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BULLETIN

Volume 83 Number 2

March—April 2008

Established 1925

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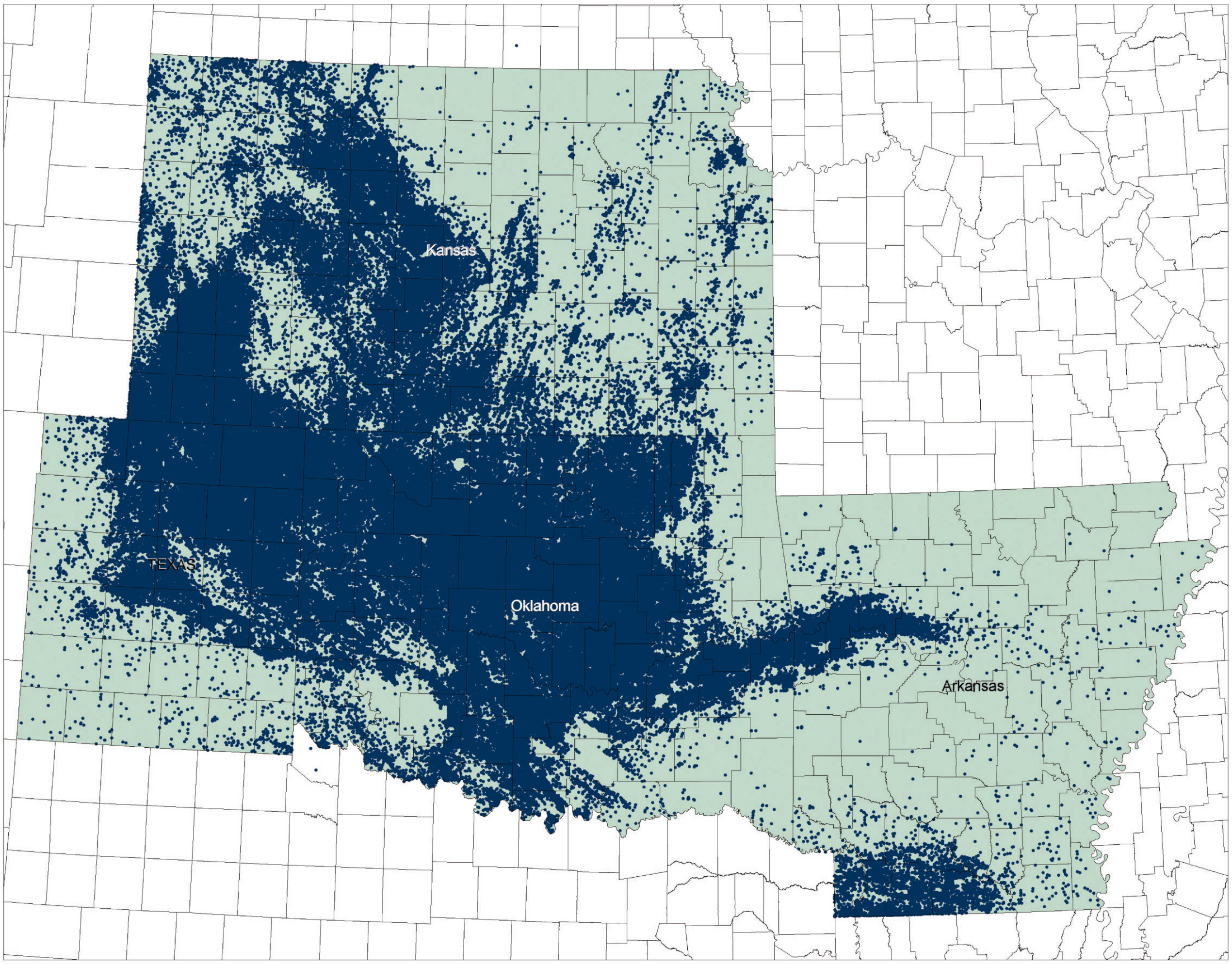

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A now common scene of a well being drilled in our beautiful state—this one is in the Red Hills, Barber County

CALL FOR PAPERS

The Kansas Geological Society Bulletin, which is published bimonthly both in hard-copy and electronic format, seeks short papers dealing with any aspect of Kansas geology, including petroleum geology, studies of producing oil or gas fields, and outcrop or conceptual studies. Maximum printed length of papers is 5 pages as they appear in the Bulletin, including text, references, figures and/or tables, and figure/table captions. Inquiries regarding manuscripts should be sent to Technical Editor Dr. Sal Mazzullo at salvatore.mazzullo@wichita.edu, whose mailing address is Department of Geology, Wichita State University, Wichita, Kansas 67260. Specific guidelines for manuscript submission appear in each issue of the Bulletin, which can also be accessed on-line at the Kansas Geological Society web site at http://www.kgslibrary.com

SOCIETY Technical Meetings

Spring 2008

Please Note: Most Tech Talks Will Be On <u>Tuesdays</u> This Spring

Mar. 11—Don Whitmore , "Fate & Identification of Oil-brine Contamination in Different Hydrogeologic Settings"

Mar. 18—Joel Walker, Hutchinson Cosmosphere

Mar. 25—Lynn Watney, "Geo-Engineering Modeling of Shallow Upper Penn. Sandstones Associated with Recovery of Low BTU gas in Chase County"

Apr. 15—Rick Taylor, Shreveport, LA, "Inconvenient Evidence, Global Warming Goes On Ice"

Apr. 22—AAPG Convention in San Antonio, TX

Apr. 29—Dan Hitzman, Tulsa, OK, "Hydrocarbon Microseepage Surveys in Kansas: Reconnaissance to Prospect Evaluation Strategies?

May 13—Susan Nissen

May 20—TBA

May 27—TBA

Attention!

<u>Location for Technical Meetings</u>

*All KGS technical presentations are held at 12:30 p.m. at the **Wichita Bar Association**, located at **225 N. Market**, ground floor conference room, unless otherwise noted.*

Note: For those geologists who need 30 points to renew their licenses, there will be a sign-in sheet at each presentation and also a certificate of attendance.

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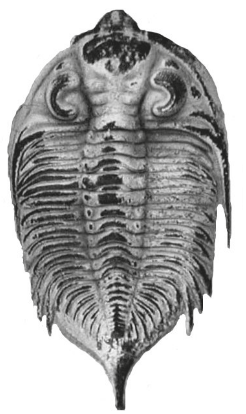

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Bulletin **committee members and PhD's in Paleontology are prohibited from entering.**

The Kansas Geological Society Wishes to Thank the Following For Supporting the Annual Banquet

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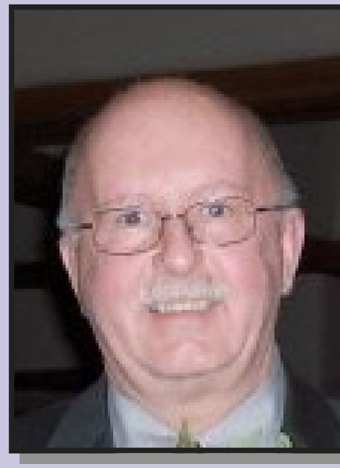
President's Letter



Dear Members,

As we look forward to spring and warmer weather I think of the fact that oil closed at $100.74 per barrel today. This is a bit of a mixed blessing; you can not help but think about drilling wells for these prices but in this election year I feel like we have a target painted on our backs; only time will tell. This price should keep the already busy library more so.

The digital library is in "Beta Testing". This means that it is out to a handful of users within the Society that can evaluate the features and look for any bugs within the program. After the bugs have been worked out, the program will go out to the digital membership. The Beta Testing phase should get any of the problems fixed well before a less than technical person such as myself have a chance to get in trouble way over my head.

