Free and Almost Free Petroleum Information: Low-Cost and Open-Source Software*

Susan Smith Nash[1]

Search and Discovery Article #70209 (2016)
Posted February 1, 2016; revised February 15, 2016

*Adapted from oral presentation given at AAPG Geoscience Technology Workshop, "Reservoirs Revitalization," San Antonio, Texas, December 1-2, 2015

[1]Director of Education and Professional Development, AAPG, Tulsa, OK (snash@aapg.org)

Abstract

Obtaining data is a challenge in any environment, but particularly so in a downturn. This presentation provides links to sources of petroleum information that can be obtained at a very low cost, and in many cases, at no cost at all. Further, access to low-cost software can enable geologists, engineers, and analysts to create maps, process data, find patterns, and discover new relationships that could result in optimized operations and new discoveries. Finally, though, how one uses the information gathered is important. In addition to considering the overall purpose of the report or presentation, it is also important to consider the audience, the type of information, and other factors. To that end, the presentation begins with a brief guide to selecting, organizing, and deploying evidence in your reports and presentations.

Using and Deploying Your Information: Selecting and Organizing Evidence

There are many ways to support your argument, and there are many different types of evidence that you can use in your reports and presentations.

What kind of evidence makes the most sense, given your overall objective, and the "rhetorical situation"?
Which evidence do you highlight that will most effectively help you make your case?

Selecting Your Approach

In terms of evaluating and organization evidence, here are a few aspects that will help you select your approach.

1. **Who is your audience?** Knowing your audience makes all the difference in the world. They will not be persuaded equally by all kinds of evidence.

For example, if you are discussing sustainability and developing a sustainable community, you need to tailor your argument to the specific community. Let's take the example of Mineral Wells, Texas, located around an hour west of Fort Worth. Once a very popular spa town due to

its mineral water, Mineral Wells has sunlight, charming old buildings, and a small downtown where lofts and small businesses could be placed in order to allow people to live, work, and enjoy life in the same neighborhood without long commutes. However, to reach the audience, you will need to talk in a manner that will relate to your audience.

2. Include many different types of evidence. Each person has an "evidence preference" (a term I am coining) which refers to the kinds of evidence that they find most compelling. Their "evidence preference" depends on their personal experience, their beliefs about a topic, and their willingness to believe, or conversely, their skepticism (a "skeptibility quotient").

What makes con artists and grifters so effective? Many are masters at listening to individuals and finding out just exactly what a person wants to believe, and where that person has a low skeptibility quotient (or, perhaps a high "gullibility quotient"). Be mindful of the fact that people can be amazingly tenacious regarding the things they really want to believe, even when there is evidence to the contrary.

Nevertheless, include statistics, historical background, case studies, social media reviews, blogs, peer-reviewed journals, and more when considered useful. If something is subjective, be sure to note it as such. Blog posts can be highly opinionated, but still relevant.

3. **Don't discount the role of personal experience.** Testimonials and personal narratives lend authenticity. Have you ever read the reviews on Amazon or on TripAdvisor? They are very persuasive and people will make their decisions based on the reviews, especially if they feel affinity with the reviewer.

4. **Relatability and affinity with the author**. Affinity and perceived community of interest may explain why you are persuaded by a review or a testimonial, or why you may find yourself nodding in agreement as you read a personal narrative.

If you are framing your argument and you are using personal experience, it is a good idea to include enough background and humanizing details to make you as relatable as possible, which can also help you with your credibility.

Organizing the Evidence

Now, the big question becomes, how do you organize the evidence?

In order to organize the evidence, keep the following items in mind. These have to do with rhetorical strategies and the "rhetorical situation" (what do you want your audience to DO?)

1. **Think about what you want your audience to do.** What kinds of actions do you want to trigger? If you want them to purchase a piece of property or sign up to stay at your B&B, then think of the highest impact piece of evidence you have and put that first.

2. **What is the most objectively credible?** Statistics are often boring, but they show that you have done research, and they lend an aura of credibility to the entire set of evidence.

3. **Hook the reader and use an adequate emotional pull.** Yes, you can overdo this. It is possible to be too cloying, sweet, or folksy, or alternatively to be too fear-mongering and apocalyptic. Yet whatever you do, don't leave the reader flat or bored.

Although you might not think of evidence as an engagement strategy, it certainly is (and more). You can use evidence to compel your reader to keep reading, to pique their curiosity, and to trigger questions.

The construction of an argument that uses evidence is also a part of the social construction of reality. Simply put, when you present evidence, you are reinforcing "truth" and "reality" narratives. For that reason, you need to be well versed in the dominant discourse, and make sure that what you are using as evidence is considered legitimate and is easily validated by your peer group or the powers that be. Once you have learned how to select, organize, and deploy your evidence, you will find that your documents will be more likely to have the impact that you desire.

