



Arizona Geological Society Newsletter

FEBRUARY 2015

February 3, 2015 DINNER MEETING

Who: Don Yurewicz will present “Assessing Unconventional (Continuous) Hydrocarbon Resource Plays”
Where: Sheraton Tucson Hotel and Suites, 5151 East Grant Road, (at the intersection of Grant and Rosemont on the North side of Grant in the *PIMA BALLROOM* (enter at northwest corner of the building) and go upstairs to the meeting room.
When: Cash Bar at 6 p.m.—Dinner at 7 p.m.—Talk at 8 p.m.
Cost: Members \$27, Guests \$30, **Students Members** free with on-line reservation (\$10 without).

RESERVATIONS ARE REQUIRED: CALL (520) 663-5295 or reserve on the AGS website (www.arizonageologicalsoc.org) by 11 a.m. Friday, January 30th. Please indicate Regular (Pork Loin Medallions), Vegetarian, or Cobb Salad meal preference. Please cancel by 11 a.m. Friday, January 30th if you are unable to attend - no shows and late cancellations will be invoiced.



The February dinner meeting is sponsored by: Arizona Oil and Gas, Inc.

The Arizona Geological Society is grateful for Arizona Oil and Gas, Inc.'s sponsorship, which helps us to offset dinner meeting costs.
Learn more about Arizona Oil and Gas at

www.azoilgas.com

Abstract

Assessing Unconventional (Continuous) Hydrocarbon Resource Plays Don Yurewicz, ExxonMobil (Retired)

Unconventional resources plays (also referred to as continuous resource plays) are regionally extensive hydrocarbon accumulations that lack any obvious relationship to structural closures or stratigraphic traps with downdip water contacts. Reservoir and fluid properties vary considerably within these plays but most are characterized by extremely small pores and very low permeability. Reservoirs include mudstones (shale), sandstones, coals, and carbonates, and fluids range from dry gas to oil (including heavy oil). The established processes for assessing conventional plays which relies on risking, sizing, and counting discrete prospects or fields is not applicable for continuous plays (Hood and Yurewicz, 2008). Most continuous resource plays are

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better assessed as a single large hydrocarbon accumulation with highly variable resource density. Because economic margins may be thin in these plays, business success often depends on early identification of favorable areas with higher resource density, which in turn correlates to areas of better well performance. In addition to determining in-place and recoverable volumes, the assessment methodology for continuous resources must, therefore, be flexible enough to map variable resource density, to relate hydrocarbon volumes to well performance, and to adapt to situations ranging from little or no well data to thousands of wells (Hood, Yurewicz and Steffen, 2012).

Play assessment provides a powerful mechanism for integrating geologic insights into business decisions. To incorporate the unique aspects of continuous resources, a process was developed to apply a hybrid grid and polygon based methodology (Hood and Yurewicz, 2008). The play is subdivided into a series of analysis polygons that provide the basis for probabilistic calculations. The polygon boundaries can be dynamic (mapped geologic limits), static (leases), arbitrary, or some combination of these. Those geologic properties mapped spatially as grids (e.g. gross thickness, net-to-gross, or porosity) are evaluated within each analysis polygon to obtain inputs for the probabilistic assessment. Geologic properties that are not available as spatially varying estimates can be assigned directly with appropriate ranges of uncertainty. Resource uncertainty can be captured both as ranges around most likely parameter estimates and as multiple geologic or operational scenarios. Risk dependency and volumetric correlation must be defined in order to obtain robust probabilistic aggregations of multiple analysis polygons. Fully probabilistic results lead to better informed business decisions by providing information on high-side and low-side outcomes.

