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Association Round Table

AAPG MID-CONTINENT SECTION MEETING

Wichita, Kansas, October 16-18, 1983

Theme: Energy Impact on the Future

Abstracts of Papers

AMORUSO, JOHN J., Independent, Houston, TX

Outlook for Domestic Exploration (AAPG President's Address)

No abstract.

BERG, J. ROBERT, Wichita State Univ., Wichita, KS

A Mid-Continent Basin: A Reappraisal

One of the largest unevaluated basins in the Mid-Continent is the Salina basin in Kansas and its extension into eastern Nebraska. The purpose of this study is to update all older data, reconstruct new maps, and reappraise the potential for further exploration. The last comprehensive publications on the area were in 1948 and 1956.

The Salina basin includes 12,700 mi^2 (33,000 km^2) in north-central Kansas, and approximately 7,000 mi^2 (18,000 km^2) in east-central Nebraska. The basin is delineated by the zero isopach of Mississippian rocks bordering the basin. The Central Kansas uplift borders the basin on the southwest and Nemaha ridge on the east; the southern limit is an ill-defined saddle in the vicinity of T17S. Boundaries of the Nebraska basin are less well defined, but the axis of the basin trends directly north from the Kansas border along the boundary of Ts10 and 11W, to 41°N lat., and then bifurcates to the northwest toward the Siouxiana arch and northeast for an unknown distance.

Conventional structure maps have been constructed on several horizons, and a series of cross sections depicts anomalous structures. Recent gravity, magnetic, and seismic reflection profiling also provide information on basement tectonics which may influence structures in the younger sediments. Basement depth ranges from 600 ft (180 m) on the northeast Nemaha ridge boundary of the basin, to a depth of 4,750 ft (1,450 m) or −3,000 ft (−915 m) below sea-level datum in Jewell County; therefore, there may be an approximate total of 10,000 mi^3 (42,000 km^3 of sediments for future exploration.

BROWN, HAROLD A., TXO Production Corp., Wichita, KS

Adell Field and Vicinity—Sheridan and Decatur Counties, Kansas

The Adell field in northeastern Sheridan County, Kansas, and other smaller fields in the area, produce oil from multiple zones of the Lansing-Kansas City. Porous zones of this age are shoal deposits consisting of rounded carbonate grains, many of which have superficial oolitic coating. Carbonate grain distribution was controlled by water turbulence and relief on the sea floor. The Jennings anticline existed during Lansing-Kansas City deposition and provided the necessary relief on the sea floor for shoals to occur. Differential rates of sea-floor subsidence and cyclic nature of sediment accumulation account for the multiple porous pay zones which are stacked on top of each other.

CALDWELL, CRAIG D., Cities Service Research, Tulsa, OK

Kansas-Type Cyclothems and Porosity Development in Middle Pennsylvanian Marmaton Group, Dirks Field, Logan County, Kansas

Seven depositional units are recognized in the Texaco 2 Dirks core (4,374 to 4,419.5 ft, 1,333 to 1,347 m) from the upper part of the Middle Pennsylvanian (Desmoinesian) Marmaton Group, Dirks field, Logan County, Kansas. These units make up two Kansas-type cyclothems, the Altamont and Lenapah, and record deposition in response to fluctuating sea level and differing terrigenous influx on the broad, epeiric shelf that was the northern extension of the Hugoton embayment. The units correspond to Heckel's basic, Kansas-type cyclothem members, which are (transgressive) middle limestone, (transgressive) core shale, (regressive) upper limestone, and (regressive) outside shale. The Altamont cyclothem lacks the core shale and perhaps the middle limestone, both of which are present in outcrops in eastern Kansas. The overlying Lenapah cyclothem contains all of the basic members of Heckel's Kansas-type cyclothem.

The (transgressive) middle limestone of the Lenapah cyclothem is a relatively thin, locally burrowed, bioclast wackestone containing *Osagia*-coated bioclasts and a relatively diverse marine biota. Overlying this is calcareous, olive-gray to olive-black, fissile core shale containing phosphorite(?) nodules and local brachiopods. Outside (regressive) shales in the Dirks 2 core are greenish to brownish gray. Although generally unfossiliferous, brachiopods and crinoids are present in the upper part of one of the outside shales. Evidence of plant roots is present locally, and nodular, unfossiliferous limestone with calcite-filled desiccation fractures occurs in the outside shale of the Lenapah cyclothem.