Selected References

Editor's note: Websites without authorship are linked from their citations in the pages that follow. Each has been accessed January 12, 2016.

Amelia Resources, www.ameliaresources.com; http://www.ameliaresources.com/tuscaloosa-trend.htm; www.tuscaloosatrend.blogspot.com. Websites accessed January 9, 2016.

Chopra, S., R. Sharma, and K. Marfurt, 2014, Shale gas reservoir characterization workflows: Search and Discovery Article #41266 (2014). Website accessed January 9, 2016.

Dotsey, P., Logs Reveal Marcellus Sweet Spots:TGS. Story Number 3-3M, T1, A2. 4p. Website accessed January 9, 2016, http://www.tgs.com/uploadedFiles/CorporateWebsite/Modules/Articles_and_Papers/Articles/0311-tgs-marcellus-petrophysical-analysis.pdf.

Loucks, R.G., S. Ruppel, R.M. Reed, and U. Hammes, 2011, Origin and classification of pores in mudstones from shale-gas systems: Search and Discovery Article #40855 (2011). Website accessed January 10, 2016.

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Negraru, P.T., D.D. Blackwell, and K. Erkan, 2003, Heat flow in Texas (abstract, AAPG Annual convention): Search and Discovery Article 90026 (2004). Website accessed January 9, 2016.

Negraru, P.T., and D.D. Blackwell, 2003, Heat flow in Texas: Search and Discovery Article #90026 (2016). Websites accessed January 9, 2016, http://geology.heroy.smu.edu/~negraru/Heat_texas.

Olea, R.A., 2009, A practical primer on geostatistics: USGS Open-File Report 2009-1103, 346p. Website accessed January 12, 2016, http://pubs.usgs.gov/of/2009/1103/ofr2009-1103-rev-jan2010.pdf.

Padilla y Sánchez, R.J., 2013, et al., National Autonomous University of Mexico Tectonic Map of Mexico GIS Project, AAPG GIS Open Files series. Website accessed January 12, 2016, http://www.datapages.com/gis-map-publishing-program/gis-open-files/geographic/tectonic-map-of-mexico-2013.

Pratsch, J-C., 1996, Exploration concepts in the new "sub-salt" play, off- and Onshore Gulf Coast Region: Transactions, 1995 AAPG Mid-Continent Section Meeting, Tulsa Geological Society, 11p. Website accessed January 10, 2016, http://archives.datapages.com/data/tgs/tgs-sp/data/049/049001/14_tgs-sp0490014.htm?q=%2BauthorStrip%3Apratsch.

Free & Almost Free Petroleum Information: Low-Cost and Open-Source Software

Susan Nash, Ph.D.
AAPG

Sources of Free and Low-Cost Data

State Information Sources

Texas Bureau of Economic Geology
http://www.beg.utexas.edu/

Colorado Oil and Gas Conservation Commission
http://cogcc.state.co.us/#/home

Oklahoma Geological Survey: reports, maps, statistics
http://www.ou.edu/ogs

Oklahoma Corporation Commission: digitized well logs, production, well information
http://imaging.occeweb.com/

Oklahoma Well Search
http://occoapp1.occeweb.com/occoghlp/W_G27HELP.html

Louisiana Department of Natural Resources (SONRIS – GIS, oil and gas data, well log information)
http://dnr.louisiana.gov/

State Information Sources

Pennsylvania Oil and Gas Resources:
http://dcnr.state.pa.us/topogeo/econresource/oilandgas/index.htm

Ohio: Information / Well Log Database
http://oilandgas.ohiodnr.gov/

New York: oil, gas, other data: http://www.dec.ny.gov/energy/1524.html
Information on 42,000 deep wells: https://esogis.nysm.nysed.gov/

New Mexico: well logs / data http://ocdimage.emnrd.state.nm.us/imaging/default.aspx

California: http://www.conservation.ca.gov/dog/Online_Data

Wyoming: http://wogcc.state.wy.us/

North Dakota: https://www.dmr.nd.gov/oilgas/

Kansas: http://www.kgs.ku.edu/

GIS Information Sources and Maps

Intermountain Oil and Gas BMP Project: Great portal page for free / low-cost data and software
http://www.oilandgasbmps.org/resources/gis.php

US Energy Information Administration – Natural Gas
https://www.eia.gov/pub/oil_gas/natural_gas/analysis_publications/maps/maps.htm

