

depositional environment, and correlation. Wireline measurements together with direct measurements of the rock in the form of cuttings and cores must be understood by the geologist and geophysicist using them to achieve the proper confidence in their interpretation.

Examples of some of the limitations of borehole measurements illustrate a wide variety of problems that can occur. However, with understanding of these limitations, remarkably sound interpretation can be made.

YANCEY, THOMAS E., Texas A&M Univ., College Station, TX, and RAYMOND C. DOUGLASS, U.S. Geol. Survey, Washington, D.C.

Carboniferous-Permian Boundary Sequence of Northern Oquirrh Basin, Idaho-Utah

The Carboniferous-Permian boundary occurs in the middle of the Oquirrh Group in the northern part of the Oquirrh basin, the largest basin formed east of the Antler tectonic belt during the middle Carboniferous. Good sequences of fusulinid faunas for the northern part of the basin are exposed in the Sublett and Deep Creek Ranges of southern Idaho, a position midway between the basin's bathymetric low and the basin edge. In the Sublett Range, Late Pennsylvanian-Early Permian fusulinids occur through 1,500 m of mixed quartzose sands and limestones of the Trail Canyon Formation and basal part of the overlying Hudspeth Cutoff Formation. The Missourian interval is thin relative to the Virgilian interval. Near the base of the Trail Canyon Formation, possible Missourian fusulinid faunas appear containing *Triticites* and *Eowaeringella*, and extend through a 250-m section, which is overlain by a 400-m section with Virgilian fusulinids, including *Triticites* sp. aff. *T. cullomenensis* and *T.* sp. aff. *T. subventricosus*. The Carboniferous-Permian boundary occurs at about the top of the middle limy unit of the Trail Canyon Formation, and Wolfcampian fusulinids, including *Schwagerina* and *Pseudoschwagerina*, occur through 800 m of section. *Pseudofusulinella* is common through Virgilian and Wolfcampian interval on the western side of the Sublett Range, but has not been found in this interval on the eastern side. Leonardian fusulinids have yet to be found here, contrary to earlier published reports.

YANG, WANLI, LI YONGKANG, and GAO RUIQI, Scientific Research and Design Institute of Daqing Oil Field, China

Formation and Evolution of Nonmarine Petroleum in Songliao Basin, China

We will discuss the geochemical characteristics of the formation of nonmarine petroleum and its evolution regularities in the Songliao Basin and put forward the most favorable conditions for the formation of petroleum of nonmarine origin. The nonmarine kerogen of China can be classified into three types with two subtypes by composition and three types with six subtypes by both origin and composition.

In large lake basins, source rocks containing combined sapropelic kerogen have a high transformation ratio and a high genetic potential for petroleum. They offer the material basis for the formation of a large nonmarine oil field. On the basis of geologic and geochemical data and the results of thermal simulation of kerogen, we confirm that the maturation sequence of kerogen is Type-1, Type-2, and Type-3. The petroleum formation from combined sapropelic kerogen has its own characteristics, and it is necessary to set up a new model.

YOUN, SUN HO, Univ. Calgary, Calgary, Alberta, Canada

Elmworth Gas Field, Alberta, Canada: Depositional Environments and Diagenetic Consideration of Low Permeability Gas Reservoir

Elmworth is a giant gas field in low permeability sedimentary rocks and is considered part of the Deep Basin in Alberta, Canada. Gas production is obtained mostly from conglomerates with unusually high permeability but with some difficulties in producing from lower permeability zones. The study of Falher conglomerate and sandstone (Lower Cretaceous) reveals that this low permeability gas reservoir owes its origin to a unique combination of depositional environments and diagenetic processes.

A detailed study of Falher A and B units shows that sediments were deposited during a regression in the following coastal environments: beach, shore, lagoon-bay, coastal plain, and fluvial. Cyclic patterns of vertical sequences indicate an oscillating shoreline and five such sequences are recognized.

