KANSAS GEOLOGICAL SOCIETY

BULLETIN

Volume 94 Number 3 May - June 2019

Established 1925

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Flatirons
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Conglomeratic Sandstone

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 manager@kgslibrary.com or mailed to 212 N. Market, Ste. 100, Wichita, KS 67202. 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

KGS 2019 Technical Talks

May 8 **Kristie Ferguson - Tulsa *"Granite Wash-Anadarko Basin"***

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Kansas Geological Society (KGS) Medallion for Scientific Distinction and Excellence

The Kansas Geological Society (KGS) Medallion for Scientific Distinction and Excellence may be given annually for peer-recognized, sustained significant scientific contributions to all facets of applied Kansas geology, including work either in Kansas or in surrounding states if the latter contributions pertain directly and significantly to Kansas geology. No more than one award may be given each year, an award does not have to be given every year, and members of the KGS Awards Committee that handle nominations for this award cannot nominate themselves for this award. The candidates need not be active KGS members, and they must be living at the time of selection. The primary consideration in the selection of a candidate shall be his or her sustained, published, significant contributions to any facet of Kansas geology. Contributions may be varied in form such as development of geologic concepts, advancement in discovery thinking, and recognized leadership in exploration concepts. Oral and/or written publications in peer-reviewed geological venues is a requisite criterion for any candidate for this award. The name of a candidate shall be presented by the Awards Committee to the KGS Board of Directors for their approval. Once approved, the recipient shall be presented an appropriate award in the form of a medallion or plaque recommended by the Awards Committee and approved by the Board of Directors at the annual business meeting of the society. This is a new award given by the KGS for distinction and achievement in Geological research in Kansas.

Awards Committee members are Sal Mazzullo, Mike Dealy and Alfred James.

President's Letter

Dear KGS members and friends,

Spring is here with warmer weather and rain. Oil prices have improved and at present are holding more or less steady. Our hope of course, is that activity will become stronger as operators recover financially and begin to fund a 2019/2020 drilling program.

Doug Davis and I will be attending the AAPG ACE in San Antonio, TX in May from the 18th through the 22nd as delegates. Doug, of course, is the current President of the Mid-Continent Section. It is our hope that many of you will also attend this meeting to see the current technology and network with possible future partners and current partners in your exploration programs.

Although we have yet to solve the bookkeeping issue here at the KGS, Beth Isern has made it her mission in life to get this done. At this writing we have yet to get the final consolidation of the KGS and WDL accounts completely merged. We have given AGH until the end of May to get this done. At that point, the KGS Board will need to make the decision to outsource our accounting or hire a qualified in house bookkeeper.

On a positive note, we have hired Madison Moore to our staff at the KGS Library. Madison will graduate from Wichita State this May. She has not been hired as a bookkeeper, but is working well with both Rhonda (on data entry, filing, and banking duties) and Angela with reproduction of logs, maps and geo reports. By all accounts she is a fast learner and does things accurately. She is also a really pleasant addition here at the KGS.

The 24th Annual KGF Spring Mixer will be held at the Wichita Petroleum Club on Thursday, May 23rd from 4:30 to 8:00 PM. One does not have to be a member of the KGF to attend, but we do encourage you to join our endeavor to continue to integrate donated logs etc. into our files and onto the WDL. As always, hors D'oeurves, beer and wine will be provided. The KGF also funds student scholarships and grants-in-aid for research related to Kansas geology. Donations to defray the costs of this event and new memberships will be greatly appreciated.

On a personal note, I turned 68 on April 9th. Betty and I along with a recently widowed friend spent that week in the Big Cedar area south of Branson, MO. On a trip to Dogwood Canyon, I remained in the bar and grill, with my sore knee, while Betty and our friend traipsed into the canyon. As I sat at the bar eating a cup of chili and nursing a couple of light beers, I stared at a waterfall through the floor to ceiling windows. I began to wax melancholy. I started thinking about " what have I done in my life for the benefit of others expecting no reward or accolade." I found that I was sorely lacking in that endeavor. Each of us need to start thinking those same thoughts. Help and respect everyone. Ask nothing for your efforts.

Bye for now,

Wes

AAPG Section Meeting Updates

May 2019	**AAPG ACE May 18-22** **San Antonio, TX**
September 2019	**Rocky Mountain September 15-18** **Cheyenne, WY**
October 2019	**Mid-Continent October 5-8** **Wichita, KS**
	Eastern October 12-16 **Columbus, OH**
	Gulf Coast October 23-25 **Houston, TX**

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ANNOUNCEMENT
KANSAS GEOLOGICAL FOUNDATION

Per a Notice that was distributed to owners of seismic data that has been stored under the auspices of the Kansas Seismic Exchange (KSE), circumstances have occurred such that the storage of those contents have had to be removed from that library, as of December 31, 2018.

In the interest of preservation of the unique data, gathered over many decades, and which has inherent value, the Kansas Geological Foundation (KGF) became involved in a process to assist in the transfer of the data out of KSE facilities. As of December 31, 2018, the KSE relocated all seismic data in their library to the Wichita facility of Underground Vaults and Storage (UVS), located at 707 E. 33rd St. North, Wichita, KS 67219.

The owners of the data had the option, via Notice, to either recover their records/data, or make a tax deductible contribution related to that data to the KGF. If, at the end of a two year period ending December 31, 2020, data is not claimed by respective owners, it will automatically be transferred as to ownership from the owners of the KSE to the KGF.

The KSE has agreed to release index files, plat maps, and other reference items that relate to the stored data to the KGF. The KGF plans to relocate these reference files to a facility within the Kansas Geological Society and Library (KGS). Library members will be able to access these files and, for fees yet to be determined, obtain copies of plats, etc, such that if they wish to access actual data at the UVS facility, that can be accomplished by individuals who have access codes, which will be controlled by UVS and the KGF.

Various elements related to these processes are still being worked out, and the KGF will provide updates in the near future as to additional details. For those members of the KGF who have supported its efforts such as the major accomplishments related to the development of the Walters Digital library and the ongoing integration project, the KGF Board wishes to express deep gratitude. We will also closely monitor progress of this new undertaking and carefully evaluate cost/benefit of it into the future. Should it become infeasible to continue, we will exercise options to discontinue our involvement with the activity.

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2019 AAPG Mid-Continent Section Meeting

October 5-8, DoubleTree by Hilton, Wichita, KS

Hosted by the Kansas Geological Society

General Chair: Toby Eck, KGS President: Wes Hansen

For general inquiries, advertising, or donations,
contact Toby Eck (316) 305-0572, toby@shakespeare-oil.com
or Doug Davis (316)641-4469, doug5696@gmail.com

Submit an Oral or Poster Abstract by May 15, 2019

Send oral abstract and contact info in a Word document to Tandis Bidgoli: bidgolit@missouri.edu
Send poster abstract and contact info in a Word document to Franek Hasiuk: franek@kgs.ku.edu
Authors will receive notification of acceptance by May 31, 2019