Summary Maps: Natural gas in the Lower 48 States and North America
Gas production in conventional fields, Lower 48 States PDF (2.8 MB) JPG (2.5 MB)
Gas production in offshore fields, Lower 48 States PDF (0.4 MB) JPG (1.5 MB)
Shale gas and oil plays, Lower 48 States (4/13/2015) PDF (1.4 MB) JPG (0.6 MB)
Shale gas and oil plays, North America (5/9/2011) PDF (0.4 MB) JPG (1.2 MB)
Major tight gas plays, Lower 48 States PDF (1.6 MB) JPG (2.2 MB)
Coalbed methane fields, Lower 48 States PDF (1.8 MB) JPG (2.7 MB)

Natural Gas Production
https://www.eia.gov/naturalgas/data.cfm#production

GIS Information Sources and Maps

Good overview: http://inside.mines.edu/LIB-Maps-GIS

US Energy Mapping System http://www.eia.gov/state/maps.cfm

Geospatial Data Gateway https://gdg.sc.egov.usda.gov/ click the Get Data Button

ESRI online
http://www.arcgis.com/home/group.html?owner=esri&title=ESRI%20Data%20%26%20Maps&content=all

EIA http://www.eia.gov/opendata/widgets.cfm

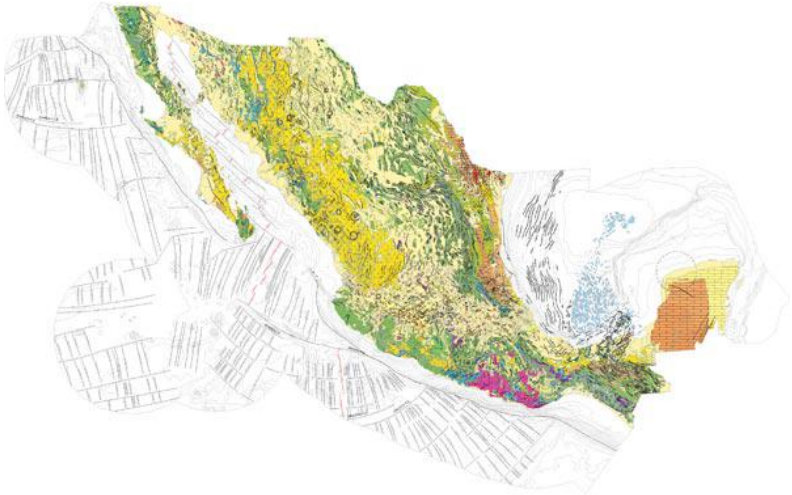
Data.Gov http://catalog.data.gov/dataset

The National Map http://nationalmap.gov/

EPA Map Viewer http://gis.epa.ie/Envision/

EPA Enviromapper http://map11.epa.gov/myem/efmap/index.html?ve=9,32.77814865112305,-96.79540252685547&pText=Dallas,%20TX

Maps



EIA Base Maps
https://www.eia.gov/state/maps.cfm?src=home-f3

Google Maps for Oil and Gas
https://www.google.com/work/mapsearth/oilgas/

Core Repositories (portal page – somewhat dated)
http://www.carbonates.us/cores.htm

Tectonic Map of Mexico (Dr. Padilla y Sánchez)

State Geological Surveys

Core Information, Repositories, etc.
http://www.carbonates.us/cores.htm

State Geological Surveys: Links / Searchable
http://www.stategeologists.org/surveys.php

Portal to State Geological Surveys
http://www.conservation.ca.gov/cgs/information/other_surveys

Articles / Journals – Open Access

Directory of Open Access Journals: https://doaj.org/

AAPG Search and Discovery: http://www.searchanddiscovery.com/

PetroWiki (SPE): http://petrowiki.org/PetroWiki

Journal of Petroleum Exploration and Production Technologies
https://doaj.org/toc/2190-0566

Oil and Gas Science and Technology
https://doaj.org/toc/1953-8189

Petroleum and Coal
https://doaj.org/toc/1337-7027

Journal of Petroleum Engineering
https://doaj.org/toc/2314-5013

Mexico – Useful Information

Comisión Nacional de Hidrocarburos
Production (monthly and historical)
http://www.cnh.gob.mx/5100.aspx

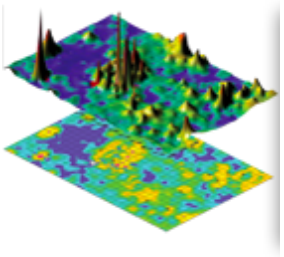
Reserves (by Field)
http://www.cnh.gob.mx/5600.aspx#