Conglomerate and coarse sandstone occur in beach facies, while fine sandstone rich in detrital clays and organic matter predominates in shore facies. Detrital dolomite is characteristically distributed in shore facies and this is taken to indicate the direction of transport. Conglomerate and sandstone are overlain by carbonaceous shale and coal deposited in a swamp environment.

Vitrinite reflectance data indicate that the sediments were subjected to deep burial and associated important diagenetic processes.

Authigenic minerals are found to be most significant in Falher sediments. Quartz in the form of overgrowths and microcrystalline crystals is most extensively developed in sand-supported conglomerates and mineralogically mature sandstones in various environments. Kaolinite is predominant in most conglomerates and in sandstone, which show high primary porosity and permeability. Illite is more common in sandstone than in conglomerate though this trend is obscured by detrital clays in shoreface sandstone. Carbonate cement, mostly calcite and dolomite, is important, as it reduces porosity drastically. Diagenetic processes are strongly related to the depositional environments and their study is important not only in understanding the nature of the reservoir but in delineating the reservoir quality.

YOUNG, IAN F., Esso Resources Canada Ltd., Calgary, Alberta, Canada, and RICHARD L. CHASE, Univ. British Columbia, Vancouver, British Columbia, Canada

Wrench-Related Folds in Neogene Sediments Developed Along Offshore Sandspit Fault Trend, Queen Charlotte Basin, British Columbia

Net movement on the Sandspit fault, which marks the western edge of the Queen Charlotte basin, is a combination of dextral strike slip movement with significant downdrop of the east block. Evidence of Neogene-Holocene strike slip on Queen Charlotte Islands includes slickensides and offset drainage patterns, topographic features, and geochemical anomalies. The northwest-trending fault parallels the better documented Rennel-Louscoone wrench fault system and the Queen Charlotte transform fault.

Continuous reflection seismic and magnetic profiling in western Hecate Strait was conducted to investigate the offshore extension of the fault zone. A broad magnetic trough in Hecate subbasin, colinear with the Sandspit trend, suggests a crustal dislocation developed in "basement" Cretaceous sediments and Upper Jurassic volcanic rocks. En echelon, gen-

tle open folds in shallow Neogene bed rock, likely to be crustally pervasive, are draped over the indicated fault zone. Lengths of major fold axes range from 25 to 45 km, with dips on fold limbs ranging from 2 to 11°. Wavelength of folds averages 3 km with indicated shortening at the pre-Pleistocene unconformity of 1.5 to 2.5%. The curvilinear trend of fold axes and associated minor faults is oblique to the Sandspit trend. Lack of a through-going fault in Neogene sediment cover demonstrates that the zone is in an early or incipient stage of wrench-related structural development. Deep coupling movements along the buried fault zone are interpreted as the drive which has produced the observed shallow structural pattern.

Temporal and spatial relations of the major northwest shears suggest part of the North American-Pacific plate motion has been taken up by the Sandspit and Rennel-Louscoone faults. Earlier lateral movements along major faults in Queen Charlotte Sound, that may form part of a further Sandspit extension, might explain geophysical anomalies and tectonic events recorded in Insular Belt rocks.

Exploratory drilling in the late 1960s tested a number of wrench anticlines along a broad zone parallel to the offshore Sandspit fault trend.

YUAN, PETER B., Louisiana State Univ., Baton Rouge, LA

Lower Cretaceous (Neocomian) Sedimentation of Sable Island Area, Scotian Shelf, Eastern Canada

Neocomian sedimentation in the Sable Island area, Scotian Shelf, eastern Canada, has been studied by analysis, of 13 offshore wells, using log analysis binocular and petrographic microscope examination of cutting-samples and cores, and stratigraphic map analysis.

The Neocomian is represented in the study area by the Missisauga Formation, a dominantly sandstone sequence containing thick sand units with minor limestone and shale interbeds in the central part of the Scotian basin. The Neocomian sandstones are texturally immature to supermature, and range from subarkose to volcanic sublitharenite with rare quartzarenite. Limestones include both sparry and micritic types. Shales are mostly carbonaceous, pyritic, and silty.