I want to thank all that showed up for the technical talk I gave in February. It was a nice crowd and there were even questions that I could answer. This brings me to the thought that these talks are kind of like the saying about books. They say everyone has a potential book in them or at least a series of short stories. The same goes for technical talks or articles for the bulletin. Almost everyone has field they have worked on that could become a talk or article for the bulleting. PowerPoint makes the talks much easier to do and Sal's expertise makes the articles for the bulletin something we all can do.

Speaking of involvement, in April the AAPG will be held in San Antonio, Texas. A great place to go for a convention; no matter how many of these I attend there is always something new and exciting to look at. For those that have never attended a national convention this would be a good one to go to. The dates of the convention are April 20th -23rd. See you there.

Respectfully submitted,

Ernie Morrison

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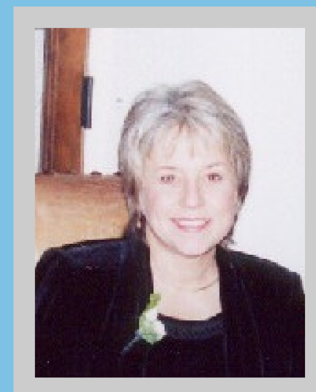
From The Manager



Dear Members,

The spring of 2008 looks to be a continuation of good times for our industry. The library is staying very busy with orders and processing all of the new data coming our way either by operators or the KCC. We are investing in some new printers to keep things moving along and to be able to offer more services to you, our members.

We will be attending the AAPG annual convention again this year. It is being held in San Antonio and I am looking forward to seeing many of you members from outside Kansas. For those of you attending, we will be in booth 3154. If you have any time to give while you are there, we would love to have you spend some time in the booth or just stop by to say hi.

We also plan to have a booth at a new event this year; the first annual Mid-Continent Prospect Expo in Oklahoma City May 6th & 7th. There is an advertisement for this on page 12 and more information on our web site.

We are still processing the "catch up" boxes from the KCC but the girls have made great headway on them. We are also fine tuning the new digital software and have had several people testing it out for us. The final go live date is coming up! I want to again thank those of you who have been so patient in waiting on this new version of the software.

We had a very nice turn out for the KGS Banquet which was held on January 25th. Look for some pictures of the event throughout this publication.

Respectfully submitted,

Rebecca Radford
Manager

Member Profile

Wilbur Bradley

The time has arrived to profile a native Wichitan and one of the most prominent operators/geologists of the city, Wilbur Bradley

Wilbur was born July 20, 1937 to Millie and O.E. Bradley. His father was from northern Oklahoma and was an attorney by profession, but worked primarily as a landman. His mother was originally from Weatherford, Oklahoma. The family moved to Wichita in 1925. Wilbur has two sisters: Mary Lou Owens now residing in Palm City, Florida and Margie Lee Swengel of Haven, Kansas.

He attended Hyde Elementary, Robinson Intermediate and East High School where he graduated in 1955. Being influenced by his father who was involved in the oil industry and took him to wellsites, Wilbur enrolled at the University of Oklahoma in Geology and was a student there from 1955 until 1961, receiving both a Bachelor of Science and a Master's in Geological Engineering. In the summers while enrolled at OU, he was employed by Shell Oil Company: 1st summer in Oklahoma City and 2nd in Wichita where Bob Euwer was his boss. Enrolled in OU during this period were KGS members Mack Knighton and Dean Seeber. Wilbur was later to work with Dean on many prospects in Eastern Kansas, but was not acquainted with him when they were in school. He recalls several professors who he believes were excellent educators: Dr. David Kipps, Vertebrate Paleontologist, Dr. Carl Moore, one of his thesis advisors, and Dr. Harris who taught sample studies. Wilbur remembers Dr. Harris giving as an exam, ground-up coke bottles and mudballs from the South Canadian River and asking the class to describe them.

After graduation, Wilbur joined the California Company, a division of Standard Oil of California in New Orleans, before returning to Wichita in June of 1962. Since returning, he has been a Consulting Geologist devoting a considerable amount of time and effort to exploring and producing in Eastern Kansas in conjunction with Dean Seeber.

In 1957 while enrolled at OU, Wilbur married Nancy Reeves of Texarkana, Arkansas. They have two children: Mike who works with Wilbur in operating White Pine Petroleum and Dana, a wildlife biologist in Crested Butte, Colorado.

Professionally, Wilbur has been very active in the Society of Independent Professional Earth Scientists (SIPES). He has served as President of the Wichita Chapter, served two terms on the National Board including holding the office of Secretary. He has also been National President of the SIPES Foundation. Locally, Wilbur has served on the Board of the Petroleum Club.

For eleven years Wilbur was in charge of the seminar that the Kansas Securities Commission office provided for the purpose of providing their investigators information about the Oil and Gas Industry. Also in attendance at these seminars were postal inspectors, County Attorneys, Attorney Generals from other states, KBI personnel and Security Commissioners from other states

Other organizations in which Wilbur has been active include: Rotary Club, University Congregational Church and various Masonic bodies including the Shrine.

Looking back at his life as a consulting geologist, Wilbur remembers several tests both puzzling and interesting. He mentions test in South Louisiana, near Crowley that was the first well drilled on a salt dome that penetrated the dome and took sidewall cores in the salt. Wilbur says this was a "fun well". One of the most puzzling and challenging tests was in Butler County. He had no drilling time or samples and it was necessary to repair a leak in the surface casing before any information could be obtained.

Like all geologists, Wilbur encountered characters in the "oil patch". He believes perhaps the biggest one, Oscar

Koepke, who was a "doodlebugger" in Eastern Kansas, but who was also very savvy about oil and geology.

There isn't any doubt in Wilbur's mind that if he had it all to do over, he would still be a Petroleum Geologist. He has enjoyed it so much that he hasn't any plans to retire.

It isn't "all work and no play" with Wilbur. He likes to travel, particularly to his favorite fishing spots in Colorado and Canada. He has made fifteen trips to Canada.

This short profile really doesn't tell the full story of this successful geologist who has been so much a part of our profession and industry.

This years 50 year members: from left seated, Bob Vincent, Don Shawver, Calvin Noah & Bill Shepherd standing.

The Kansas Geological Foundation awarded Mrs. Lois Eppich of Seneca, Kansas, with the Science Teacher of the Year Award at this years annual Banquet.

Ken Dean, outgoing president of the Kansas Geological Foundation thanks Mrs. Earl Knighton for the Knighton Family donation to the Foundation.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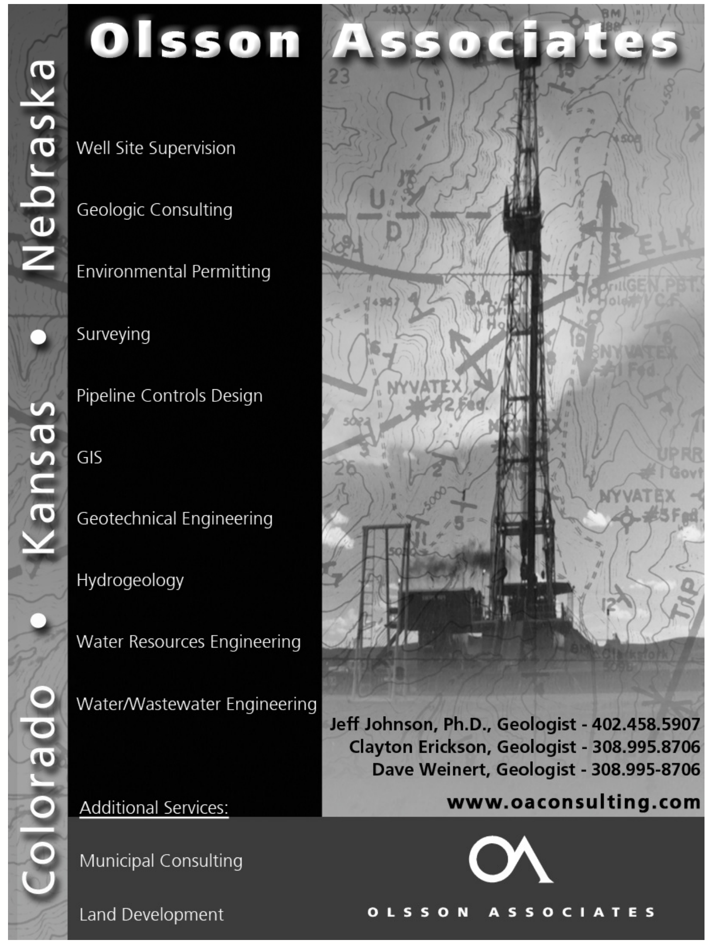