Pemex
http://www.pemex.com/ri/Publicaciones/Paginas/IndicadoresPetroleros.aspx

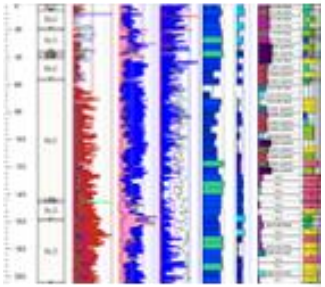
Dr. Ricardo Padilla y Sánchez – Tectonic Map
http://www.datapages.com/gis-map-publishing-program/gis-open-files/geographic/tectonic-map-of-mexico-2013

Tools and Techniques

Golden Software

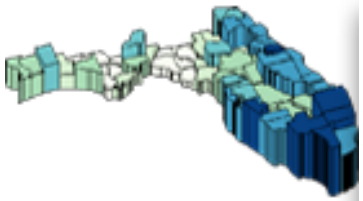


Surfer is a full-function contouring and surface modeling package that runs under Microsoft Windows. Surfer is used extensively for terrain modeling, bathymetric modeling, landscape visualization, surface analysis, contour mapping, watershed and 3D surface mapping, gridding, viewshed analysis, volumetrics, and much more.
http://www.goldensoftware.com/products/surfer

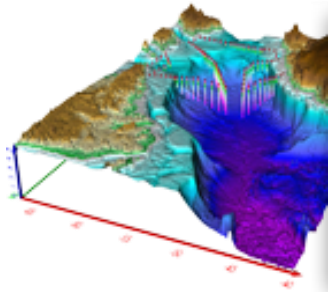


Strater displays your raw data as borehole and well logs, maps and cross sections. Strater offers unsurpassed flexibility in design and layout. Strater's intuitive point-and-click user interface makes it easy to quickly visualize your subsurface data and create professional reports.
http://www.goldensoftware.com/products/strater

Golden Software



MapViewer is an affordable mapping and spatial analysis tool that allows you to easily produce publication-quality thematic maps. Precisely display your data distribution with the most intuitive functions and features.
http://www.goldensoftware.com/products/mapviewer



Voxler. Create powerful, fast, customized 3D images and 3D models with a fusion of your geologic data, GIS data, well and borehole data, and point cloud data with Voxler 4. Easily import and combine data in a multitude of file formats to create stunning 3D models that visualize the relationships across your data set. This robust, yet user-friendly, application gives you the power to display your data in full 3D. http://www.goldensoftware.com/products/voxler

Didger. All the advanced georeferencing, digitizing, coordinate conversion, and mapping features you need in a low-cost, unbelievably versatile program. This is the ultimate geoprocessing and data conversion tool for any map maker, cartographer, geologist, oil and gas professional, or GIS analyst.
http://www.goldensoftware.com/products/didger

DOE / NETL Software

Simulators, etc.

BOAST
http://www.netl.doe.gov/research/oil-and-gas/software/simulators#BVHS

EOR
http://www.netl.doe.gov/research/oil-and-gas/software/predictive-models#EORPM

Low-Cost Resources

Useful Low-Cost Resources:

MATLAB (by MathWorks), a software package that includes a language and interactive environment, used for numeric computation, data analysis and visualization, programming and algorithm development, and application development and deployment: http://www.mathworks.com/?requestedDomain=www.mathworks.com.

Spotfire (by TIBCO), data visualization and analytics software: http://spotfire.tibco.com/spotfire-desktop-analytics?mreferer=dpadwords&gclid=CM_X6ZfBp8oCFQGTaQodU-cE1g.

Octave (open-source alternative to MATLAB): https://www.gnu.org/software/octave/.

USGS's A Practical Primer on Geostatistics, by Ricardo A. Olea. USGS Open-File Report 2009-1103. http://pubs.usgs.gov/of/2009/1103/ofr2009-1103-rev-jan2010.pdf

Free Petroleum Engineering Software: http://petroleumsupport.com/petroleum-software/freepetroleumsoftware/

Data-Mining Software

Orange: Open-source data visualization and analysis for novice and expert. It is maintained and developed by the Bioinformatics Laboratory of the Faculty of Computer and Information Science at the University of Ljubljana (Slovenia): http://orange.biolab.si/.

Weka: Machine-learning software written in Java, and developed by the University of Waikato, New Zealand: http://www.cs.waikato.ac.nz/~ml/weka/.

RapidMiner: An integrated environment for machine learning, data mining, predictive analytics, and business analytics: http://www.rapidminer.com.