Ultimately, assessments based on well performance provide the clearest indication of the recoverable resource and economic viability of a play. Unfortunately, well performance-based approaches are not reliable until a high operational efficiency has been achieved and the number of wells with adequate production histories is sufficient to clarify the primary controls on resource density. To provide early prediction of well performance within the context of volumetric assessment, probabilistic ranges of well EURs are estimated for each assessment polygon based on volumetric inputs coupled with assumptions about likely drainage areas (Hood, Yurewicz and Steffen, 2012). As performance-based EUR projections become available for wells, they can be compared to the specific recoverable volume prediction from the resource density grid along with the distribution of well EURs predicted for the polygon.

Well performance is key to the economic viability of a play. Combining analog datasets of initial potential (IP) with well EUR provides a dynamic linkage of the volumetric assessment to well performance. Applying relationships between EUR and IP from analog plays to EUR curves (one per polygon) for the play of interest yields spatially varying families (distributions) of IP's. By recasting assessed volumes in terms of well productivity, this process supports economic analyses explicitly linked to spatially varying geologic inputs.

References

- Hood, K. C., and D. A. Yurewicz, 2008, Assessing the Mesaverde basin-center gas play, Piceance Basin, Colorado: AAPG Hedberg Series No. 3, p. 87-104.
- Hood, K. C., D. A. Yurewicz, and K. J. Steffen, 2012, Assessing continuous resources – building the bridge between static and dynamic analyses: *Bul. Canadian Petroleum Geology*, v. 60, p. 1-22.

About the February Dinner Speaker



Don Yurewicz received a B.A. in geology from Rutgers University (1970) in New Jersey and M.S. (1973) and Ph.D. (1976) degrees in geology from the University of Wisconsin. Don's graduate work at Wisconsin focused on sedimentology, stratigraphy and diagenesis of deep- to shallow-marine carbonates.

Don began his career as a research specialist in carbonates at Exxon Production Research Company in Houston in 1977. His research focused on the hydrocarbon source potential of carbonate rocks and the application of fluorescence microscopy in carbonate petrographic studies. He also assisted in exploration and production projects of carbonate reservoirs at Prudhoe Bay in Alaska, the Maracaibo Basin in Venezuela, the Midland Basin in West Texas, and in the South China Sea. Teaching was a major part of his work at Exxon's research center and he led courses in modern and ancient carbonates for Exxon offices around the world.

He then transferred to an exploration assignment in 1985. His work ranged from prospect and play identification in the U. S. Gulf Coast and Mid-continent regions, to an array of regional studies in North and South America, the Middle East, and the Caspian focusing on hydrocarbon systems, reservoir characterization, basin modelling and hydrocarbon assessment.

Don began working on unconventional resources in 2002 when he conducted a study of fluid distribution in tight gas sandstones in the Piceance Basin, Colorado. While working in the Piceance Basin he helped assessors from the Technology division of ExxonMobil in the development of a methodology for assessing this unconventional play. That methodology was later adapted for evaluating a broad range of unconventional plays including shale gas, tight oil, coal bed methane, and heavy oil. During the last 7 years of his career, Don specialized in assessing unconventional resources and assisted in evaluation of unconventional plays around the world. Teaching remained an integral part of Don's long career. In addition to teaching in carbonate schools, Don developed a popular field seminar in unconventional resources and a workshop for assessing unconventional resources.

Arizona Geological Society Membership Stats

Total Membership	Professional Members	Student Members	Organizational Members
544	375	162	7

A Special Note of Thanks!

Ralph Stegen served as AGS Ex. Com. Vice President for Field Trips for 2014 before resigning in January 2015. As field trip VP, Ralph organized two highly successful trips: the first to Freeport-McMoRan's Christmas Mine property (approximately 40-50 AGS members attended); and a trip to Sabino Canyon to examine debris flow deposits (with ~ 25 AGS member attending).

Ralph, on behalf of AGS membership and the AGS Ex. Com, thank you for your service.

In Memoriam

Dr. Harold "Hal" Bohmer

(1930-2014)

(Published in Arizona Daily Star (January 4, 2015))

Harold "Hal" Bohmer died Monday, December 29, 2014, at home in Tucson, Arizona, surrounded by his loving family after a short illness.