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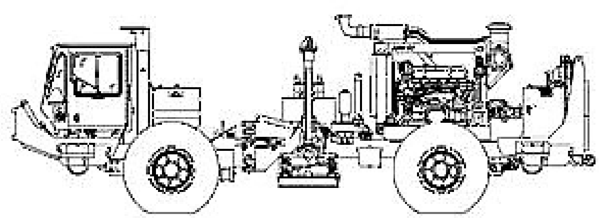

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CHERT RESERVOIRS IN THE COWLEY FORMATION (MISSISSIPPIAN), SOUTH-CENTRAL KANSAS: PARAGENESIS, OXYGEN AND SILICON ISOTOPE GEOCHEMISTRY, AND TIMING OF SILICIFICATION AND POROSITY FORMATION

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ABSTRACT

The productive Cowley Formation in Rhodes Field is a depositional sequence between the underlying Osagean and overlying Meramecian sequences. The Cowley sequence internally is cyclic and punctuated by unconformities. Within each cycle, lithologies shallow upward from basinal dark spiculitic shale, to lenticular and/or flaser-bedded spiculite in matrices of dark gray shale (slope deposits) to green shale (moderate water-depth, outer-platform deposits), to shallow platform bedded spiculite, locally with some fossils. Three generations of replacement chert are recognized in the rocks (1st, 2nd, and 3rd), and their interpreted origins are based on observable paragenetic relationships in the rocks, and stable $^{18}O/^{16}O$ and ^{30}Si geochemical compositions. The 1st-generation chert precipitated essentially syndepositionally from marine pore fluids in shallow-buried sediments. These rocks have the most enriched ^{18}O and ^{30}Si compositions. The 2nd and 3rd-generation cherts have progressively more depleted ^{18}O and ^{30}Si compositions, and they precipitated from mixed meteoric-marine to progressively more meteoric groundwaters during periods of sea -level fall and eventual lowstand subaerial exposure. Secondary reservoir porosity in the rocks was created by dissolution mainly between the 2nd and 3rd chert generations, and it its origin is allied to subaerial exposure.

INTRODUCTION

Mississippian siliceous rocks, including cherts (and Achat@), locally are prolific oil and gas reservoirs throughout Kansas, especially where they are in close proximity to the pre-Pennsylvanian unconformity (Montgomery et al., 1998). General depositional, diagenetic, and petrophysical attributes of Mississippian chats were described most recently by Montgomery et al. (1998) and Watney et al. (2001). The focus of the present study is a specific group of subunconformity, siliceous rocks that is productive in south-central Kansas B namely, the ACowley@ section. The so-called ACowley Formation@ (Lee, 1940) was considered by Lane and DeKeyser (1980), and subsequently others, to be outer-shelf and shelf-margin lithofacies equivalents of shallow-shelf carbonates to the north. According to Maples (1994), the Cowley is Kinderhookian to Meramecian in age. Recent work by Wilhite et al. (2007) in south-central Kansas, however, suggests alternatives to these contentions. That is, the Cowley is *not* a deeper-water facies of up-dip platform carbonates. Rather, it comprises an unconformity-bounded depositional sequence of spiculitic strata that overlie typical cherty Osagean carbonates and cherts, and in turn, are overlain by somewhat less-cherty Meramecian carbonates (Figure 1). As such, the Cowley should again be regarded as a formation within the Mississippian as was originally suggested by Lee (1940). Although the Cowley was deposited during several cycles of transgression and highstand (regression), the extent of coastal onlap (that is, the relative magnitude of sea-level rise) during deposition was considerably less than during Osagean and Meramecian times (Figure 1). Cowley rocks have produced prodigious amounts of gas, and some associated oil, throughout much of Barber County. Neither Montgomery et al. (1998) nor Watney et al. (2001) described the Cowley *sensu stricto* in their studies, hence, the origin of chert and porosity in this economically important group of rocks has not been evaluated.

This study discusses the types and origin of chert, timing of silicification, and the timing of porosity formation in these rocks. Conclusions were based on paragenetic relationships (that is, relative timing of diagenetic events observable in the rocks) and inferences from stable oxygen and silicon isotope compositions of the cherts (Mazzullo et al., 2007). The section was examined and sampled initially in three long, continuous cores and additional shorter cores taken in the Cowley in Rhodes Field in Barber County. This field, which to date has produced 12.5 MMBO and 109.7 BCFG (primarily from the Cowley but locally also the Viola, Lansing-Kansas City, Douglas, Shawnee, and Elgin), is along the Pratt Anticline. Toward the north-northwest, progressively older rocks are eroded from the Precambrian crystalline core of the Central Kansas Uplift, including cherty or otherwise siliceous Mississippian, Viola, and Arbuckle

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strata. The Cowley in Rhodes Field was examined by Clark (1956), and most recently by Mazzullo et al. (2007) and Wilhite et al. (2007). According to the latter two studies, the Cowley comprises several progradational and aggradational highstand depositional cycles separated by relatively minor lowstand unconformities (Figure 1). In a complete section, each cycle shallows upward from: (i) basinal dark spiculitic shale; (ii) lenticular and/or flaser-bedded spiculite in matrices of dark gray shale (slope deposits) to green shale (moderate water-depth, outer-platform deposits). These rocks locally are glauconitic and dolomitic; and (iii) bedded spiculite, locally with some fossils (mainly crinoids) in rarely preserved innermost-platform deposits at the very top of the section. In addition to siliceous spicules, the rocks include multiple generations of chert. Within each cycle the amount of chert and porosity in the rocks both increase dramatically in up-dip directions toward cycle-bounding unconformities. Similar relations were described in non-Cowley chats in south-central Kansas by Watney et al. (2001).

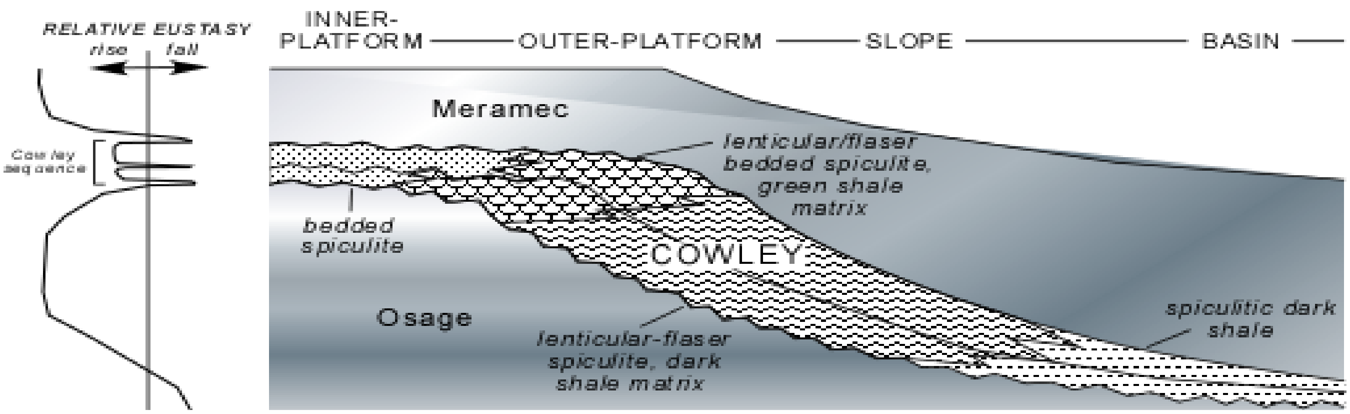

Figure 1. - Diagrammatic representation of the geometry of stratal units, and facies and inferred depositional environments in the Cowley in the Rhodes Field and adjoining area in Barber County, Kansas (based on Wilhite et al., 2007). Relative sea-level curve on the left indicates that the Cowley sequence was deposited during a lower sea-level highstand than during deposition of the underlying Osage and overlying Meramec.