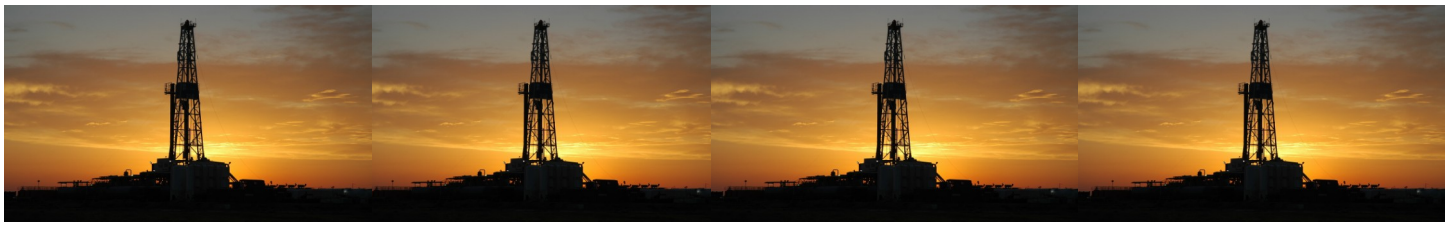
GREAT LINEUP OF WORKSHOPS/SHORT COURSES

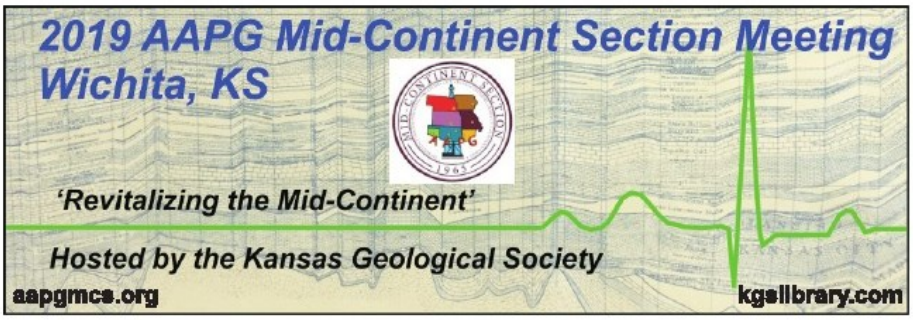
- **Mississippian Core (to be determined)**
- **Seismic Attributes (Marfurt)**
- **Digital Borehole Geology (Doveton)**
- **Machine Learning in Oil and Gas (AAPG DPA)**

Call today for advertising opportunities at the convention, on our website, and in our program.

ACE 2019 in San Antonio, TX
May 18-22
Please plan to attend to make this year's convention a success.

2019 Mid-Continent Section Meeting
Wichita, KS
October 5-8, 2019
Calling on all geologists, young and old, to come to this meeting in support of all the volunteers giving their time to the Kansas Geological Society's hosting of this meeting





Andrew Eck General Chairman
toby@shakespeare-oil.com

October 3-4 Field Trip:
Chester and Upper Meramec of NE Oklahoma and NW Arkansas (Stack Play)
Leaders: Dr. Cory Godwin and Dr. James Puckette OSU

October 5-6 Short Courses:
Seismic Attributes of the Mississippian by Dr. Kurt Marfurt OU
Bore Hole Logging by Dr. John Doveton KGS
Machine Learning and Analytics Hosted by Dr. Susan Nash AAPG

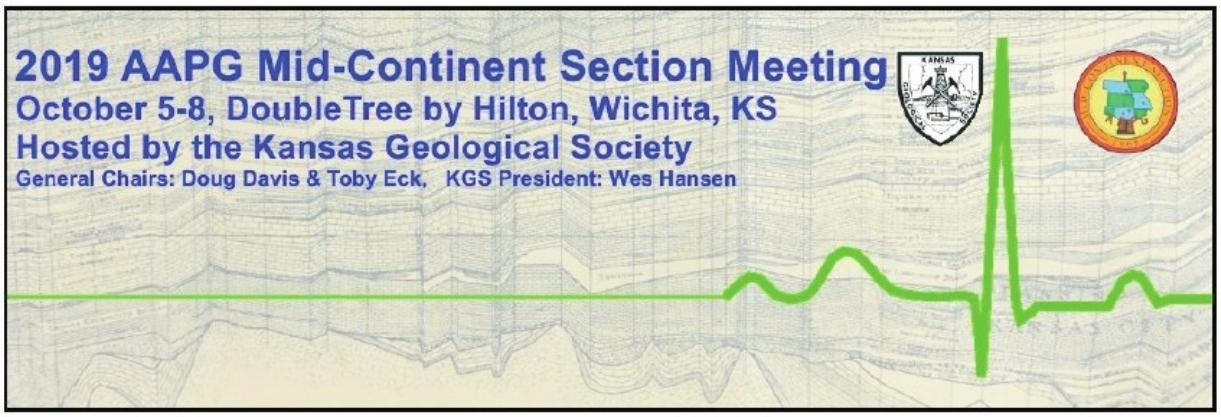
October 7 All-Convention Luncheon 11:30 am- 1:15 pm
Dr. David Houseknecht USGS New Alaskan Oil Discoveries
Young Professional and Student "Meet & Greet"
Alumni Gatherings

October 8 Division of Professional Affairs Luncheon 11:30 am to 1:15 pm
John Jordan, President DPA

Financial Support for the Mid-Continent Section Meeting

Every six years the Kansas Geological Society hosts the AAPG Mid-Continent Section Convention. It will be held at the DoubleTree by Hilton October 3-8, 2019. The convention will have between 500 and 700 geologists, geophysists, and petroleum engineers attending from across the entire country. Also there will be both local and national companies exhibiting.
The Finance Committee respectfully requests both company and individual financial support. Please contact us at your convenience with any questions that you may have.
Respectfully submitted,

Douglas Davis, Finance Chair	**doug5696@gmail.com**	**316-641-4469**
James Beilman Finance Co-Chair	**jbeilman@mulldrilling.com**	**316-264-6366**

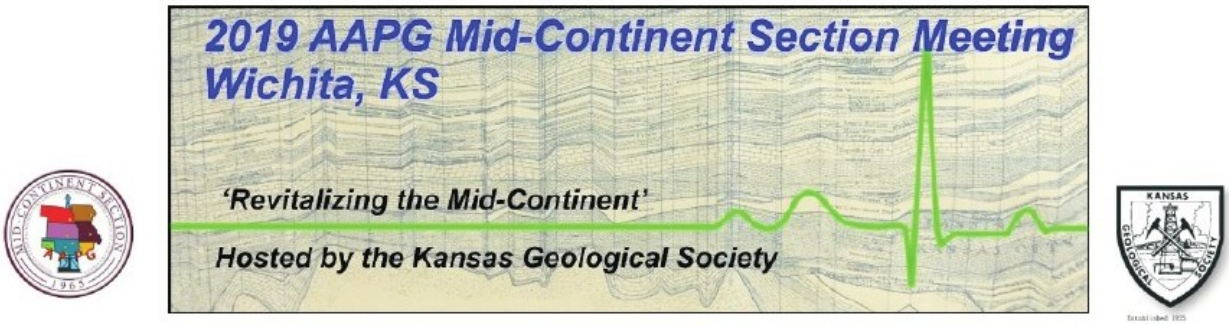


Submit an Oral or Poster Abstract by May 15, 2019

Oral and Poster abstracts of up to 2,000 characters (not including spaces) must be submitted to the respective Technical Chairperson, Tandis Bidgoli or Franek Hasiuk, by **May 15, 2019**.
Send oral abstract and contact info in a Word document to Tandis Bidgoli: bidgolit@missouri.edu
Send poster abstract and contact info in a Word document to Franek Hasiuk: franek@kgs.ku.edu
Authors will receive notification of acceptance by May 31, 2019

Technical Program Themes:

- **New Stratigraphic and Structural Concepts for Mid-Continent Plays**
- **Advancing Mature Plays Through New Technologies**
- **Wastewater, Seismicity, and Other Challenges for Mid-Continent Production**
- **Mid-Continent Shale Plays: Woodford, SCOOP/STACK and Beyond**
- **C02 Utilization and Storage in Mid-Continent Reservoirs**
- **Petrophysics, Diagenesis, and Chemostratigraphy of Mid-Continent Plays**



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Call for education/non profit pricing! Booths are 8' by 10'

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Platinum: $5,000-9,999	web-based event application
Diamond: $10,000+	

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1/2 page B&W	$800
1/4 page B&W	$400
Business card	$100

Will the Arbuckle Group Remain a Viable Disposal Zone in Kansas?*

by
Newell, K. David[1], Peterie, Shelby[1], Killion, Michael[1], DeArmond, Brandy[2], Ridley, Carrie[3], Mandel, Rolfe[1], and Buchanan, Rex[1]

[1]Kansas Geological Survey, University of Kansas, Lawrence, KS 66047
[2]Kansas Department of Health and Environment, Bureau of Environmental Remediation, Topeka KS 66612
[3]Kansas Department of Health and Environment, Bureau of Water/Geology, Topeka KS 66612

*this manuscript is an abbreviated version of Newell and others (in review), to be published in *Current Research in Earth Sciences* (an online research forum on the Kansas Geological Survey website; www.kgs.ku.edu).