During the early Berriasian, coarse clastics were introduced to the study area from the north and northwest, and gradually built up a high-constructive, lobate-type delta. The source area included granite, acidic to intermediate volcanic rocks, and sedimentary and possibly some metasedimentary rocks. A regional transgression at the end of Neocomian terminated the delta.

ZAIKOWSKI, A., and E. H. ROBERTS, Bendix Field Engineering Corp., Grand Junction, CO

Importance of Resolution for Helium Detectors Used in Uranium Exploration

One aspect of the Department of Energy's National Uranium Resource Evaluation (NURE) program sponsored through Bendix Field Engineering Corp. involves evaluation of instrumentation used for uranium exploration. In recent years ^4He has been useful in exploring for both uranium ore and petroleum deposits. As a consequence, mass spectrometers (leak detector type) have been used to seek small (a few percent) variations of ^4He in soil gases and aquifers. We modified one of these instruments to ascertain its reliability regarding resolution (the ability to separate adjacent mass

peaks). We used the Veeco MS 17 AB because it provides twice the resolution of comparable instruments. An electromagnet was substituted for one of the permanent magnets to enable scanning the 0 to 5 amu mass range.

Acquired spectra allowed the determination of the contribution to mass three ($\text{HD} + \text{H}_3 + ^3\text{He}$) from mass two (H_2). Interference is significant at the 1% level (the size of helium anomalies usually sought) when the abundance ratio ($M = 2)/(M = 3) \geq 75$. This value is valid for the $\text{H}_2/{}^4\text{He}$ ratio for an equivalent system with 50% lower resolution.

Additional experiments identified dissociated water or hydrocarbons as the principal source of H_2 . Correlations of ${}^4\text{He}$ with soil gas moisture found in prior studies may not be due to true variation in ${}^4\text{He}$ but are ascribable to artifacts resulting from H_2 contributions to ${}^4\text{He}$. Corrections for such artifacts can be made by converting field instruments to a scanning mode.

ZIEGLAR, A. M., Univ. Chicago, Chicago, IL, R. K. BAMBACH, Virginia Polytechnic Inst., and State Univ., Blacksburg, VA, S. F. BARRETT, Univ. Chicago, Chicago, IL, et al

Mesozoic and Cenozoic Paleogeography

A series of reconstructions showing land-sea relations, sedimentary facies, and volcanic types has been drawn. Continental orientations were determined using paleomagnetic, climatic, biogeographic, and sea-floor anomaly data. The main differences between these and existing maps are seen in south Asia. Here, Late Triassic sutures, involving Indochina, South China, and North China, indicate that Pangea did not form until this time. Paleoclimatic indicators associated with these south Asian blocks would place them in the tropics in the Triassic rather than the temperate zone as suggested by most published maps. Another innovation in the maps is the palinspastic restoration of the zone between India and the Tarim basin. Published paleogeographic maps show a 1,500 km-wide ocean between Indian and Asia in the late Eocene, the time that lithofacies and biogeographic data indicate that they were in contact. Present crustal thicknesses across the Himalayas and the Tibetan Plateau are double the norm, and so by "unthrusting" the Himalayas, and "unfolding" Tibet, we have constructed a series of maps that show the Asian blocks in contact at the appropriate times. All of the above changes result in an areally restricted Tethyan seaway. The effect of crustal foreshortening in the Tertiary may help to explain the extreme lowering of sea level during this time. The telescoping of continental crust would result in wider ocean basins at the present than at any time since the end of the Permian. This would have the effect of draining the epeiric seas.

1981 AAPG Student Chapter Program Abstracts

AUER, KATHLEEN T., Univ. Maryland, College Park, MD

Estimate of Volcanic Production Rate for Galapagos Islands, Ecuador

The Galapagos Islands, located midway between the East Pacific Rise and the South American continent, constitute one of the most volcanically active regions of the world. Satellite imagery, aerial photographs, and previous land surveys were used to estimate the volume of material produced from the