INFERENCES BASED ON THE OBSERVABLE PARAGENETIC SEQUENCE

The spicules in the rocks examined appear to have been composed initially of biogenic (hydrated) silica. As in other spicule-rich Mississippian rocks in Kansas, the fossil source of these spicules is presumed to have been sponges (e.g., Thomas, 1982; Rogers et al., 1995; Watney et al., 2001; Franseen, 2006). Paragenetic study of the Rhodes Field cores suggests that there are three main generations of silicification in the spiculitic rocks (1st, 2nd, and 3rd), and they are present in bedded spiculite and lenticular/flaser-bedded spiculitic deposits.

1st-generation chert

This chert occludes much primary interparticle micro-porosity between spicules and at least some of the primary micro-intraparticle porosity within initially hollow spicules. Such silicification resulted in the conversion of unconsolidated spiculitic sediment to chert (Figure 2A). In many cases the silicified spiculites are transected by thin calcite-filled cracks, commonly later replaced by opaque white chert, that subsequently were deformed by soft-sediment deformation due to mild mechanical compaction. Lenses of 1st-generation-silicified spiculite in the lenticular/flaser-bedded deposits also locally deformed surrounding argillaceous sediments. Additionally, in associated shales in these deposits there locally are nodules (3"-3" diameter) of coarse crystalline, replacive calcite that in turn were later partly to completely replaced mimetically by opaque white and locally translucent chert. Displacive growth of these calcite nodules also locally deformed surrounding sediments (Figure 2B). Together, these attributes of the 1st-generation chert and calcite nodules suggest that they formed as a result of early silicification and calcitization, respectively, within shallow-buried, unconsolidated sediments.

(Continued on page 16)

2^{nd} and 3^{rd}-generation cherts

The 2^{nd}-generation chert is opaque and light gray, locally with a slight blue tint. It is present either as scattered small (few mm) to larger poikilotopes within 1^{st}-generation chert in some sections of core, or more commonly, it nearly pervasively replaces that chert (Figures 2C and D). The chert that partly to completely replaced early-formed calcite nodules in lenticular/flaser-bedded deposits locally abuts against and slightly deforms 1^{st}-generation-silicified spiculite lenses. Hence, this chert probably also is of 2^{nd}-generation origin. Most of the secondary porosity in the rocks, discussed below, post-dates the 2^{nd}-generation chert, and locally is partly occluded by the 3^{rd}-generation chert.

The 3^{rd}-generation chert is light yellowish tan and opaque. It typically either partly replaces earlier chert generations, or light green shale that infilled original inter-clast pores within chert-clast breccias (Figures 2C and D). The origin of these breccias will be discussed in a forthcoming paper. Such breccias are present in close proximity to the pre-Pennsylvanian unconformity, and locally, some of the more subtle unconformities within the Cowley section. Component chert clasts in these breccias consist entirely of 1^{st}- and 2^{nd}-generation cherts that are Ahealed@ by 3^{rd}-generation chert..

Chert Stratigraphic Distributions

The amount of 2^{nd} and 3^{rd}-generation cherts in the Cowley increases in an up-dip direction toward unconformities within the Cowley section and also the pre-Pennsylvanian unconformity. The 3^{rd}-generation chert is present almost exclusively in very close proximity to these unconformities, whereas the 2^{nd}-generation chert extends farther down-dip, below the unconformities, within the Cowley. These attributes of chert distribution seemingly suggest a causative relationship between silicification generations 1 and 2 and subaerial exposure. The amount of 1^{st}-generation chert in the lenticular/flaser-bedded deposits and bedded spiculites, excluding breccias, instead decreases in an up-dip direction, suggesting that this stage of silicification was not temporally related to subaerial exposure.

Relevance of Breccias and Basal Cherokee Reworked Breccias/Conglomerates

The breccias in the rocks (Figure 2D) contain clasts of commonly fractured 1^{st} and 2^{nd}-generation chert, which suggests that these stages of silicification occurred prior to exposure and brecciation. Where present, overlying basal Cherokee rocks include chert-clast breccias or conglomerates wherein the commonly rounded and peripherally-oxidized clasts were derived from a number of sources (e.g., from the Viola and Arbuckle), including 1^{st}-, 2^{nd}-, and 3^{rd}-generation Mississippian cherts. The presence in these rocks of the latter cherts indicates that silicification of Mississippian rocks occurred prior to Cherokee time.

STABLE OXYGEN AND SILICON ISOTOPE GEOCHEMISTRY

The ratios of ^{18}O and ^{16}O (in l relative to SMOW B Standard Mean Ocean Water) and the amount of ^{30}Si in the cherts assist in constraining interpretations of the site and timing of silicification in the rocks. For this purpose, samples were collected of the 1^{st}, 2^{nd}, and 3^{rd}-generation cherts from two of the long, continuous cores in Rhodes Field (the Continental #10 Harbaugh and Continental #15 Harbaugh). A plot of gross $^{18}O/^{16}O$ compositions versus depth in the cores (Figure 3A) shows scatter of data from 21-33l but with no significant change in isotope composition relative to depth, and also no significant variation in compositions between the two cores sampled. These data are interpreted to suggest that the fluid chemistry of silicification was relatively simple, and that is was mostly similar from core to core. Plotting ^{30}Si versus $^{18}O/^{16}O$ (Figure 3B) suggests a trend of slight depletion in ^{30}Si from the 1^{st}-generation cherts to the 3^{rd}-generation cherts. This trend is accompanied by $^{18}O/^{16}O$ compositions that also show slight but progressive depletion in ^{18}O from the 1^{st}-generation cherts to the 3^{rd}-generation cherts; and the most isotopically-enriched of the cherts is the 1^{st} generation chert (as indicated in the following summary table taken directly from Figure 3B):