ABSTRACT
Industrial and municipal wastewater and oilfield brines have been disposed into the Cambrian-Ordovician Arbuckle Group for decades in the Mid-Continent. In parts of south-central Kansas, static fluid levels (SFLs) in Arbuckle disposal wells are close to the surface, in some localities at depths <100 ft. In some wells SFLs are rising a few feet annually. This begs the question of whether the volume of disposed water sent into the Arbuckle is in danger of exceeding its storage capacity in some localities.

Most information about Arbuckle SFLs in Kansas is derived from annual testing of 49 Class-I disposal wells, which are overseen by the Kansas Department of Health and Environment. A few Class-II wells that dispose of oilfield brines (administered by the Kansas Corporation Commission) could also be utilized to better understand movement of water in the Arbuckle.

INTRODUCTION

The Cambrian-Ordovician Arbuckle Group in Kansas has been utilized for decades for wastewater disposal by industrial, municipal, and oilfield facilities. Increases in earthquakes in northern Oklahoma and southern Kansas since 2011 (Peterie and others, 2018) have put fluid and pressure movement within the Arbuckle under scrutiny. In addition, fluid levels are rising in wells open to this unit. These fluid levels are within 100 ft of the surface in some areas and the Arbuckle locally may be reaching a limit to the amount of water that can be injected into it.

CLASS-I and CLASS-II DISPOSAL WELLS

Two types of disposal wells – Class I and Class II – are relevant to fluid disposal in the Arbuckle. Class-I disposal wells serve industrial and municipal facilities and are regulated by the Kansas Department of Health and Environment (KDHE). Class-II wells dispose of fluids associated with oil and gas production and are overseen by the Kansas Corporation Commission (KCC).

Forty-nine active Class-I disposal wells in Kansas send hazardous and non-hazardous waste water into the Arbuckle. This disposal water, by regulation, must enter the unit by means of gravity (personal communication, Mike Cochran, KDHE, 2016). Conversely, Class-II wells can be pumped and pressured up to hydrofracturing pressure (personal communication, Ryan Hoffman, KCC, 2016).

By law, each facility with one or more Class-I wells must have at least one well annually tested for fluid pressure, and the static fluid level (SFL) must be measured in every well annually. The testing usually includes measuring pressures several times down the borehole in a fall-off test (see Earlougher, 1977, p. 77-85). A graphical engineering construct -- a Horner Plot (Horner, 1951) -- is generally utilized to project the interim pressures to a final estimated formation pressure (P*).

TABLE 1. Class-I and -II disposal wells -- two sets of rules and characteristics that apply to two classes of disposal wells.

CLASS-I DISPOSAL WELLS	CLASS-II DISPOSAL WELLS
Regulated by KDHE	Regulated by KCC
Gravity feed of effluent	Pressurized injection allowed
SFL, downhole pressure, tested annually, with mechanical integrity testing	Mechanical integrity tested every 5 years
Injection volume continually recorded & reported monthly	Injection volume recorded by various means; reported yearly
Mostly industrial/municipal waste water	Mostly oilfield water
Injected water can be nearly fresh to dense	Injected water is mostly dense & saline
50 active wells in Kansas; 49 dispose into Arbuckle	~5000 active wells in Kansas; ~2725 dispose into Arbuckle
Entire Arbuckle usually accessed	Mostly upper Arbuckle accessed
Individual well disposal volume can be prolific	Collective well disposal volume is prolific
Annual collective disposal volume is nearly constant	Annual collective disposal volume varies with energy price
2010-18 Arbuckle disposal volume = ~85,000,000 bbls/yr	2010-18 Arbuckle disposal volume = ~715,000,000 bbls/yr
Represents 10.9% of all water sent into the Arbuckle	Represents 89.1% of all water sent into the Arbuckle
99.9% of all Class-I disposed water goes into Arbuckle	80.5% of all Class-II disposed water goes into Arbuckle

The Oil and Gas Wells Database maintained by the Kansas Geological Survey (2019) lists 44,164 Class-II disposal wells. Of these wells, approximately 16,600 are now permitted for use. There are two kinds of Class-II wells: enhanced oil recovery (EOR) and salt-water disposal (SWD), with present-day EOR and SWD wells numbering about 11,600 and 5,000 respectively.

EOR wells are those wells in which formation water, co-produced with oil or gas, is cycled back to the pay zone in water-flood operations. If production water is not reused, it is necessarily eliminated by SWD wells. Of the ~5000 Class-II SWD wells currently active, ~2725 wells direct their water to the Arbuckle. In heavily drilled Arbuckle oil fields on the Central Kansas Uplift, there is some uncertainty regarding exact SWD and EOR disposal volumes. SWD, EOR, and producing wells can have their designations changed with time and there is sometimes very little difference in depth between nearby SWD and EOR wells. This invites the possibility that some disposed water may actually be recycled rather than permanently eliminated into the Arbuckle.

RELATIVE VOLUMES of DISPOSAL WATER by CLASS-I and CLASS-II WELLS

Class-I wells in Kansas dispose of a relatively constant volume of water into the Arbuckle -- ~85,000,000 bbls per year (Figure 1). Over a 9-year period (2010-2018), the collective volume from 2736 Class-II Arbuckle wells (i.e., 6.428 billion bbls) was almost 8 times that of the Class-I Arbuckle wells (0.789 billion bbls; Figure 1). Furthermore, 80.5% of all Class-II disposal volume is sent into the Arbuckle, and 82.2% of all Class-I and Class-II disposal water goes into the Arbuckle.

Oil prices crashed in late 2014. Consequently, Kansas associated Class-II disposed water dropped in subsequent years (Kansas Geological Survey, 2019; Figure 1).