Data-Mining Software

Databionic ESOM Tools: A suite of programs that perform data mining tasks such as clustering, visualization, and classification. They use Emergent Self-Organizing Maps (ESOM) as the core tool. http://sourceforge.net/projects/databionic-esom/

Vowpal Wabbit: Helps users develop fast, scalable, and useful learning algorithms. http://hunch.net/~vw/

OpenNN – Written in C++ and consists of an open-source class library which implements neural networks. Most appropriate for advanced users who can program well in C++ and who possess machine-learning skills. http://www.artelnics.com/opennn

Tools and Techniques

Types of Sweet Spots

Geologic:

- Good source rocks
- Good reservoir thickness
- Natural fractures
- Formation energy
- Pore pressure
- Local structure
- Connectivity of pores
- Pore architecture

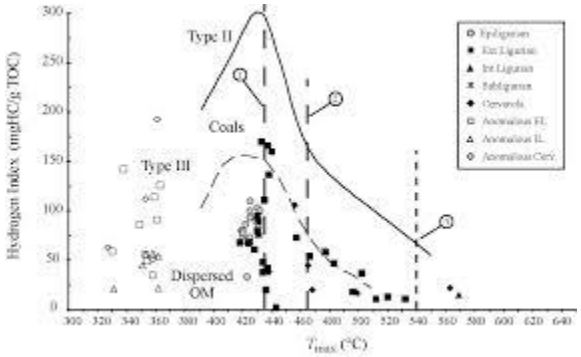
Engineering:

•Good fracability
•Anisotropy of crustal stress
•Pore pressure
•Pore conductivity
•Less relative heterogeneity

Economic:

•Large resource scale
•Good oil quality
•Accessible
•Amenable to pad drilling
•Not too deep

Pyrolysis and TOC – Tmax



Overview: *Interpretation of pyrolysis and TOC data using the compiled graphical plots is a suitable tool for geosteering while drilling for tight oil targets because it provides a means for predicting sweet spots and also delineating formation tops.*

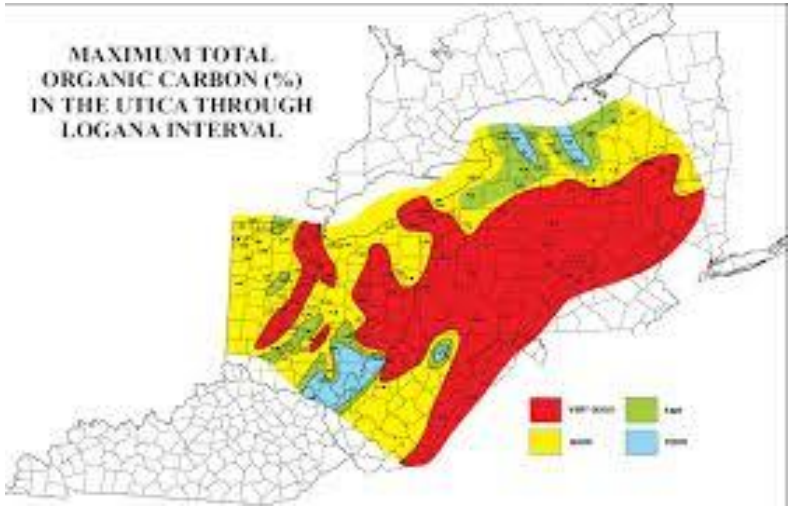
The pyrolysis data comprised of S1, S2, S3 and Tmax. TOC is the organic carbon content of the rock.

Drawbacks: Requires core analysis; cores may not be available.

Santinder Chopra, etal (2014) Shale Gas Reservoir Characterization Workflows http://www.searchanddiscovery.com/pdfz/documents/2014/41266chopra/ndx_chopra.pdf.html

Maende, Albert. (2013) Pyrolysis and TOC Identification of Tight Oil Sweet Spots. UrTEC 2013