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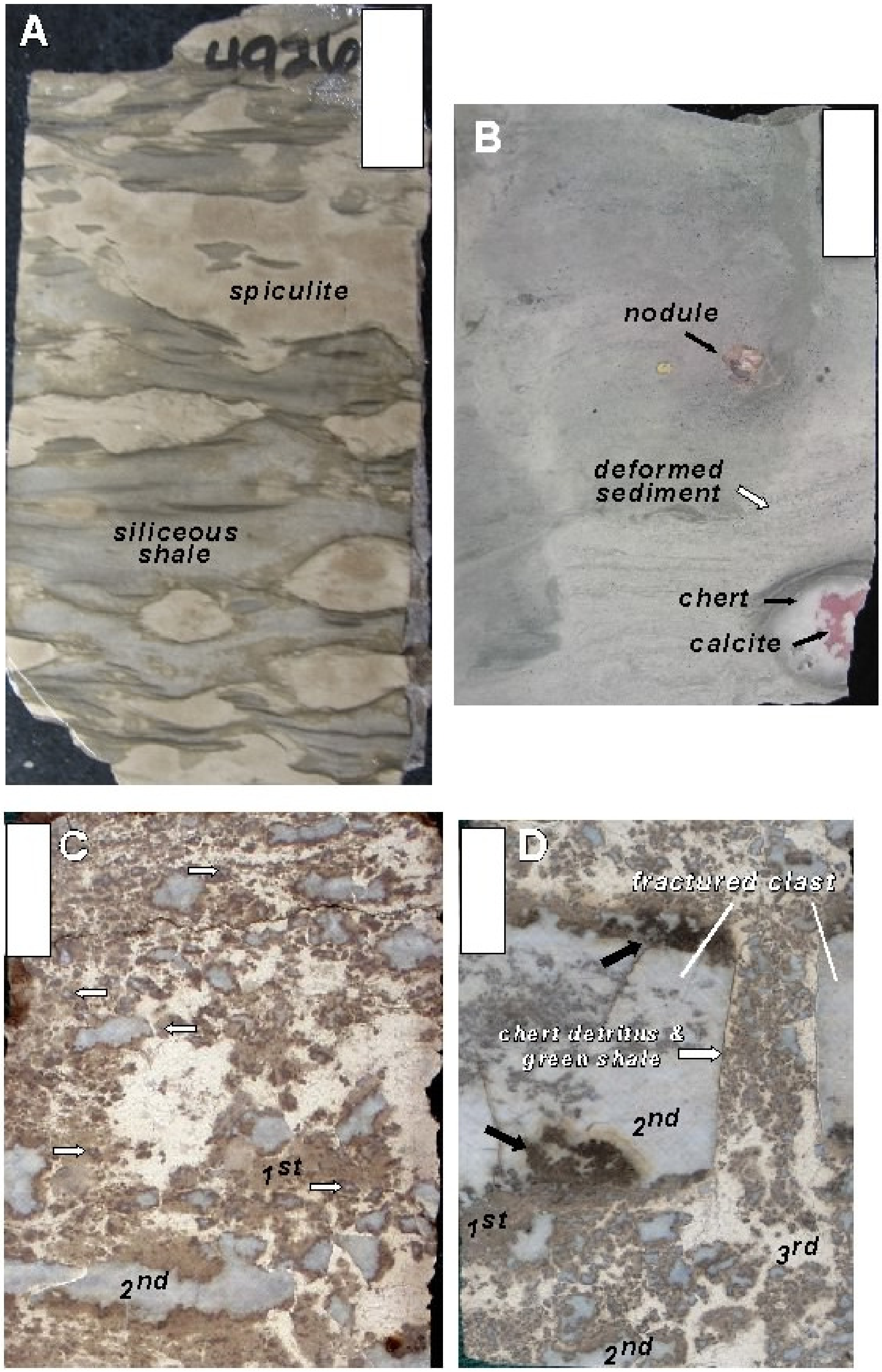

Figure 2. - Rock slabs of representative Cowley cores from Rhodes Field. White scales are 1" in length and positioned at stratigraphic top of samples. (A) 1st-generation silicified spiculite lenses in lenticular/flaser-bedded spiculitic and silicelus shale. (B) In lower right and near the middle, early calcite nodules that deformed surrounding sediment. Initial calcite (stained red with Alizarin) later was mostly but not entirely replaced by opaque white chert. (C) Three chert generations (labeled 1st, 2nd, and 3rd) in bedded spiculite. Arrows point to some poikilotopes of blue-tinted, 2nd-generation chert. (D) Close-up of breccia showing the three chert generations (labeled 1st, 2nd, and 3rd) . Note that the space between two ends of a fractured clast was infilled with detrital 1st-generation chert, detrital poikilotopes of 2nd-generation chert, and green shale, and then these components were occluded by 3rd-generation chert. Oil-stained micro-porosity that formed between the 2nd and 3rd chert generations is indicated by black arrows. The 3rd-generation chert tends to occlude secondary porosity in the rocks, and in most cases it replaced infilling green shale between the chert clasts.

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Chert Generation	Range ^{30}Si(l)	Range ^{18}O/^{16}O(l)
1^{st}	0.3 to 0.5	28.4 to 29.7
2^{nd}	0.1 to -0.9	26.7 to 27.0
3rd	0.1 to -0.9	24.1 to 25.1

Inferred Timing and Origin of 1^{st}-Generation Chert

Based on the inferred paragenetic sequence the 1^{st}-generation chert formed early, soon after deposition, in shallow-buried sediments. Accordingly, that this chert has the most enriched ^{18}O composition (28.4 to 29.7l) is interpreted to suggest that silicification occurred in the shallow-burial, sub-sea floor environment soon after sediment deposition, with silica precipitated by slightly-modified marine pore fluids. Such early (essentially syndepositional) silicification likely was promoted by the inherent instability (by virtue of high solubility) of biogenic silica B that is, dissolution of at least some of the biogenic silica spicules and its re-precipitation as more stable chert. Such diagenetic processes, including associated precipitation of some carbonates such as in the early-formed calcite nodules in the rocks (Figure 2B), are very common in shallow-buried, typically organic-rich, fine-grained marine sediments (e.g., Pisciotto, 1981a, b). The most enriched ^{30}Si compositions of the 1^{st}-generation cherts (0.3 to 0.5l) likewise are interpreted to be primary values of silica precipitated by marine pore fluids.

Inferred Timing and Origin of 2^{nd} and 3rd-Generation Cherts

Precipitation of the 2^{nd} and 3^{rd}-generation cherts clearly post-dated the 1^{st}-generation chert, and moreover, these cherts seemingly are related genetically to unconformities within the Cowley section and to the pre-Pennsylvanian unconformity. As indicated in Figure 3B and the table above, the ^{18}O/^{16}O compositions of the 2^{nd} and 3^{rd}-generation cherts show progressive depletion in ^{18}O compositions relative to that of the 1^{st}-generation chert, with values from 26.7 to 27.0l and 24.1 to 25.1l, respectively. Such ^{18}O depletion is interpreted to reflect 2^{nd}-generation silicification by mixed meteoric-marine (brackish) fluids, followed by progressively more meteoric influx accompanying sea-level fall and eventual subaerial exposure and precipitation of 3^{rd}-generation cherts within the groundwater diagenetic system. Hence, whereas the 1^{st}-generation cherts precipitated from marine pore fluids, the subsequent cherts reflect the evolution of groundwater diagenetic fluids from being of mixed marine-meteoric composition to fully meteoric composition (Figure 4).

Sources of Silica

Rocks in the Cowley section are inherently rich in silica in the form of originally biogenic siliceous spicules and detrital silt- to clay-sized grains in associated shales. Remobilization of just this silica via dissolution and re-precipitation can readily account for a large part of the chert in these rocks. Dissolution and re-precipitation likely occurred first in the marine environment by dissolution of unstable spicules, and later by dissolutional-cannibalization of detrital silica and of earlier-formed 1^{st}-generation cherts in subaerially exposed, up-dip portions of the Cowley during sea-level falls. The slight depletion in ^{30}Si accompanying ^{18}O depletion from the 1^{st}-generation cherts (0.3 to 0.5l) to the 2^{nd} and 3^{rd}-generation cherts (0.1 to -0.9l) is interpreted to reflect the addition of dissolved silica to the groundwater geochemical system derived from these sources as well as from older siliceous rocks exposed along the crest of the Central Kansas Uplift to the north-northwest.

POROSITY TYPES, ORIGIN, AND RESERVOIR PETROPHYSICS

There are two main types of matrix porosity in the Cowley spiculites B primary and secondary. Primary pore types are very small B hence they represent micro-porosity B and they included interparticle pores between spicules and intraparticle pores within spicules. Much, but not all, of this porosity was occluded by the 1^{st} and 2^{nd}-generation cherts. Secondary porosity later developed in the rocks by meteoric dissolution accompanying sea-level falls and ensuing subaerial exposure. Secondary pore types include exhumed and enlarged primary pores, and also small to large vugs in the silicified spiculites. Fractures also are common in the rocks and formed during periods of subaerial

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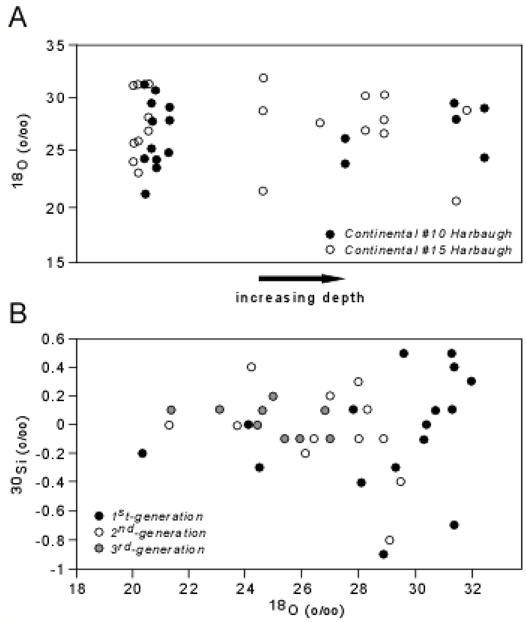

Figure 3. - (A) Gross $^{18}O/^{16}O$ isotopic compositions of cherts in the Cowley versus depth in the sampled Continental #10 and #15 Harbaugh cores in Rhodes Field. (B) Covariant plot of the $^{18}O/^{16}O$ and ^{30}Si isotopic compositions of the three chert generations in the aforementioned cores.

