bisher and Lilley Formations of south-central Ohio. Areal distribution of microfacies indicates biohermal accumulation of the Lilley Formation, suggests new paleogeographic interpretation of the formations, and may explain morphologic differences among some Silurian reefs.

The Bisher Formation is subdivided by bedding and silicification. Isopachous mapping indicates that the lower Bisher was deposited as a carbonate sand blanket which was covered by north-northeast-trending upper Bisher silty carbonate sediment ridges. Intervening troughs received finer grained sediments and were populated by a moderately diverse fauna.

Highly diverse faunas of the Lilley Formation occur in bioclastic, biohermal, and biostromal facies which are subdivided by bedding, grain composition, and apparent transport of grains. Isopachous and lithofacies maps display a distinct relationship between Lilley and Bisher facies distributions. Bioclastic Lilley facies fill Bisher troughs, biohermal facies overlie Bisher ridges, and biostromal facies blanket the filled troughs and populated ridges.

The Bisher and Lilley Formations represent part of a Silurian regressive sequence on the northeast margin of the Cincinnati arch. As easterly derived clastic input decreased, Lilley fauna populated Bisher ridges. Rate of drop in sea level nearly equaled rate of subsidence in the area. Circulation was curtailed by basin infilling and shallowing seas in late Lilley time. These new conditions favored the relatively restricted fauna and lithologies of the conformably superjacent Peebles formation, a massive dolomite of Middle Silurian age.

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Diagenetic Effects of Salt Intrusions—An Alternate Model of Caprock Development

Mineralogical, chemical, and isotopic changes were found as depth increased in texturally homogenous sediment recovered from six 300-m (985-ft) boreholes on the outer shelf and slope of the northwestern Gulf of Mexico. In 2 of the 3 boreholes on the shelf and in all 3 boreholes on the slope, sediments of late Pleistocene age were found to be directly in contact with salt at the top of piercement structures. The other borehole was drilled on the flank of a salt intrusion also penetrating late Pleistocene sediment. In sediments over the top of the salt, the abundance of expandable clays (smectite) compared with nonexpandable clays (illite) decreases with depth. Within the carbonate fraction, $\delta^{13}C$ values range from -2% near the salt-sediment interface to 1% at the surface. This deviation is apparently a response to reprecipitation adjacent to the salt-sediment interface, with lighter isotopes derived from oxidation of the isotopically light organic matter. No mineralogical, chemical, or isotopic trends were found in sediments on the flank of the salt intrusion.

Clay transformation caused by heat of the salt stock releases a significant amount of intercellular water ($\approx 200\ L/m^3$ or $1.5\ gal/ft^3$), which dissolves the leading edge of the salt intrusion leaving a residual concentration of granular anhydrite. High sulfate concentration in the presence of organic material sets chemical conditions by which sulfate is reduced to sulfide and bicarbonate is formed. The subsequent buildup of bicarbonate leads to precipitation of calcite and also formation of more water to continue dissolution of salt. Isotopic data of the carbonate fraction in sediment above the salt mass supports this model.

The most commonly accepted model of cap rock formation requires the intrusion of a salt stock into a flowing aquifer, a unit which supplies water needed to dissolve salt concentrate, the anhydrite, and provide the subsequent chemical environment for gypsum and calcite formation. In the proposed model, water is the result of diagenesis caused by sediment-salt interaction. Cap rock formation then may occur well below base level and well out on the continental slope.

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A New Method of Estimating Risk-Adjusted Reserve and Economic Potential of Exploratory Prospects

Most explorationists follow one of two approaches when analyzing risk. (a) Application of single probability estimates combined with unique reserve potentials. Often, development potential is incorporated incorrectly on a no-risk basis. (b) Detailed analysis using, for example, Monte Carlo approaches, requiring an abundance of data and computer processing.

The method presented here combines advantages of both approaches, and permits rapid calculations using data routinely available.

Before a prospect is drilled, precise reserve volumes are unknown. However, the likely range of reserves should be predictable with some certainty. The explorationist should also be able to estimate associated ranges of probabilities by careful matching with previous history in the area (or analogous area) combined with specific geologic conditions unique to the prospect.

Reserve and probability ranges are estimated for the initial exploratory well, and presuming success, for subsequent development wells. Examples are: 2% probability of 200,000 bbl of oil, maximum; 25% probability of 10,000 bbl of oil, exploratory; 70% probability of 10,000 bbl of oil, development (latter 2 are economic limits).

Data are plotted on cumulative probability logarithmic plots because reserve estimates, like field size distributions, should be logarithmically distributed. Expected volume reserves (initial well and development wells) are incorporated with costs and prices, using Bayesian principals, to predict economic outcome before any drilling commences.

Analytic procedures are described, together with predictions of several exploratory programs compared with actual outcome. If the prospect group is sufficiently large, pre-drilling predictions are generally within 30% of actual results.

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Morphological and Morphometric Characterization of Microborings Caused by Heterotrophic Endoliths

Microbial endoliths leave morphologically characteristic and preservable boring traces within carbonate substrates. When cast in resin and studied by scanning electron microscopy, these morphologies can be correlated with distribution, environmental conditions, or geological age of the substrate for use as paleoenvironmental indicators. This paper assesses morphological characteristics of a cluster of ichnotaxa comparable to the description of the genus *Dodgella* (cladochytrid, lower fungi). These forms have a worldwide distribution in Holocene marine sediments