Porosity development in the Altamont and Lenapah cyclothems of the Dirks 2 is restricted to the upper limestone members. The upper limestone of the Lenapah cyclothem, the Idenbro limestone member, is a bioclast packstone and grainstone grading upward into cross-stratified, ooid grainstone. This unit contains intergranular and secondary moldic (principally oomoldic) porosity. Portions of this regressive limestone are slightly oil stained, and porosity is poor to locally fair. The upper limestone member of the Altamont cyclothem, the Worland limestone member, is strongly oil stained and is a pay zone in this well and in the study area. This unit consists of bioclast wackestone overlain by chaetetid-coral bafflestone, and above that, dolomite containing angular limestone clasts, irregular-shaped vugs, and sediment-filled fractures. The Worland limestone displays intragranular, secondary moldic, solution-enlarged moldic, vuggy(?), and fracture porosity. Porosity and permeability are fair to good locally and are thought to reflect, for the most part, meteoric diagenesis related to subaerial exposure on a subtle Altamont high on the sea floor. A cross section through the study area shows a slight thinning of strata overlying the Altamont Limestone in wells where Worland porosity is well developed (i.e., Worland pays) relative to wells where the Worland limestone is "tight." This thinning may indicate an Altamont high, the crest of which may have been situated just northeast of the present-day structure.

CHAUDHURI, S., V. BROEDEL, L. NICASTRO, and R. ROBINSON, Kansas State Univ., Manhattan, KS

Strontium Isotopic Variations of Oil-Field Waters: A Clue to Migration History of Oils

Oil-field waters produced from Middle to Lower Pennsylvanian and Mississippian stratigraphic units in several localities in Ness, Hodgeman, Ford, and Clark Counties of Kansas were analyzed for their strontium isotopic compositions to determine the influence of associated rocks on the chemical characters of the fluids. The $^{87}Sr/^{86}Sr$ ratios of these oil waters, ranging between 0.710 and 0.727, are significantly higher than the

$^{87}Sr/^{86}Sr$ ratios of any seawater during the Phanerozoic. The lithologic character of the host reservoir rocks had little influence on the strontium isotopic composition of the oil waters. The $^{87}Sr/^{86}Sr$ ratios of the waters, at least those from Ness, Hodgeman, and Ford Counties, correlate positively with Sr/Ca ratios (2×10^{-2} to 10×10^{-2}) and negatively with total dissolved solid (TDS) contents (32 to 48 g/L). The results of the strontium isotopic investigation have several implications for understanding migration and accumulation histories of the oils. The strontium isotopic data can be useful in providing information on the hydrologic relationship among oil pools in an oil field and in determining the genetic relationship among oils produced from stratigraphically separate reservoirs within an oil field. The strontium isotopic data of oil-field waters are useful potentially in differentiating an oil-bearing reservoir from an oil-barren reservoir within an oil field.

FORD, JON R., Resource Technology Corp., Denver, CO

Influence of Precambrian Shear Zones on Paleozoic Rocks in Southeastern Colorado

Recurrent movement along Precambrian-age shear zones throughout the Pennsylvanian and Mississippian has been a significant factor controlling depositional patterns during these periods. The displacement, although subtle and superposed on the epeirogenic movement, appears to have affected locally the bathymetry or paleotopography in the vicinity of the Las Animas arch. As a result, lithofacies distribution of either clastic or carbonate rock is related to proximity to the shear zones.

Surface lineations derived from Landsat analysis, coupled with lithofacies mapping based on subsurface data, identify the location of several shear zones in the region. The northeast and northwest orientations of these fault zones is subparallel to mapped faults in the Rocky Mountain region. Lithofacies mapping on a regional scale indicates the fault zones may have controlled the orientation and location of middle Morrowan sandstones. Similarly, the fault zones are thought to control Mississippian facies and subsequent dolomitization.

In addition, differential movement of fault blocks bounded by the shear zones is thought to have influenced formation of the Sierra Grande and Apishapa uplifts as well as the Las Animas arch. Isopach and lithofacies mapping show that precursors to the present Las Animas arch were present intermittently during the Mississippian and Pennsylvanian. Although these ancestral folds were not as positive as the present arch, they were oriented in the same general direction and as a result were influenced by the same set of shear zones.

The significance of the shear zones in controlling stratigraphy and structural development of the arch has been a factor largely overlooked during past petroleum exploration in the region. Further study of these shear zones is expected to lead to significant future petroleum discoveries.

FORREST, BETSY, and ANDREW AHROON, Voyager Petroleums, Inc., Denver, CO

Computer-Assisted Exploration in Kansas

Some explorationists have regarded computers in the same category as dry holes, however, their capabilities for efficiency, assembling, and manipulating data cannot be disputed.