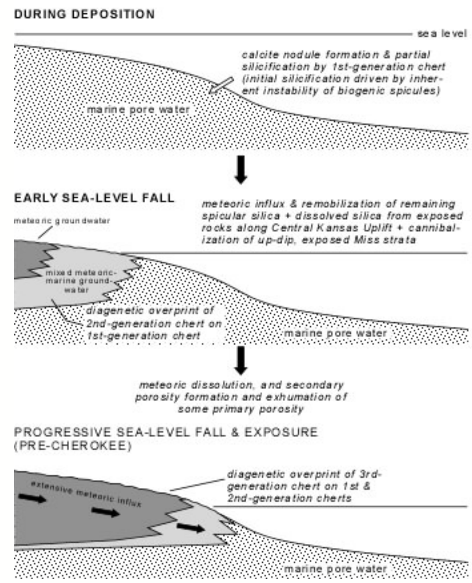

Figure 4. - Diagrammatic representation of sequential chert diagenesis and porosity evolution in the Cowley in Rhodes Field.

exposure. A minor amount of secondary porosity is present in the rocks in the form of isolated vugs within chert nodules (e.g., the nodules in Figure 2B) that formed by dissolution of remnant calcite that had not been replaced by chert. Much of the secondary porosity in the rocks formed prior to precipitation of the 3rd-generation chert as this chert tends to occlude porosity (see figure 2D).

In the two Rhodes Field cored wells analyzed, typical values of reservoir porosity and permeability range from: (i) in the first well, 9.6% to 27% (average 15%) and 0.1 md to as much as 337 md, respectively; and (ii) in the second well, 3.4% to 13.6% (average 10.5%) and <0.1 md to as much as 180 md, respectively (Figure 5). There is a trend of decreasing porosity with depth in the well that had the most core-based porosity-permeability data (Figure 5), which is consistent with a subaerial meteoric origin of the secondary pore system in the rocks.

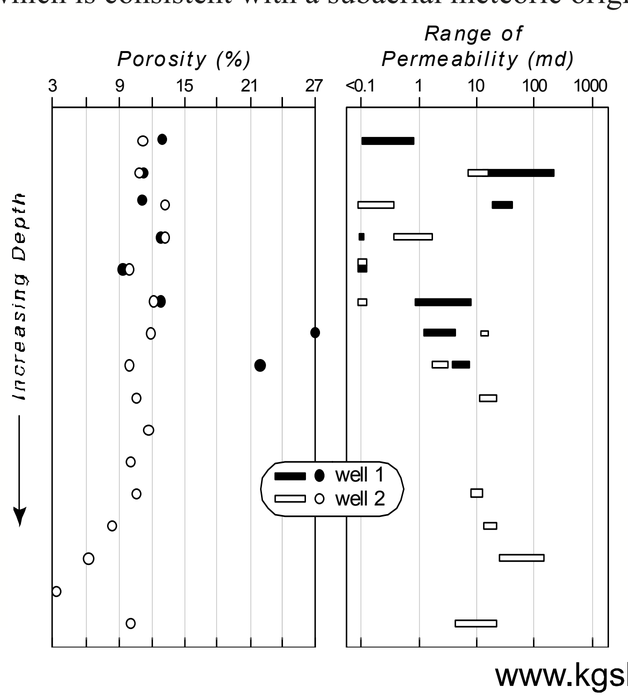

Figure 5. - Reservoir porosity and permeability data in two representative cores in the Cowley Formation in Rhodes Field.

CONCLUSIONS

The Cowley Formation in Rhodes Field in Barber County, Kansas comprises a depositional sequence that is unconformably sandwiched between the underlying Osagean and overlying Meramecian sequences. Lithologies in the internally cyclic Cowley section shallow upward from basinal dark spiculitic shale, to lenticular and/or flaser-bedded spiculite in matrices of dark gray shale (slope deposits) to green shale (moderate water-depth, outer-platform deposits), to shallow platform bedded spiculite, locally with some fossils. Three generations of replacement chert are recognized in the rocks (1st, 2nd, and 3rd), and based on paragenetic relationships and stable oxygen and silicon isotope geochemistry, their inferred origins are: (i) 1st-generation chert B precipitated from marine pore fluids essentially syndepositionally; (ii) the 2nd and 3rd-generation cherts - precipitated from mixed meteoric-marine to progressively more meteoric groundwaters during periods of lowstand subaerial exposure. Secondary porosity formed in the rocks by meteoric dissolution between chert generations 1 and 2, and the 3rd-generation chert tends to occlude some of this porosity.

ACKNOWLEDGEMENTS

The authors wish to acknowledge financial support from the Office of Research Administration and the Department of Geology at Wichita State University to Hongsheng Cao. We appreciate Woolsey Operating Co., LLC for providing the cores for this research. We are also grateful to Prof. Tiping Ding and Dr. S.H. Tian (Stable Isotope Geochemistry Laboratory, Institute of Mineral Resources, Chinese Academy of Geological Sciences) for isotopic analyses of the cherts examined in this study. Oral versions of this paper were presented by the senior author at the 2007 Mid-Continent Section AAPG meeting in Wichita, and a month later at a noon luncheon meeting of the Kansas Geological Society.

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Exploration Highlights

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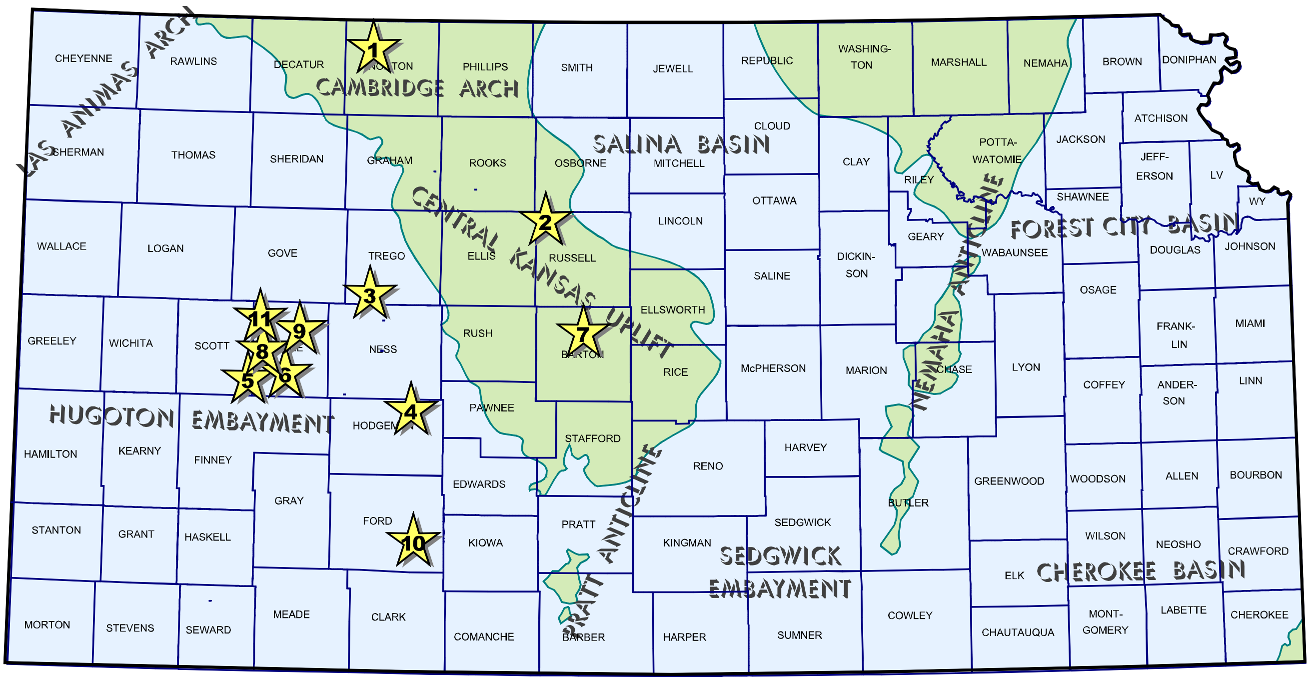