Hal was born in Northampton, Massachusetts, in 1930 and attended Williston Academy, now known as the Williston-Northampton School. He graduated from Amherst College following four years of service in the U.S. Navy during the Korean War. Hal went on to complete both an M.S. degree and a Ph.D. in geology at the University of Cincinnati, where he was awarded two National Science Foundation Fellowships.

He then worked as senior research scientist for P.P.G. Industries for 34 years. He worked in the research facility in Barbarton, Ohio, and then for the last six years of his career in Monroeville, PA. Research expeditions in Sierra Leone and Greenland were highlights of his career.

He retired to Tucson with Cynthia in 2002. As avid hikers, they enjoyed many adventures with their children and grandchildren, as well as numerous off-road geological expeditions with family and friends in his Jeep Wrangler. He was an active member of the Arizona Geological Society. He loved Tucson, the Santa Catalina Mountains, and the wildlife.



Offered For Sale (\$10,000)

Olympus Innov-X Alpha 6000 X-Ray Spectrometer, with case, stationary stand, and 3 batteries. S/N 9708. Manufactured March, 2008. The X-Ray gun has had 220 hours of use. We paid over \$30,000 for it new in 2008. Money back guarantee.

Contact Rex Loesby

E-mail - RexLoesby@aol.com

Tel/Cell: 303-771-9610



Shining a Light on the Lindgren Collection

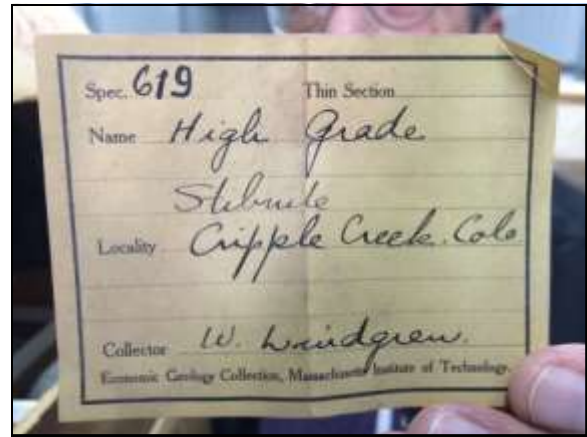
In January 2002, the University of Arizona's Dept. of Geosciences (UA) acquired the Waldemar Lindgren Ore Collection from Harvard University. AGS and the Tucson Gem and Mineral Society played a pivotal role by jointly providing ~\$25,000 for curating and transport of the collection to Tucson.

For 12 years the collection has been secure in a shed off campus in Tucson. The Lindgren Ore Collection – at a glance:

- 10 shrink-wrapped wood pallets (see picture)
- ~ 840 boxes of minerals and rocks
- ~ 10,000 hand specimens in individual trays
- Assorted paperwork and perfunctory catalog listing the 840 boxes, generally by location.
- Many samples have much more specific locality and specimen descriptions written on labels in the bottom of individual trays.



AGS Ex. Com. member Bruce Walker shepherding 10 pallets of boxes of rocks and minerals that comprise the Lindgren Ore Collection.



A representative example of sample information from the collection. Before arriving at Harvard the collection was curated by the Economic Geology program at MIT.

What to do? The Lindgren Collection has been gathering dust for the past 12 years. It appears the time is right to revisit with our UA and TGMS colleagues, how we can leverage the collection to benefit science and the general public.