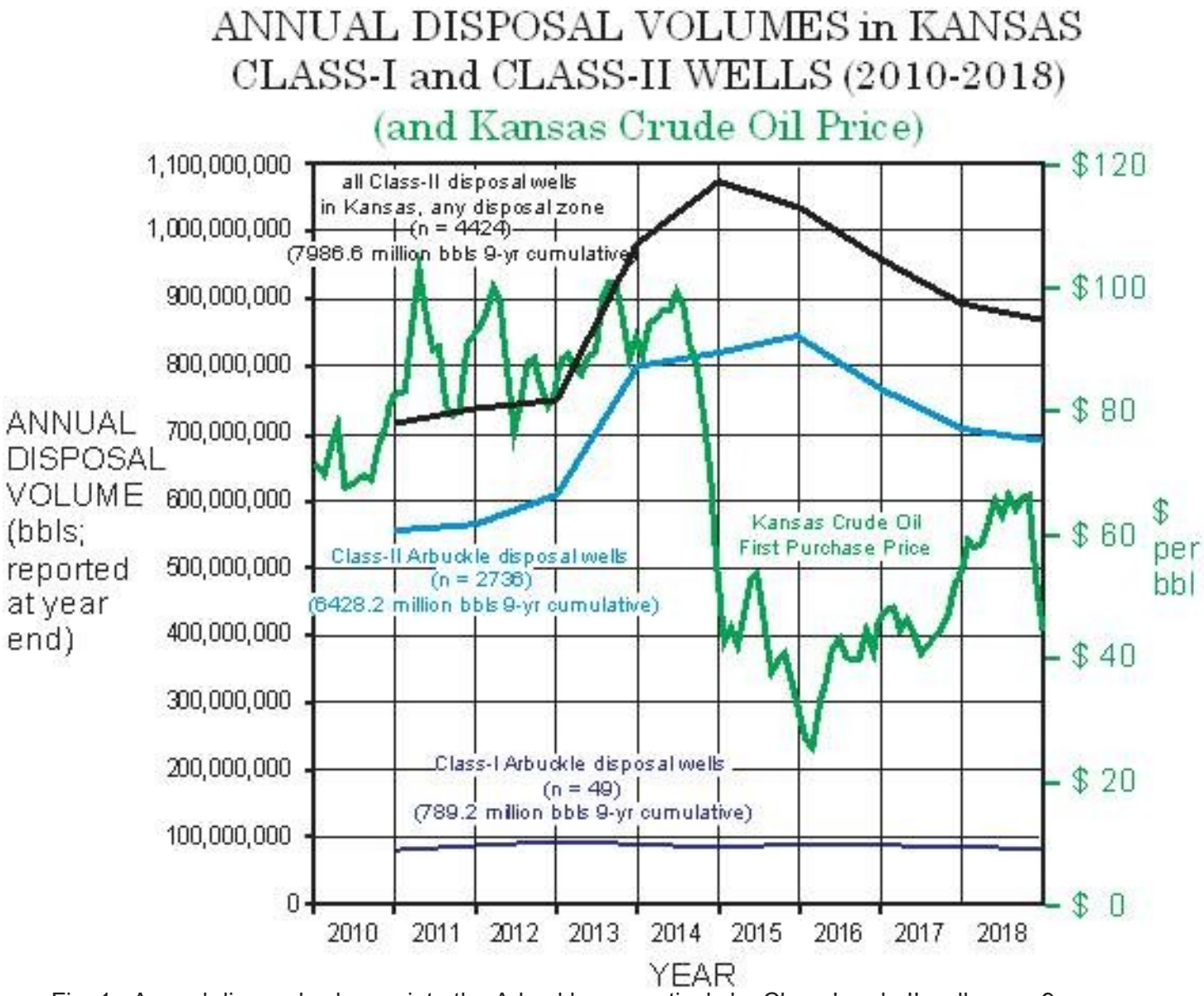

Fig. 1. Annual disposal volumes into the Arbuckle respectively by Class-I and –II wells over 9-years (2010-2018). Wells on the CKU have equivocal EOR vs. SWD designations, thus there is some uncertainty imparted to disposal volumes in this region. Kansas crude-oil prices are from the U.S. Energy Information Administration (2019).

ARBUCKLE POTENTIOMETRIC SURFACE

When a well bore is opened to a geologic formation, either by perforations or open-hole completion, formation water enters and rises up the well bore when the well is open to atmosphere. The elevation to which the water column rises and ultimately stabilizes is referred to as the "static fluid level" (SFL). SFLs in Arbuckle wells typically equilibrate below the ground surface, sometimes several hundred feet, so the unit is termed "under-pressured".

Dahlberg (1982, p. 41) defines a potentiometric surface as "an imaginary surface, the topography of which reflects the fluid potential of the formation water from place to place within a subsurface reservoir". A potentiometric surface is constructed by contouring separate data points that are, in effect, SFL elevations from individual wells. A potentiometric-surface contour map of an aquifer ostensibly defines subsurface directions of water movement, as flow will proceed from an area where the potentiometric surface is high to a nearby region where it is relatively low "down-gradient", regardless of the actual structural elevation of the aquifer in the two areas (see Dahlberg, 1982, p. 42-52).

Contouring a potentiometric-surface map is relatively straight-forward *if* the density of the water is constant. Such is the case with a freshwater aquifer. However, salinity of Arbuckle formation water varies, ranging from fresh water in southeastern Kansas (Carr and others, 1986) to saline water in central and western Kansas, with 10,000 to 60,000 parts per million total dissolved solids (ppm TDS). Southward toward Oklahoma where the Anadarko Basin deepens, Arbuckle brines can be very saline, ~250,000 to 300,000 ppm TDS. Density of basinal brine can be as high at 1.21 g/cc, or more.

The SFL for a dense brine in a 4000-ft well will lay as much as 500-600 ft lower than a freshwater SFL, even though P* in both wells could be identical, so corrections to a common density (usually 1.0 g/cc, that of fresh water) are made in some potentiometric maps (Carr and others, 1986). The application of a density correction to an SFL is elaborated upon in Newell and others (in review).

A potentiometric-surface map (Figure 2) indicates water in the Arbuckle generally moves eastward from Colorado and northeastward from Oklahoma into south-central Kansas. Fresh water moves down-gradient into southeastern Kansas from exposures in southern Missouri on the Ozark Dome. Most of the water in the Arbuckle eventually flows northeastward from eastern Kansas and then exits the state in a broad region south of Kansas City. The water in the Arbuckle presumably continues eastward and then seeps upward from subcrops beneath alluvium into the Missouri River valley.

Subtraction of the normalized Arbuckle potentiometric surface from surface elevation yields a hybrid map highlighting regions where the Arbuckle is capable of imbibing more effluent from disposal wells and other areas where additional disposal may cause problems. This map (Figure 2) is not a "depth-to-water" map *per se*. In reality, the actual SFLs for the Arbuckle over Kansas are still below ground, because the relatively high density of the formation water depresses the SFL.

A potentiometric surface at a higher elevation than that of ground level (i.e., the blue-toned regions in Figure 2) does not mean an Arbuckle disposal well in these areas is artesian. Instead, this indicates that any fresh water disposed down a well will not have a sufficient hydrostatic head to enter the formation. Water would fill to the top of the casing at the surface, and remain there. Since Class-I wells cannot be pressurized in Kansas, a Class-I disposal well in the "blue-shaded" areas in Figure 2 would not function if its effluent water was nearly fresh.