(1) IA Operating, Inc. has discovered oil deposits in the Lansing-Kansas City 'C' zone at their Ella Mae #34-1, located in the NE/4 of section 34- T2s- R24W, Norton County. The wildcat well found new reserves over one mile north of abandoned oil production in the Oronoque Field, which also produced crude from the LKC for about three years beginning in 1979. The Ella Mae discovery recovered 2740 ft. of clean oil, no water, during Drill Stem Test. Shut-in pressure registered 1165 psi. After the pay zone was perforated at an undisclosed depth, the zone was swab tested at a rate of 19 barrels of oil per hour, no water, naturally. Pumping equipment is currently being installed at site six miles west of Norton, Kansas. The new field has been named Ella Mae.

(2) Independent John O. Farmer, Inc. has discovered crude oil trapped in the Arbuckle formation at a discovery site in Russell county. The Larosh #1 is pumping an undetermined amount of oil at site three-quarter miles east of the Worley South Field in the SW/4 of section 3- T11s- R15W. The wildcat well was drilled to a total depth of 3410 ft. by Discovery Drilling. Pay zone was perforated with hole plugged-back to a depth of 3389 ft. Site is located three and one-quarter miles west of Paradise, Kansas. The new field has been named Fairport Northeast.

(3) R. L. Investment LLC has discovered a new Mississippian oil field about seven miles northwest of Ransom, Kansas. The new Kinderknecht Field was discovered by the Kinderknecht #1, spotted in the SW/4 of section 13- T15s- R24W, which was placed on pump for an undisclosed rate in October last year. WW Drilling tools drilled the Trego County well to a total depth of 4350 ft. Closest known production to the new discovery lies nearly one and one-quarter miles southwest in the Hille Field where the Marmaton formation has produced oil.

(4) A new oil field that is producing from the Marmaton (Fort Scott) limestone has been established by Hartman Oil Company in Hodgeman County. The Frusher Farms #1, spotted in the NE/4 of section 7- T21s- R22W, is pumping crude at an undisclosed volume at site located eight and one-half miles northwest of Hanston, Kansas. Exploration focused on area over three-quarters mile west of the Wieland Northwest Field (Mississippian oil). The field has been named Frusher Farms.

(5) Carmen Schmitt, Inc. has opened two new oil fields in Lane County. The #1 Ehmke is producing an undisclosed amount of oil from the Marmaton formation to open the Mammoth Kill Field. The discovery, spotted in the NE/4 of section 2- T19s- R30W, lies nearly two miles from other production in the area.

(6) In addition, the #1 Louise is producing Lansing-Kansas City oil at site located in the NE/4 of section 1- T19s- R30W. The well opens the Dull Knife Field. The new oil deposits were found over two miles north of the Clark (Marmaton oil) Field. Both wells lie about three miles southeast of Amy, Kansas.

(7) Shelby Resources LLC has completed two new oil discoveries in south central Kansas. The #1-18 Hoffman, NE/4 of section 18- T17s- R13W, is producing an unknown amount of oil from the

Arbuckle formation. The Barton County well found deposits three-quarter mile north of the Foughty Field, about three miles north of Hoisington, Kansas. Also, the #1-25 Horney has been completed as a Simpson Sand oil producer in the NW/4 of section 25- T29s- R14 in Pratt County. The 4750 ft deep well found isolated reservoir three-quarters mile southwest of production in the Coats Field. no details have been released. The two new fields have not been named.

(8) Marmaton and Cherokee formations are producing oil at an unknown rate at the Steele #1-21 in Lane county. Operated by Larson Engineering, Inc., the new unnamed pool discovery found oil deposits at site located in the SW/4 of section 21- T18s - R30W, about two miles west of Amy, Kansas. Rotary total depth is 4640 ft. The well was completed and put on pump on December 10, 2007. Robert E. Lewellyn was wellsite geologist.

(9) Mull Drilling Company is producing an undetermined amount of oil from perforations in the Lansing-Kansas City and Marmaton zones at their Schneider #1-12 in Lane County. Located in the SW/4 of section 12- T17s- R28W, the wildcat well found new reserves three-quarters mile south of existing production in the Schmeig Field (LKC oil). Operator hired WW Drilling tools to drill the well to a total depth of 4695 ft. The unnamed field lies four and one-half miles southeast of Shields, Kansas.

(10) In Ford County, natural gas reserves have been discovered nearly three and one-half miles from the Steel Field by Ritchie Exploration, Inc. Discovery well is the #1 Lamb-Lance, NW/4 of section 8- T28s- R22W, located about one-quarter mile south of the city of Ford, Kansas. The well was drilled to a total depth of 5950 ft. No details have been released. The new discovery opens the Lamb Field.

(11) Ritchie Exploration, Inc. has also established the new Cramer Field in Lane County with the completion of the Cramer -Martin #1. The well is producing oil from the Pleasanton formation at an undisclosed rate. Well spot is in the SE/4 of section 35- T17s- R30W, about five miles southeast of Healy, Kansas. Rotary total depth is 4590 ft.

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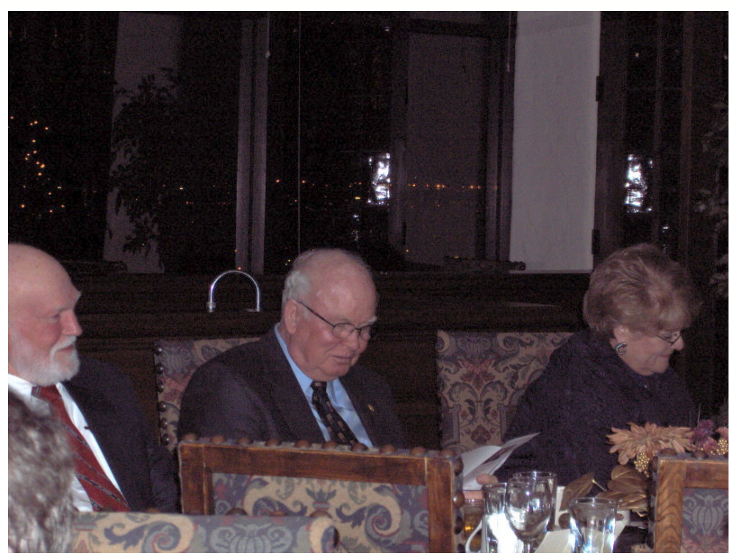

Bill Shepherd looking over
"Shepherds Monikers for the Masses"

Kansas Geological Foundation

Web Site: www.kgfoundation.org

212 North Market
Wichita, Kansas 67202

A not-for-profit educational and scientific corporation

GOALS:

- promote geology and earth science
- preserve geological records
- establish memorials and endowments
- support field trips and seminars
- financial aid and grants to students

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Kansas Geological Foundation Services

The Kansas Geological Foundation provides the following services as a part of the organization's commitment to educate the public regarding earth science.