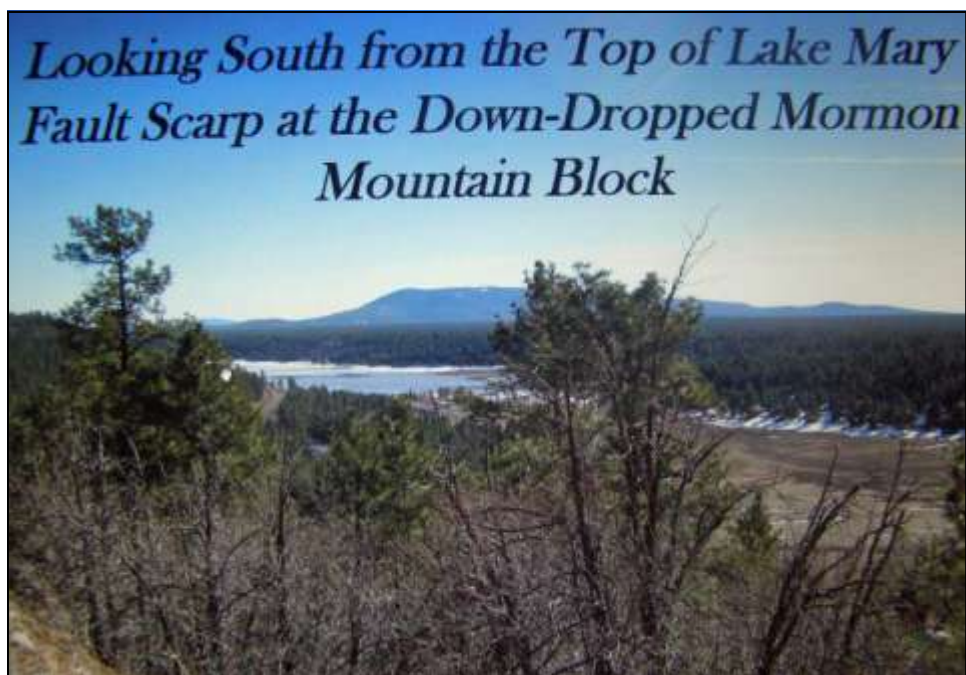
The AGS Executive Committee will hear a proposal at February's Executive Committee meeting to form a sub-committee to explore what options exist for the Lindgren Collection. That sub-committee should comprise representatives from UA Geosciences, AGS Executive Committee, TGMS and other interested parties.

We'll keep you informed going forward. In the meantime, if you have ideas or thoughts for curating or displaying the collection, please reach out to one of our AGS Executive Committee members with the details.

Notice

Due to high costs, the Arizona Geological Society's phone message service will be discontinued on January 31, 2015. After that time, those making dinner reservations or wishing to contact us must do so on-line.

AGS Spring-2015 Field Trip – Save the Date (2-3 May 2015)



[\(Photo taken from Presentation for AHS Symposium, September 19, 2012\)](#)

Geologist and long-time AGS member Paul Lindberg has graciously offered to guide AGS to the Mormon Mountain area south of Flagstaff to examine Basin and Range structures encroaching on the Colorado Plateau. Paul recently led an AIPG group through the same area.

For a detailed description of the geology of Oak Creek and the nearby Mormon Mountain Graben see Paul Lindberg's 31-page paper in the Oak Creek Watershed book now available at the AZGS's Arizona Experience.

- Date – Field trip sets off from Flagstaff at 7:30 a.m. on Saturday 2 May.
- All day excursion to Mormon Mountain and environs.
- Level of difficulty – low; there is one short rock scramble along Oak Creek.

We are looking at options for at a half-day trip to the San Francisco volcanic field for the following day.

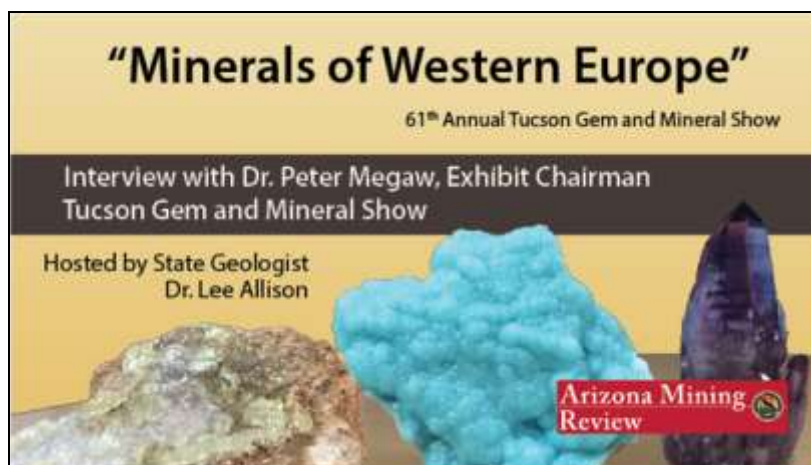
Logistics – To be announced.