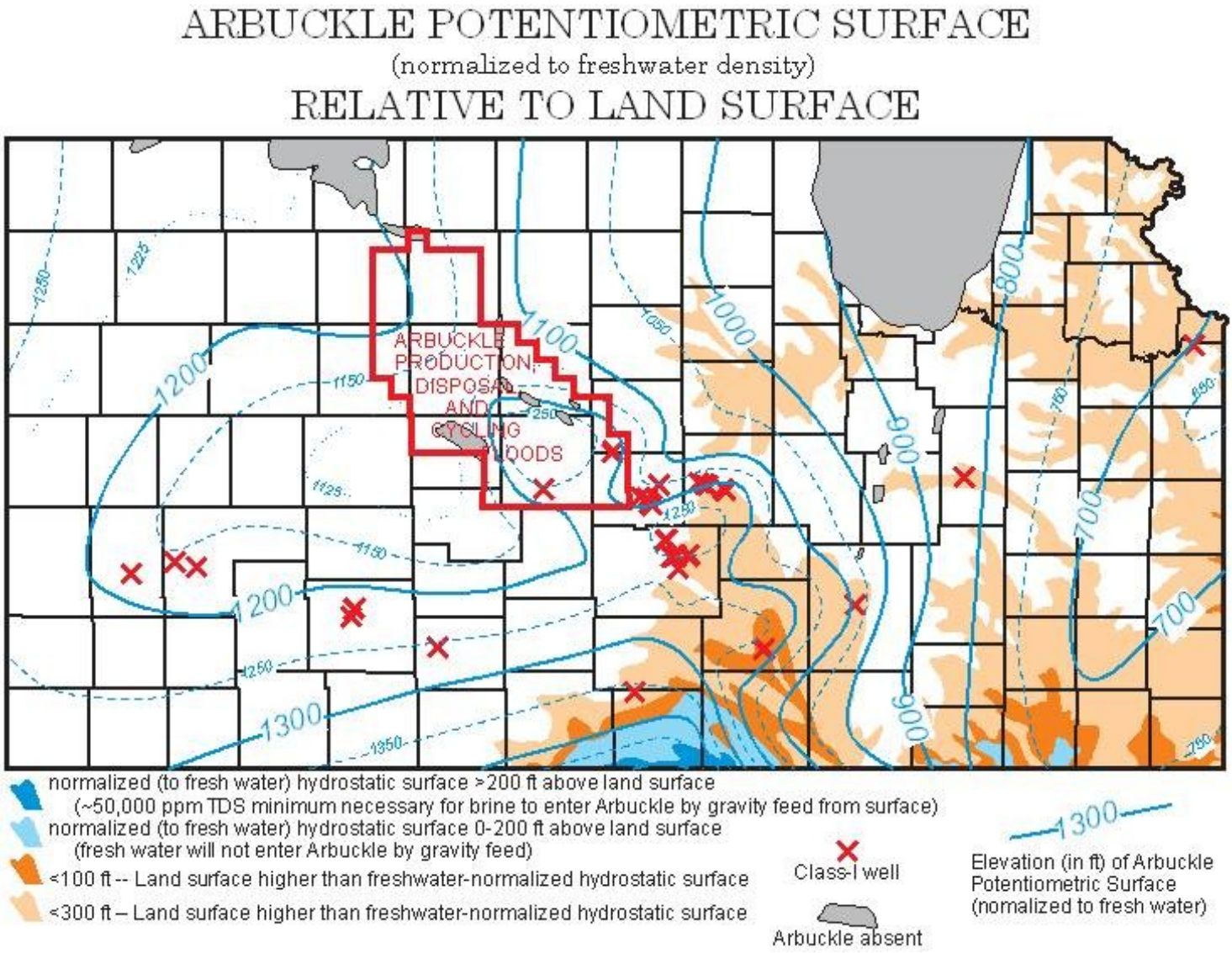

Fig. 2. Arbuckle potentiometric surface (normalized to freshwater density) relative to elevation of the land surface, for 2017. Contours are the potentiometric surface, Xs are Class-I well locations. Blue-toned areas are where SFLs (normalized to 1.0 g/cc) are higher than the land surface. In the dark-blue areas, effluent water would have to have a minimum density of ~1.035 g/cc (equivalent to ~50,000 ppm TDS) to enter the Arbuckle by gravity. Red outline is on the CKU is where EOR and SWD volumes may be unclear.

The problem of effluent not entering the Arbuckle can be solved if the hydrostatic head or the density of the water in the disposal well can be increased. In the dark-blue shaded regions in Figure 2, calculations indicate that >200 ft of hydrostatic head above the surface would be needed to force freshwater effluent into the Arbuckle. Alternately, disposal brine with at least ~50,000 ppm TDS (~1.035 g/cc) would be sufficiently dense to force entry into the Arbuckle from the surface by gravity.

Most oilfield waters from Paleozoic reservoirs in Kansas are saline brines, usually in excess of 100,000 ppm TDS (Newell and others, 2017). These brines are usually more dense than ambient brine in the underlying Arbuckle. This density difference helps force Class-II disposal water into the Arbuckle even if the water isn't pumped into the Arbuckle. However, if a Class-II well that relies on the excessive density of its brine to enter the Arbuckle ceases disposal, hypothetically the dense brine left in the well bore could eventually disperse into the disposal zone and then be replaced by less-dense formation water. A rise in the SFL would result. The danger is if this rise would be in excess of the elevation of the well head, or worse yet, if the water could enter a shallow aquifer containing potable water via abandoned and improperly plugged wells, casing leaks, or other well damage.

CHANGES IN STATIC FLUID LEVELS

Analysis of SFLs and bottom-hole pressures over time in Class-I wells reveal that the Arbuckle may not be entirely flushing away fluid introduced into it. Of the 49 Class-I Arbuckle wells in the state, all but two recorded rises in SFL since 2010. Most of the wells recording SFL rises are in southern and central Kansas, where SFLs have risen as much as 23 ft/year, although 10- to 15-ft annual rises are more common.

In western Kansas where depth-to-water in a well can be in excess of 500 ft, an annual rise of the SFL by a few feet is unremarkable. However, in wells in parts of central Kansas where current depth-to-water is <100 ft, a similar rise could cause the SFL to be at the surface within a decade or two, or even sooner. Predicting rises or falls of Arbuckle SFL is thus crucial. However, annual changes in SFLs and annual disposal volumes correspond poorly to each other, even when fluid volumes from nearby Class-I and Class-II wells are considered.

It remains to be seen whether the rate of rise in some at-risk areas will diminish or perhaps even reverse in accordance with the overall decrease in fluid volume disposed into the Arbuckle since 2015 (Figure 1). This is essentially an experiment in progress. If SFLs continue to rise though, problems may also arise.

DISCUSSION AND FUTURE IMPLICATIONS

Because most industrial facilities must plan and construct their waste-stream processes years in advance, better prediction of their disposal-well SFL behavior would be advantageous. If SFLs were to relentlessly rise, any diminished or lost capacity of the Arbuckle to take waste water may dictate closing facilities that can no longer use their Class-I wells, or abandoning economically viable oil wells dependent on nearby Class-II disposal wells. Superannuating an oilfield-related industrial facility due to Class-I waste disposal problems would obviously have an incidental adverse economic effect on oil and gas fields that feed their product to that facility.

Class-II disposal wells with deep penetration into the Arbuckle stand the best chance to supplement extant Class-I P* and SFL data to refine the SFL map and aid monitoring and forecasting. The number of wells that merit testing is considerably less than the total number of Class-II wells. For example, of 632 Class-II Arbuckle disposal wells in 10 counties in south-central Kansas, only 68 (11%) mostly or entirely penetrate the total thickness of the Arbuckle. Some are near Class-I wells, so even fewer are worth testing.

At present, any problems with fluid rise in Arbuckle disposal wells (i.e., loss of disposal capacity, subsurface contamination of shallow aquifers, surface spillage, etc.) are still hypothetical. Areas where problems may occur are only now rudimentarily identified (Figure 2), and the best solutions to any problems, should they occur, are unclear. While SFLs in Arbuckle disposal wells may decline in delayed correspondence with decreased water disposal recorded in recent years, additional data are needed to better understand the complexities of Arbuckle hydrology. Data from more users of Arbuckle pore space would lead to a better understanding of this issue and aid in the analysis of prospective solutions.