Calculated TOC & Sweet Spots

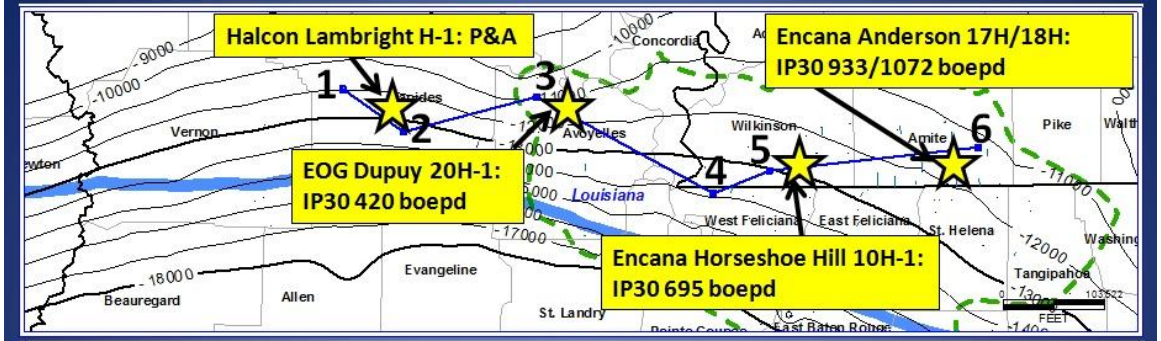


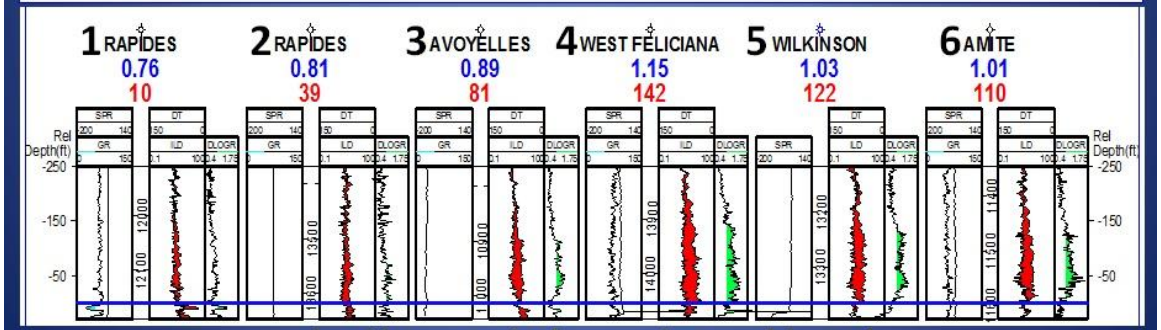
- Identify interval in the trend wells
- Digitized logs (Density-Neutron / Photoelectric index (Pe)
- Review TOC available sample data
- Develop a calibrated TOC model
- Passey Method
- Calculate TOC and porosity for the interval
- Correlate and map the geological and petrophysical results
- Connect the production data to the TOC and petrophysical maps

Dotsey, Pete. Logs Reveal Marcellus Sweet Spots. http://www.tgs.com/uploadedFiles/CorporateWebsite/Modules/Articles_and_Papers/Articles/0311-tgs-marcellus-petrophysical-analysis.pdf

Calculated TOC & Sweet Spots

Passey Log Method



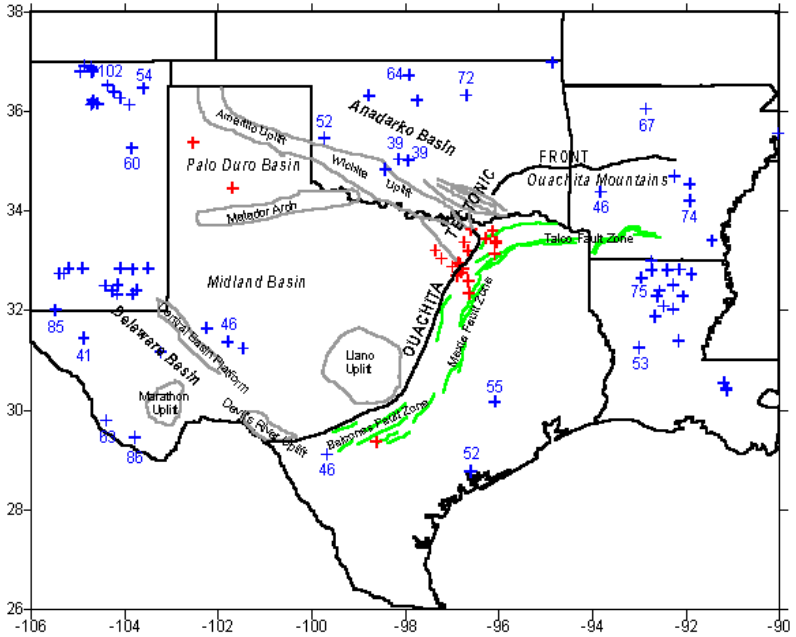


Stratigraphic Cross Section (Hung on the Base of the TMS)