Speaker's Bureau

A list of speakers available to talk about various aspects of geology may be obtained by contacting Janice Bright at the KGS Library, 265-8676. This service is free to the public.

DVD/Videotape Library

The KGF maintains a DVD & videotape library focused primarily on the various fields of earth science. These tapes may be checked out without charge by the public. To obtain a list of tapes, please contact the KGS Library, 212 N. Market, Ste. 100, Wichita, KS 67202, or call Janice Bright at 265-8676.

The Kansas Geological Foundation was founded in March, 1989 as a not-for-profit corporation under the guidelines of section 501(c)(3) of the tax code to provide individuals and corporations the opportunity to further the science of geology. It is dedicated to providing charitable, scientific, literary and educational opportunities in the field of geology for the professional geologist as well as the general public.

KGF can receive in-kind donations through which the donor may receive a tax deduction. Of equal importance, the KGF provides the financial resources to sort, process and file this data at the KGS library. If you have a donation to make, please contact the KGF at 265-8676.

Your tax-deductible membership donation helps to defray the cost of processing donations and to support public education programs about the science of geology. Annual membership begins at $50.00 per year. Donations of $100.00 or more are encouraged through the following clubs:

Century Club	$ 100 to $ 499
$500 Club	$ 500 to $ 999
Millennium Club	$1000 to $5000
President's Club	$5000 and over

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KGS Member	Date Deceased	Memorial Established
Dan Bowles	09/89	1990
John Brewer	10/89	1990
George Bruce	08/89	1990
Robert Gebhart	01/90	1990
Ray Anderson, Jr.	11/90	1990
Harold McNeil	03/91	1991
Millard W. Smith	08/91	1991
Clinton Engstrand	09/91	1991
M.F. "Ted" Bear	10/91	1991
James & Kathryn Gould	11/91	1991
E. Gail Carpenter	06/91	1993
Benton Brooks	09/92	1992
Robert C. Armstrong	01/93	1993
Nancy Lorenz	02/93	1993
Norman R. Stewart	07/93	1993
Robert W. Watchous	12/93	1993
J. George Klein	07/94	1994
Harold C.J. Terhune	01/95	1995
Carl Todd	01/95	1995
Don R. Pate	03/95	1995
R. James Gear	05/95	1995
Vernon Hess	06/95	1995
E. K. Edmiston	06/95	1995
Jack Rine	07/95	1995
Lee Cornell	08/95	1995
John Graves	10/95	1995
Wilson Rains	10/95	1995
Heber Beardmore, Jr.	09/96	1996
Elmer "Lucky" Opfer	12/96	1996
Raymond M. Goodin	01/97	1997
Donald F. Moore	10/92	1997
Gerald J. Kathol	03/97	1997
James D. Davies	08/88	1997
R. Kenneth Smith	04/97	1997
Robert L. Dilts	05/97	1997
Delmer L. Powers	06/72	1997
Gene Falkowski	11/97	1997
Arthur (Bill) Jacques	01/98	1998
Bus Woods	01/98	1998
Frank M. Brooks	03/98	1998
Robert F. Walters	04/98	1998
Stephen Powell	04/98	1998
Deane Jirrels	05/98	1998
William G. Iversen	07/98	1998
Ann E. Watchous	08/98	1998
W.R. "Bill" Murfin	09/98	1998
Donald L. Hellar	11/98	1998
Joseph E. Rakaskas	01/99	1999
Charles W. Steincamp	02/99	1999
Robert and Betty Glover	10/96	1998
Howard E. Schwerdtfeger	11/98	1999
W. W. "Brick" Wakefield	03/99	1999
V. Richard Hoover	01/00	2000
Warren E. Tomlinson	01/00	2000
James A. Morris	01/00	2000
Eric H. Jager	03/00	2000
Kenneth W. Johnson	03/00	2000
Dean C. Schaake	03/00	2000
Fred S. Lillibridge	05/00	2000
Jerry A. Langrehr	07/00	2000
Clark A. Roach	07/00	2000
Floyd W. “Bud” Mallonee	10/00	2000
Ralph W. Ruuwe	09/00	2000
Robert L. Slamal	02/01	2001
Jerold E. Jesperson	06/01	2001
William A. Sladek	06/01	2001
Harlan B. Dixon	06/01	2001
Edward B. Donnelly	08/01	2001
Richard P. Nixon	02/02	2002
Robert W. Frensley	12/01	2002
Gerald W. Zorger	01/02	2002
Don L. Calvin	03/02	2002
Claud Sheats	02/02	2002
Merle Britting	2002	2002
Harold Trapp	11/02	2002
Donald M. Brown	11/02	2003
Elwyn Nagel	03/03	2003
Robert Noll	09/03	2003
Benny Singleton	09/03	2003
Jay Dirks	2003	2003
J. Mark Richardson	02/04	2004
John “Jack” Barwick	02/01	2004
Richard Roby	03/04	2004
Ruth Bell Steinberg	2004	2004
Gordon Keen	03/04	2004
Lloyd Tarrant	05/04	2004
Robert J. “Rob” Dietterich	08/96	2004
Mervyn Mace	12/04	2004
Donald Hoy Smith	04/05	2005
Richard M. Foley	06/05	2005
Wayne Brinegar	06/05	2005
Jack Heathman	05/06	2006
Charles Kaiser	09/06	2006
Rod Sweetman	08/06	2006
Karl Becker	10/06	2006
Frank Hamlin	10/06	2006
Marvin Douglas	12/06	2006
Robert W. Hammond	04/07	2007
Eldon Frazey	04/07	2007
Pete Amstutz	05/07	2007
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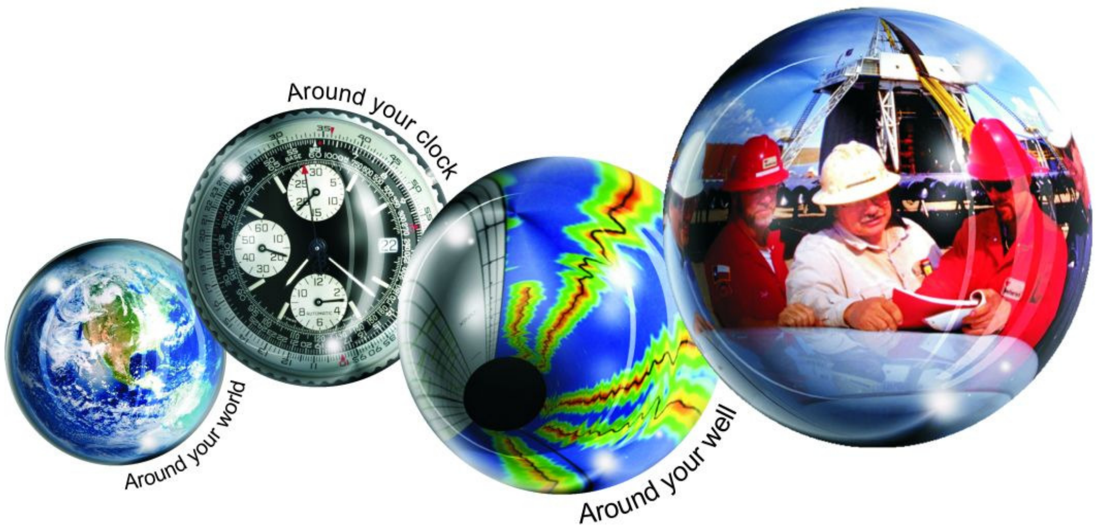

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KGS BULLETIN
March—April 2008

March 2008

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9	10	11 **Tech Talk**	12	13	14	15
16	17 St. Pat's Day	18 **Tech Talk**	19	20	21	22
23 Easter	24	25 **Tech Talk**	26	27	28	29
30	31					

April 2008

SUN	MON	TUE	WED	THU	FRI	SAT
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6	7	8 **KGS Board**	9	10	11	12
13	14	15 **Tech Talk**	16	17	18	19
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******* AAPG Meeting in San Antonio, Texas *******