By inputting the following data—(1) geologists' correlated log tops on 33 horizons, (2) location and times of selected intervals of 1,400+ mi (2,250+ km) of CDP seismic data, and (3) completion and production information on 10,000+ wells in western Kansas—the efficiency, accuracy, and productivity of the exploration department at Voyager Petroleums, Inc., have increased by at least 500%. A county map printed by the computer with geologists' correlated tops and geophysical data can be hand contoured in one working day. A prospect can be in final drafted form in two working days. Submittals can be evaluated almost instantly. All data entries are verified previously so accuracy is insured.

The use of the computer has allowed the geologist to evaluate the region in a time-efficient and cost-efficient manner. The resulting prospects therefore are based upon a thorough understanding of the geologic constraints that control hydrocarbon distribution. Additionally, computer speed and versatility allow unconventional data manipulation resulting in prospects which would have been overlooked by using conventional exploration techniques.

All newly released information is being integrated weekly insuring a complete and accurate western Kansas data base.

GAGLIARDO, DAVE, Independent, Denver, CO

Control of Arbuckle (Cambrian-Ordovician) Production by Block Faulting

The Central Kansas uplift is a collapsed arch which was eroded to granite on both sides of a central graben during the post-Mississippian. Uplift and collapse produced a myriad of horst and graben blocks affecting the Arbuckle Group below the so-called pre-Pennsylvanian unconformity.

Arbuckle production comes from horst blocks, and about 75% of the Arbuckle production on the uplift comes from blocks within the central graben. Mapping Arbuckle structures as fault blocks rather than as erosional features allows a completely different use of subsurface data and can lead to many unsuspected field extensions and wildcat prospects.

GOEBEL, EDWIN D., and RAYMOND M. COVENEY, JR., Univ. Missouri-Kansas City, Kansas City, MO, and ERNEST E. ANGINO and EDWARD ZELLER, Univ. Kansas, Lawrence, KS

Naturally Occurring Hydrogen Gas from a Borehole on the Western Flank of Nemaha Anticline in Kansas

Since August 1982, the CFA 1 Scott well in Sec. 20, T14S, R6E, Morris County, Kansas, located about 14 mi (23 km) south of Junction City, has yielded a gas composed of 50± 10% free hydrogen, 50± 10% nitrogen, and only traces of hydrocarbons. This analysis has been ascertained by gas chromatography and mass spectrography of samples taken over a period of 6 months. The reservoir rock is a "Kinderhook" sand from 2,176 to 2,196 ft (663 to 669 m) depth. The gas samples analyzed are accumulating in the head space above a fluid level (salt water) of 1,805 ft (550 m) from a bottom-hole depth of 2,197 ft (670 m).

The Scott well is located on the western flank of the complexly faulted Nemaha anticline, updip from the central North American rift system and 30 mi (48 km) south of Riley County where serpentinized kimberlites occur. The geothermal gradient is 30°C/km (87°F/mi). Basement rock beneath the well is granite, probably overlying deeply buried magnetic rocks.

Bulk composition of gas from the Scott well is similar to H_2-rich gases issuing from hydrothermal vents at the 21°N site on the East Pacific Rise, and to certain gases occurring within the Zechstein strata of Poland.

Mechanisms proposed by others to explain the origin of naturally occurring free hydrogen include: bacterial or inorganic decomposition of organic matter; bombardment of organic matter by radioactive decay products; high-temperature magmatic and volcanic processes; dissociation of H_2O by low-temperature or metamorphic reactions involving sulfur species of the $Fe^{+2} \rightarrow Fe^{+3}$ redox half reaction (e.g., during serpentinization of ultramafic rocks), and mantle out-gassing of primordial reduced gases. For some wells, artificial production of H_2 (e.g., oxidation of iron tools or pipe), also has been proposed to occur. Light, stable, isotope ratios (e.g., D/H, $^{18}O/^{16}O$, and $^{15}N/^{14}N$) may be distinctive sufficiently to rule out certain of the proposed H_2-generating mechanisms.

No single mechanism is responsible solely for generating this H_2-rich gas from the Scott well; rather, a combination of fortuitous geologic and possibly biologic processes are contributing in various proportions to the production of the H_2 and N_2. Conceivably, the local geologic setting merely is circumstantial and unrelated to the genesis of the gases. However, in view of its spatial association with the central North American rift zone, a major geologic feature with similarity to the East Pacific Rise, the Kansas gas occurrence warrants additional study.

GUSTAVSON, JOHN B., Gustavson & Associates, Boulder, CO

Basement Rift Control on Oil Production in Eastern Kansas

Improved understanding of the central North American rift system (CNARS) offers a new interpretation of the basement structure in certain parts of the Mid-Continent. In eastern Kansas, basement structure can be shown to control oil production from some producing fields. Structural