Blue Values: Mean Delta-Log-R Red Values: Feet of Delta-Log-R > 0.9

www.ameliaresources.com www.tuscaloosatrend.blogspot.com

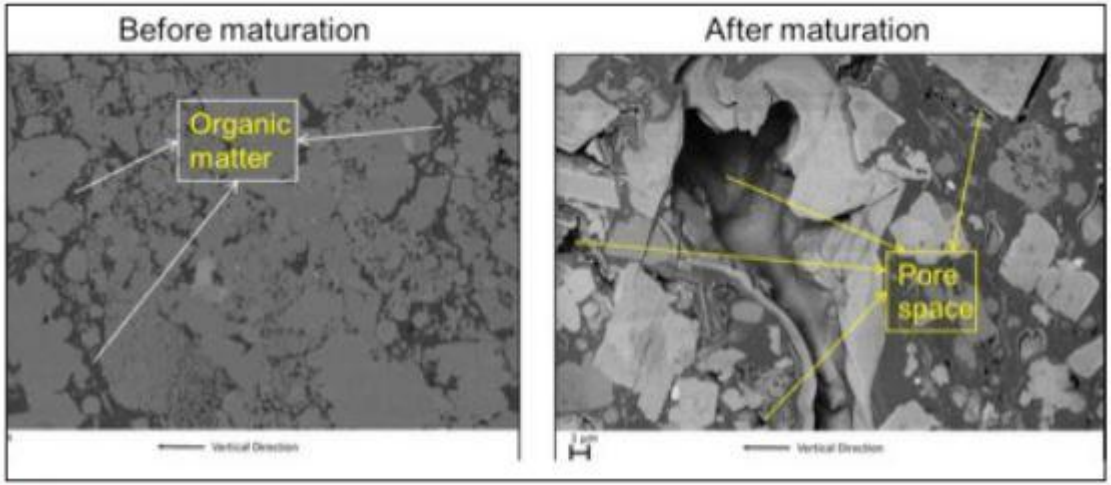
Thermal Heat Flows & Maturation / Porosity



- Basin-level heat flow / thermal patterns will help develop ideas of trends in preferential maturation
- Thermal maturation of kerogen / high TOC areas may lead to the enhancement of porosity (organic nano- and micro-porosity)
- Find heat flow maps, along with the position of basement uplifts and tectonic activity

Negraru, P. and David Blackwell. (2003) Heat Flow in Texas. http://geology.heroy.smu.edu/~negraru/Heat_texas/