2015 Doug Shakel Memorial Student Poster Event

Arizona Geological Society's annual Doug Shakel Memorial Student Poster Event will be held at the Arizona State University science center on Saturday, April 18, 2015. There will be a morning poster event, including display, oral presentations and the award of prizes. This will be followed by a catered lunch and a tour of the ASU's new Science Center. More details about this event will be announced in next month's newsletter.

There will be no regular monthly AGS meeting in April.

Arizona Geological Survey News Brief



[Arizona Mining Review](#) (AMR) e-Video Magazine – 1/27/2015

AMR salutes the annual Tucson Gem and Mineral Show display scheduled for 12-15 Feb. at the Tucson Convention Center. Peter Megaw, TGMS Show Exhibit Chair, joins Lee to describe the magnificent minerals of Western Europe that will be on display. AMR will be broadcast at 10:00 am MST on 27 January on LiveStream and will be immediately available at our [AZGS YouTube Channel](#).

Guest & Topics

- Nyal Niemuth (AZGS) on the impact of declining copper prices on the AZ mining community.
- Peter Megaw – TGM Show

New Publications – Online at the AZGS Document Repository

Conway, F.M. and Davis, R. (eds.), 2014, [Annual Report of the Arizona Geological Survey](#): Fiscal Year 2014. Arizona Geological Survey Open-File Report OFR-14-07, 52 p.

Keith, S.B., 1983, [Results of mapping project near Ray Pinal County, Arizona](#). Arizona Geological Survey Open-File Report OFR-83-14, 74 p., 11 map plates, map scale 1:12,000. (Now available online.)

Singleton, J, Bird, E. and Hatfield, M. 2014, [Geologic map of the southern Lincoln Ranch basin, Buckskin Mountains, west-central Arizona](#). Arizona Geological Survey Contributed Map CM-14-B, Map scale 1:10,000.

Slated for release on the week of Jan. 26, 2015. New or revised earth fissure mapping:

DM-EF-1 v. 2, Chandler Heights Study area

DM-8-EF, v. 2, Luke Study Area

DM-EF-27, v. 1, Avra Valley

DM-EF-28, v. 1, McMullen Valley

ANNOUNCEMENTS

Welcome New AGS Members

Robert Balcells

Larry Krause

Amanda Welch

Mark Emerson

Kelly Proctor

Jody Williams



The AGS Thanks Our 2014 Sponsors for their Support

2015 AGS MEMBERSHIP APPLICATION OR RENEWAL FORM

Please mail check with membership form to: Arizona Geological Society, PO Box 40952, Tucson, AZ 85717

Dues (check box) 1 year: \$20; 2 years, \$35; 3 years: \$50; full-time student (membership is free)

NEW MEMBER or RENEWAL? (circle one) Date of submittal _____

Name: _____ Position: _____

Company: _____

Mailing Address: _____

Street: _____ City: _____ State: _____ Zip Code: _____

Work Phone: _____ Home Phone: _____

Fax Number: _____ Cellular Phone: _____

E-mail: _____ Check this box if you do not have an email address

All newsletters will be sent by email. If you do not have an email address, we will mail a hard copy to you, but we cannot guarantee timeliness.

If registered geologist/engineer, indicate registration number and State: _____

Enclosed is a _____ tax-deductible contribution to the J. Harold Courtright or AGS Scholarship Funds.