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Monday, September 23, 2019 at Terradyne CC

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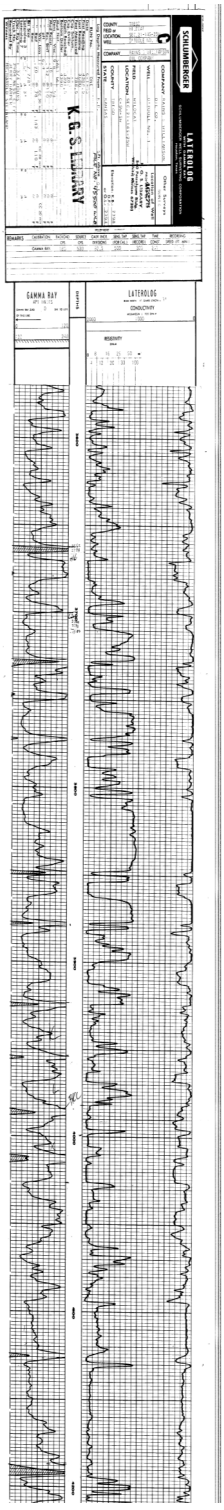

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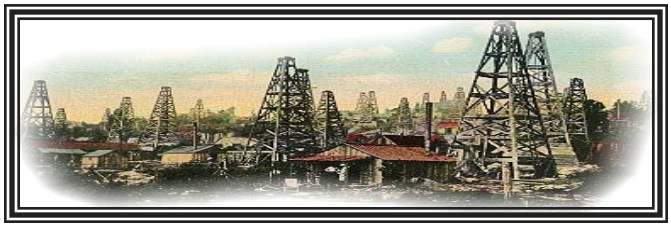
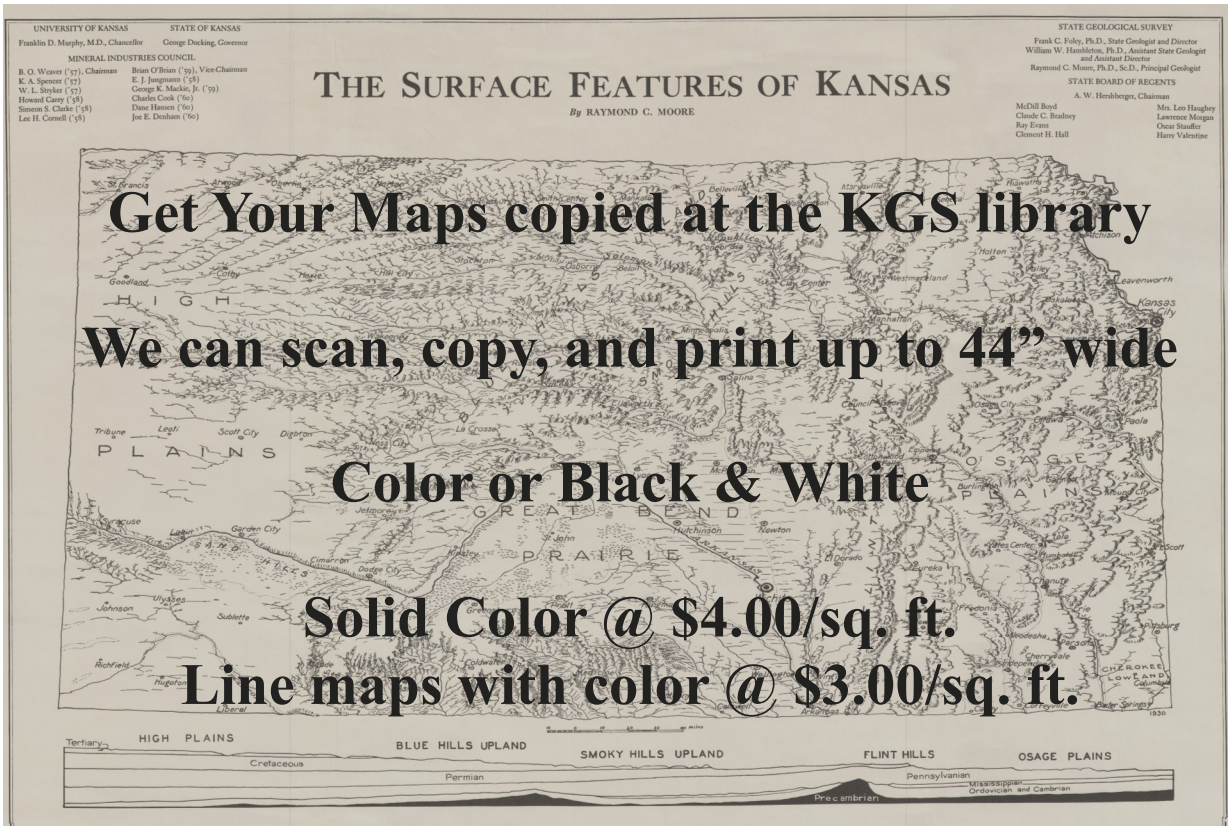
Effective January 1, 2018, only ads for service companies and geologists offering their services will be permitted in the KGS Bulletin. Furthermore, only content of geologic interest or official KGS functions (technical talks, annual banquet, golf tourney, picnic etc.) will be permitted in this bulletin. This policy is in keeping with maintaining a professional standard for this publication. Any interpretation of this policy rests solely with the editor of this bulletin.





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

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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 Wes Hansen 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
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Kansas Geological Foundation

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Kansas Geological Foundation News

Spring 2019 Scholarship Recipients

Ethan Reid	Ft. Hays State Univ.	Knighton Family Scholarship	$500.00
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Grant Request Recipients

No grant requests were received

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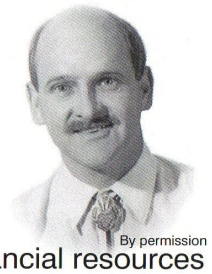

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The KGF provides the financial resources to sort, process and file, in-kind donations of geological data at the KGS library. Due in large part to the KGF this unique and rare well of information is being made available to all. Please consider telling your company management and colleagues about the benefits of a library that continues expanding in part because of the KGF.

We very much value and need your financial support.

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Kansas Geological Foundation News

Students: The KGF awards scholarships each December and May. Check with your department chairs for applications. You must submit complete applications by the deadline.

Scholarship Applications for the Fall semester will be due by May 1, 2019.
Grants to help with research on Kansas related geology are also considered for aid.

If you are in the KGS Library and see Ted Jochems or any of the integrators, give any of them a great big thanks for their efforts in continuing the tedious process of examining, scanning and integrating new logs and geologist's reports etc. into our library and the WDL.

As of January 1, 2019, the Foundation has **two full time employees** working on well log integration: Helen Cruz and Shuyao Li (a.k.a. Emily) along with Ted Jochems. They work forty hours per week, with Ted Jochems putting in 20-30 hours. More than a dozen other part-time integrators have worked on the project since 2010.

Integration Update

From 01 January to 31 March of 2019, 7,665 well logs were examined by the integrators. 1,968 (25.7%) were new logs for the Walters Digital Library. 783 logs were re-scanned to replace poor existing digital images.

Over the eight year history of the integration project, 182,699 well logs have been examined. 53,751 (29.4%) were new to the WDL, with 3,679 logs re-scanned to replace poor existing images.

With Shuyao Li (Emily) and Helen Cruz becoming full time KGF employees, the estimated wages and benefits for these two ladies for 2019 is $71,230. Ted Jochems requests that the KGF board continue to allocate $15,000 for his services as a contractor/consultant. The total estimated cost of well log integration for 2019 is $86, 230.

Submitted by Ted Jochems

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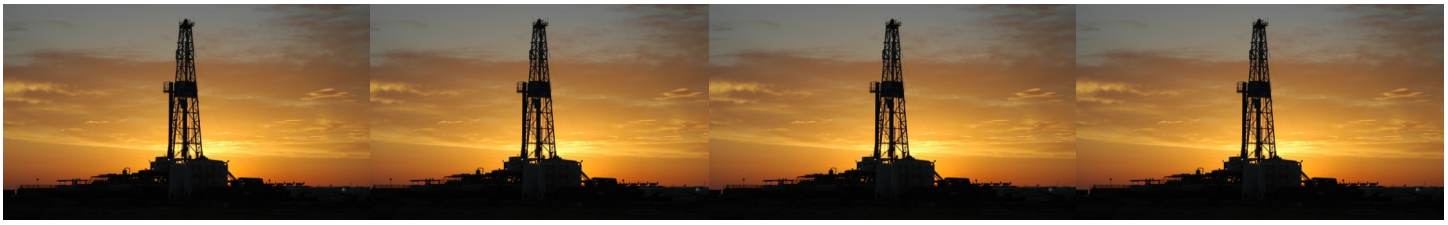
The costs for printing and mailing the bulletin far exceed the ad revenue. Advertising revenue received in 2018 totaled $ 3,590.00. Printing and postage costs for 2018 totaled $13,605.48. A shortfall of $10,015.48. Currently, one can view the bulletin online from the Kansas Geological Society website and print from one’s own computer. Discussion with the KGS Board leaned toward going totally digital, although no official motion was made or vote taken.