TOC and Organic Porosity

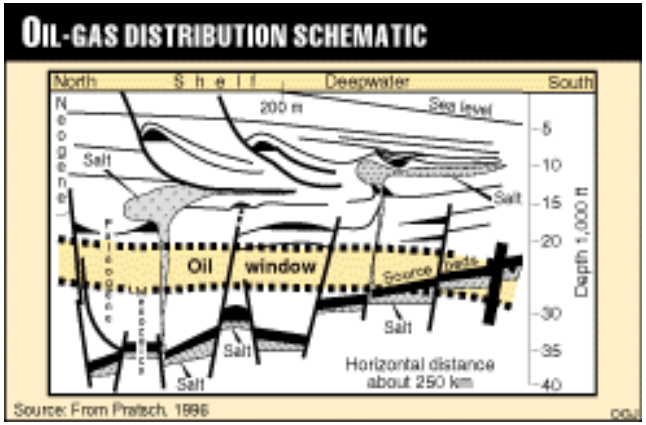


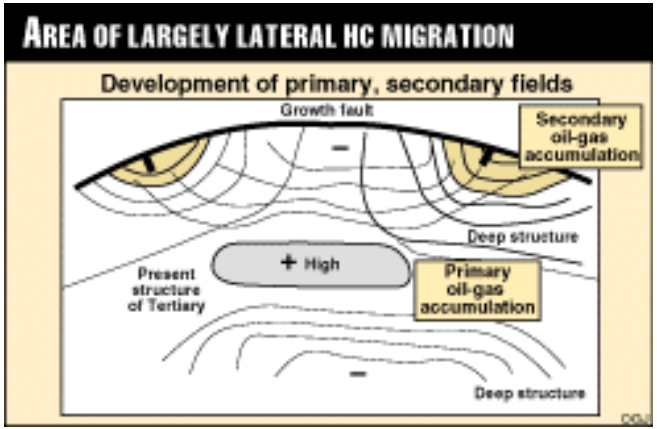
SEM images

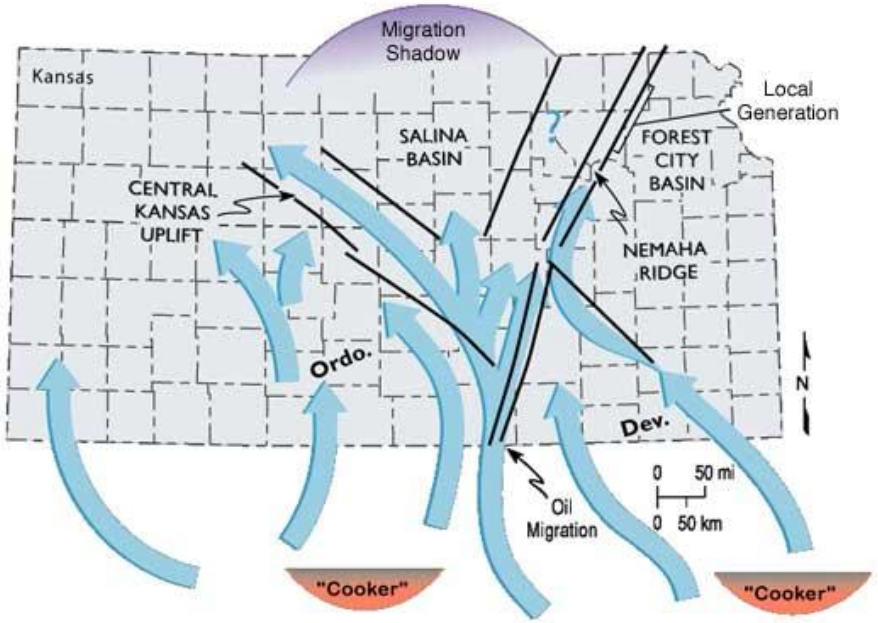
- Kerogen micro-porosity and nano-porosity
- Occur as a result of expulsion / adsorption in the thermal maturation process
- “Loucks’s porosity”
- Intraparticle pores
- Look at basin modeling

Loucks, R.G., etal. (2011) Origin and classification of pores in mudstones from shale-gas systems.
http://www.searchanddiscovery.com/documents/2011/40855loucks/ndx_loucks.pdf

Migration Pathways

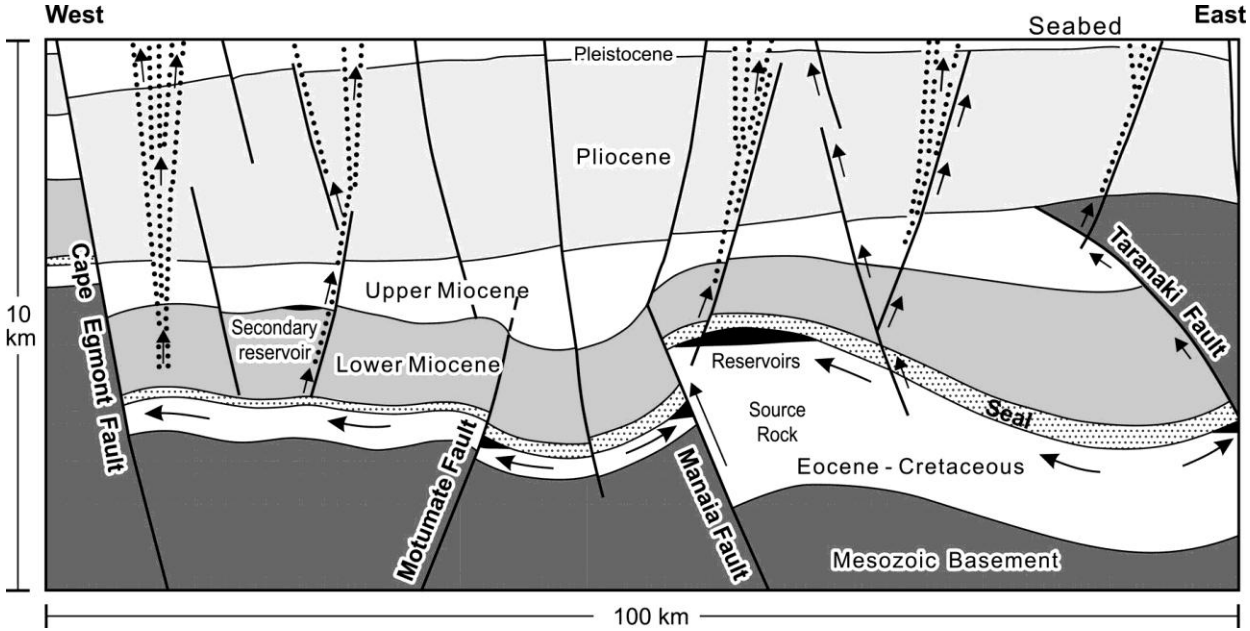






- Generation of oil
- Migration Pathways
- Can extend many miles

Faulting and Gas Migration Pathways



- Understand the major fault systems
- Normal faults and gas migration
- Active and ancient plate boundaries

Other factors --

- Understand the major fault systems
- Normal faults and gas migration
- Active and ancient plate boundaries