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The Mid Continent Section has **17 AAPG Student Chapters**, but only **3 Visiting Geoscientists**...which makes it almost impossible to have a professional geoscientist visit to each school at least once a year or even once every two years. The aim of AAPG's program is to give students a flavor of a professional life in energy resources. It also hopes to encourage dialog between industry and academia.

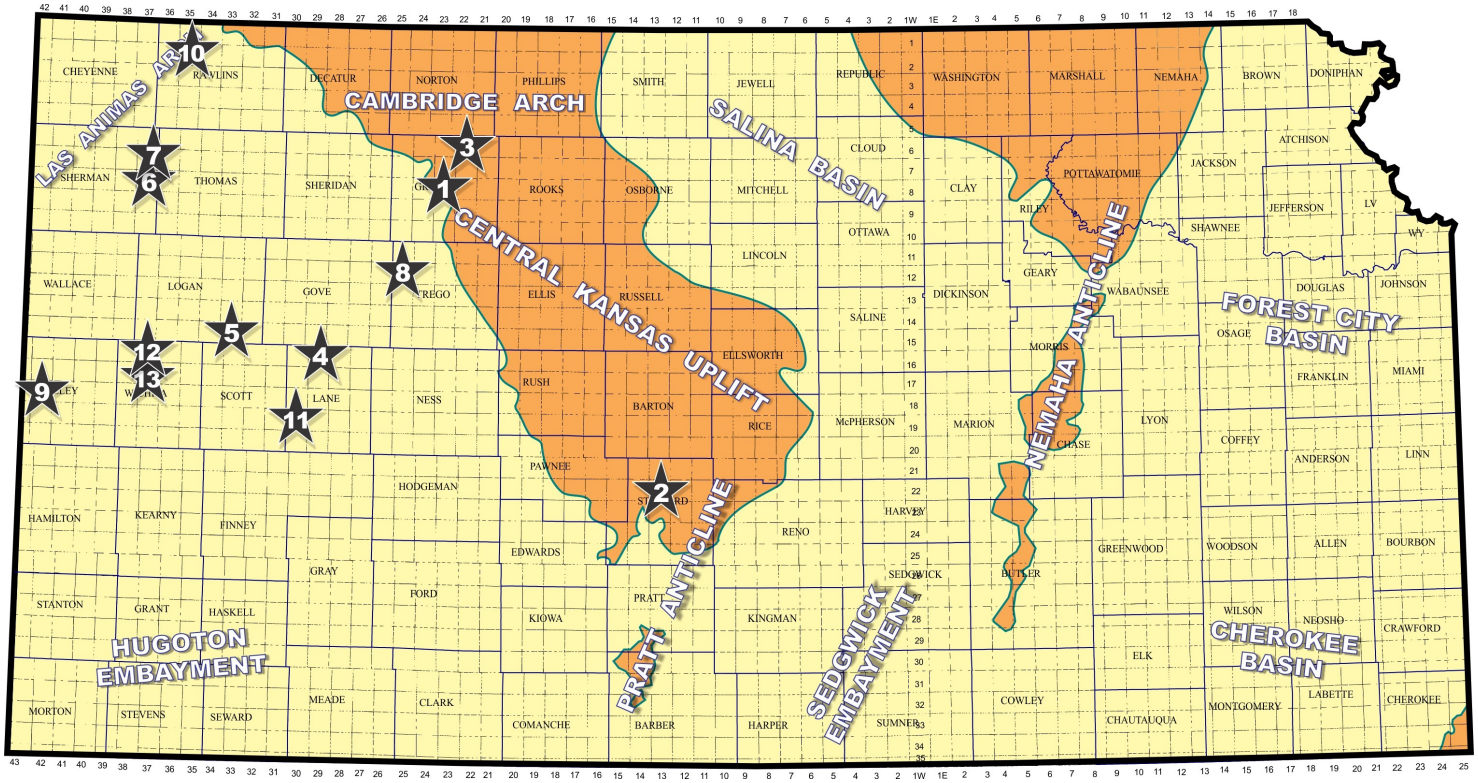
To be a Visiting Geoscientist bearing the AAPG flag, you are asked to have at least 5 years of experience and make at least one visit per year to a university. It can be a school with an AAPG Student Chapter, or a college/university without one. Your choice.

The Mid Continent schools with Student Chapters are: Missouri University, Fort Hays State University, Iowa State University, Kansas State University, Missouri State University, University of Nebraska, Northwest Missouri State University, Oklahoma State University, University of Oklahoma, University of Arkansas, University of Iowa, University of Kansas, University of Missouri, Columbia University of Tulsa and Wichita State University.

Contact Robbie Gries, co-Chair VGP committee, Denver, if you are interested in learning more. rrgries@aol.com

Exploration Highlights

By John H. Morrison, III
Independent Oil & Gas



Map courtesy of Marc Summervill

1.) **Canyon Operating LLC**, Loveland (CO), has discovered new Lansing - Kansas City oil reserves with the successful completion of the #25-1 B Bar B in Graham County. The wildcat well was drilled to a total depth of 3820 ft at drill site located in the SE/4 of section 25- T8s- R23W, about 2.5 miles south of the town of Hill City, Kansas. Completion details remain confidential. The new find lies nearly one mile south of the Hill City Field (1958, LKC oil) which produced a little over 8000 bbls of oil. Canyon's new field has been named Hill City South. (API 15-065-24158)

2.) **JEL Resources LLC**, Aurora (CO), has completed its #1-8 Lyda Rutti as new pool discovery in Stafford County. The new oil discovery lies less than one mile southwest of known production in the Besthorn Southwest Field (1971, Simpson oil), nearly 2 miles south of the town of Seward, Kansas. The Rutti well, spotted in the SW/4 of section 8- T22s- R13W, is producing an undisclosed amount of crude oil from the Viola formation. Discovery Drilling tools bottomed the well at a total depth of 3900 ft. The new field has been named Diamond South. (API 15-185-24040)

3.) **Ainsworth Operating Company**, Salem (OR), is producing an unknown amount of crude oil from the Lansing - Kansas City formation at the #1 Nelson, located in the NW/4 of section 33- T6s- R22W, in Graham County. The new Red Sun West pool discovery was drilled at a location nearly one mile west of production in the Red Sun Field - a field Ainsworth discovered in 1988 that has given up over 121,000 bbls of oil from four producing wells. Total depth was called at 3200 ft. Field area is located about 9 miles north and 3 miles west of the town of Bogue, Kansas. (API `15-065-24154)

4.) **Grand Mesa Operating Company**, Wichita (KS), has discovered new oil reserves in the Lansing-Kansas City (LKC) and Pleasanton formations at their #1-9 O`Brien that was drilled in the SE/4 of section 9- T16s- R29W, Lane County. The wildcat discovery well has established the Hickok Road oil field about 4 miles north and 4.5 miles west of the town of Shields, Kansas. Operator discovered the oil deposits over one mile from nearest production nearby in the multi-pay Jennison North Field, which has produced over 690,000 bbls of oil from the LKC, Marmaton and Cherokee formations since 1984. No completion details have been released by Grand Mesa on their latest find. (API 15-101-22619)

5.) **Concorde Resources Corporation**, Eufaula (OK), is producing an estimated 15 bbls of oil daily, no water, at the #1A-19 McDaniel new pool discovery well in Logan County. Spotted in the NE/4 of section 19- T15s- R33W , the well is producing crude from Marmaton perforations placed from 4262 to 4266 ft. Rotary total depth is 4653 ft. The new field is named Spirit Butte and is located nearly 11 miles south and 7.5 miles east of Russell Springs, Kansas.

Concorde has also established the new Wild Butte oil field in Logan County, located almost 3 miles north-northwest of the above mentioned #1A-19 McDaniel well. Operator drilled the #1-1 McDaniel to a total depth of 4615 ft in the NW/4 of section 1- T15s- R34W. The well is reportedly flowing an undisclosed amount of oil from Marmaton perforations shot between 4218 to 4222 ft. (API 15-109-21567)

6.) **VAL Energy** , Wichita (KS), is producing an undisclosed amount of crude from the Marmaton and Cherokee formations at the #1-11 Engelhardt new pool discovery in Sherman County. The 5005 ft well was drilled in the NE/4 of section 11- T8s- R37W, about one mile north and two miles west of Brewster, Kansas. No completion details have been released. Field area lies about two miles southwest of the Gertrude Field, which was discovered by Chizum Oil LLC in mid-2018 with Marmaton oil production. VAL Energy's new field is named Engelhardt Northeast. (API 15-181-20616)

7.) **Chizum Oil LLC**, Andover (KS), has established the Gertrude West Field with the successful completion of the #1-35 Gaskill, spotted in the SW/4 of section 35- T7s- R37W, in Sherman County. The well discovered oil deposits in the Marmaton and Cherokee (Johnson Zone) formations. Completion details are confidential. Total depth was obtained at 5030 ft. Field area is located about 2.5 miles north and 15 miles east of Goodland, Kansas. (API 15-181-20618)

8.) **Phillips Exploration Company LLC**, Andover (KS), has completed a new pool discovery well in Trego County at the #1-20 -CR Ziegler - Graber Unit, spotted in the NW/4 of section 20- T12s- R25W. The wildcat well was drilled to a total depth of 4486 ft by Murfin Drilling Company tools at site located over 2 miles from closest recognized production in the Collyer Townsite Field (2016, Lansing-Kansas City oil). The well is completed for 25 bbl of oil and 5 bbl of water per day from Lansing-Kansas City perfs between 4040 to 4048 ft. The new Texas Trail pool lies about 2.5 miles south of the city of Collyer, Kansas. (API 15-195-23061)

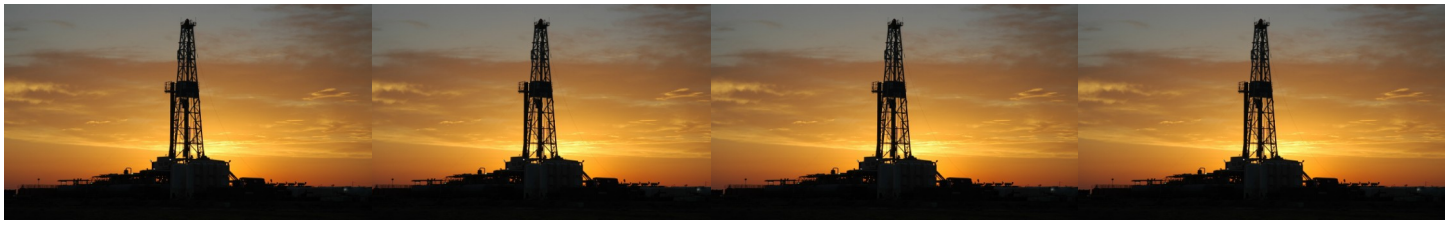
9.) **Red Oak Energy**,Wichita (KS), has found new oil reserves in the Atoka formation at their #1-30 GTD Land well in Greeley County, southwest Kansas. The wildcat well found the oil deposits over one mile southeast of Moore - Johnson Southeast oil field (1990) which has produced over 35,000 bbl of oil from the Morrow formation to date. The GTD new pool discovery was drilled to a total depth of 5059 ft in the SE/4 of section 30- T18s- R42W, about 10.5 miles south of the town of Horace, Kansas. Completion details are confidential. (API 15-071-20888)

10.) **Murfin Drilling Company**, Wichita (KS) is producing an undisclosed amount of crude oil from perforations made in the Lansing - Kansas City formation at the #1-15 Frisbie B in Rawlins County. The well establishes the new Coyote Canyon oil field in the SW/4 of section 15- T2s- R35W, about 4 miles south of the town of Beardsley, Kansas. The new reserves were discovered at drill site located over one mile southeast of known oil production in the Kopriva West Field, which Murfin also discovered in 2017 (LKC oil). The new Frisbie B pool has not been named.(API 15-153-21213)

11.) **Ritchie Exploration**, Wichita (KS) has discovered new oil deposits in Lane Count at their #1 Spece 29-D new pool discovery. The well was drilled to a total depth of 4740 ft in the SE/4 of section 29- T19s- R30W, about 8 miles southwest of the town of Amy, Kansas. The producing formation is currently being held confidential, however, the well lies three-quarters mile north of Marmaton (Pawnee) oil production in the Sutton Township Field. Ritchie also opened the Sutton Township Field in 2016 after the 1 Anderson 32-B, NW/4 in section 32, was initially completed for 80 bbls of oil and 23 bbls water from a perforated depth of 4487 to 4492 ft. Ritchie's new oil field on the Spece 29-D lease has been named Sutton Township North. (API 15-101-22616)

Elsewhere, Ritchie Exploration has established two new unnamed oil fields in Wichita County, west-central Kansas. Both new discoveries found oil deposits in the Marmaton (Altamont) formation. Completion details are currently being held confidential. First, the #1 Whitham - Smith Trust was drilled to a total depth of 4960 ft at site located in the NW/4 of section 35- T16s- R37W. The wildcat well found oil deposits nearly three-quarters mile southwest of the Campas Northeast Field that was established by Wichita-based Mull Drilling Company Inc in 2017. The one-well field has produced nearly 18,000 bbls of oil since it's inception from the Marmaton formation. The new Campas East pool discovery is located about 8 miles northwest on the town of Leoti, Kansas. (API 15-203-20342)

Secondly, Ritchie's #1 Whitham 21-A is producing oil at site in the NE/4 of section 21- T17s- R37W, almost 5 miles north and 2 miles west of Leoti, Kansas. WW Drilling tools bottomed the well at a total depth of 4960 ft. The new Whit pool discovery was made nearly 1.5 miles southeast of Marmaton (Altamont) oil production in the Carwood Field (1957). Ritchie revived production in the once abandoned field in 2015 after the #1 Biermann 8-D produced 48 bbls oil daily from perfs from 4488 to 4494 ft. (API 15-203-20343).



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KGS BULLETIN
May - June 2019

May 2019

Sun	Mon	Tue	Wed	Thu	Fri	Sat
			1	2	3	4
5	6	7	8 Tech Meeting	9	10	11
12	13	14 KGS Board	15 KGF Board	16	17	18 AAPG ACE
19 AAPG ACE	20 AAPG ACE	21 AAPG ACE	22 AAPG ACE	23 KGF Spring Mixer Petroleum Club	24	25
26	27	28	29	30	31	

June 2019

Sun	Mon	Tue	Wed	Thu	Fri	Sat
						1
2	3	4	5	6	7	8
9	10	11 KGS Board	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29