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U.S. GEOLOGICAL SURVEY ENERGY RESOURCES PROGRAM NEWSLETTER
FALL/WINTER 2010

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Thank you for subscribing to the U.S. Geological Survey Energy Resources Program Newsletter. This quarterly newsletter provides the latest news, information, and products from the USGS Energy Resources Program. In addition to recent publications, we are continuing to expand the content available through our redesigned website. Previous newsletter issues have been archived (in PDF format) and are accessible from: http://energy.usgs.gov/newsletter.html .

If you have any questions or comments regarding the ERP newsletter, please send an email to: gd-energyprogram@usgs.gov .

FALL/WINTER ISSUE – CONTENTS:

[Energy Spotlight]

U.S. Oil Shale Assessments Updated

Science: Assessment of Undiscovered Oil and Gas in the Arctic

[Features]

Alaska Studies

Appalachian Basin Studies

Coal Resources

Geochemistry and Geophysics

Human Health and Environment

National Oil and Gas Assessment

Oil Shale

Social Media

World

[Other News]

Recent Publications

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ENERGY SPOTLIGHT

U.S. OIL SHALE ASSESSMENT UPDATED

http://www.usgs.gov/newsroom/article.asp?ID=2182

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The U.S. Geological Survey has updated its assessment of in-place oil shale resources in the Piceance Basin in western Colorado.

Development of oil shale has significant technological and environmental challenges and no economic extraction method is currently available in the U.S. Therefore it is unknown how much of the assessed in-place (total amount present) resource is recoverable.

"For the first time in 20 years, we have an updated assessment of in-place oil shale in the Piceance Basin of Colorado," said Secretary of the Interior Ken Salazar. "The USGS scientific report shows significant quantities of oil locked up in the shale rocks of the Piceance Basin. I believe it demonstrates the need for our continued research and development efforts."

The Piceance Basin has an estimated 1.525 trillion barrels of in-place oil shale resources. This study also found an estimated 43.3 billion tons of in-place nahcolite resources in the Piceance Basin. This mineral is embedded with oil shale in many areas, and produces large quantities of the greenhouse gas carbon dioxide when heated in oil shale processing. Oil resources can only be obtained from oil shale rock when heated to great temperatures, 530 to 930 degrees Fahrenheit. These temperatures are required because oil shale does not contain crude oil but instead contains kerogen, which is an organic precursor to oil that must be heated for oil production.

The Piceance Basin contains one of the thickest and richest oil shale deposits in the world and is the focus of most on-going oil shale research and development extraction projects in the U.S.

This new assessment is about 50 percent larger than the 1989 assessment of about one trillion barrels. Almost all of this increase is due to assessments of new geographic areas and subsurface zones that had too little data for previous research and assessments.

The USGS is updating its assessments of oil shale resources in support of recommendations in the Energy Policy Act of 2005. The USGS is also conducting oil shale assessments in the Uinta Basin of eastern Utah and the Greater Green River Basin of southwest Wyoming.

To learn more about USGS research on Oil Shale assessment, please visit the Energy Resources Program Web site .

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SCIENCE MAGAZINE: ASSESSMENT OF UNDISCOVERED OIL AND GAS IN THE ARCTIC

http://energy.usgs.gov/arctic/

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Among the greatest uncertainties in future energy supply and a subject of considerable environmental concern is the amount of oil and gas yet to be found in the Arctic. By using a probabilistic geology-based methodology, the USGS has assessed the area north of the Arctic Circle and concluded that about 30% of the world's undiscovered gas and 13% of the world's undiscovered oil may be found there, mostly offshore under less than 500 meters of water. Undiscovered natural gas is three times more abundant than oil in the Arctic and is largely concentrated in Russia. Oil resources, although important to the interests of Arctic countries, are probably not sufficient to substantially shift the current geographic pattern of world oil production.

For more information about USGS assessment of oil and gas please visit the USGS Energy Resources Program Web site.

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FEATURES

ALASKA STUDIES:

http://energy.usgs.gov/alaska/

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Drilling and Testing the DOI-04-1A Coalbed Methane Well, Fort Yukon, Alaska

The need for affordable energy sources is acute in rural communities of Alaska where costly diesel fuel must be delivered by barge or plane for power generation. Many areas in rural Alaska contain widespread coal resources that may contain significant amounts of coalbed methane (CBM) that, when extracted, could be used for power generation. However, in many of these areas, little is known concerning the properties that control CBM occurrence and production, including coal bed geometry, coalbed gas content and saturation, reservoir permeability and pressure, and water chemistry.

In 2004, the USGS and Bureau of Land Management, in cooperation with the U.S. Department of Energy, the Alaska Department of Geological and Geophysical Surveys , the University of Alaska Fairbanks, the Doyon Native Corporation, and the village of Fort Yukon, organized and funded the drilling of a well at Fort Yukon, Alaska to test coal beds for CBM developmental potential. Although small-scale energy development in remote Arctic locations presents unique challenges, identifying and developing economic, local sources of energy remains a high priority for state and local government. This USGS Open-File Report is available at: http://pubs.usgs.gov/of/2009/1064/ .

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APPALACHIAN BASIN STUDIES

http://energy.er.usgs.gov/regional_studies/appalachians/

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Log ASCII Standard (LAS) Files for Geophysical (gamma ray) Wireline Well Logs and Their Application to Geologic Cross Section C-C' Through the Central Appalachian Basin:

USGS regional geologic cross section C-C' displays key stratigraphic intervals in the central Appalachian Basin. For this cross section, strata were correlated by using descriptions of well cuttings and gamma ray well log traces. This report summarizes the procedures used to convert gamma ray curves on paper well logs to the digital Log ASCII Standard (LAS) format using the third-party software application Neuralog™. The creation of digital LAS files from paper well logs by using Neuralog™ is very helpful, especially when dealing with older logs with limited or nonexistent digital data. This USGS Open-File Report is available at: http://pubs.usgs.gov/of/2009/1021/ .

Geologic Cross Section D-D' Through the Appalachian Basin from the Findlay Arch, Sandusky County, Ohio, to the Valley and Ridge Province, Hardy County, West Virginia

Geologic cross section D–D′ is the second in a series of cross sections constructed by the USGS to document and improve understanding of the geologic framework and petroleum systems of the Appalachian Basin. This cross section provides a regional view of the structural and stratigraphic framework of the Appalachian Basin from the Findlay arch in northwestern Ohio to the Valley and Ridge province in eastern West Virginia, a distance of approximately 290 miles. The information shown on the cross section is based on geological and geophysical data from 13 deep drill holes, several of which penetrate the Paleozoic sedimentary rocks of the basin and bottom in Mesoproterozoic crystalline basement rocks. This USGS Scientific Investigations Map is available at: http://pubs.usgs.gov/sim/3067/ .

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COAL RESOURCES:

http://energy.usgs.gov/coal.html

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Executive Summary - The National Coal Resource Assessment Overview, Chapter A

The USGS has completed the National Coal Resource Assessment (NCRA), a multiyear project by the USGS Energy Resources Program, in partnership with State geological surveys in the coal producing regions of the United States. The NCRA is the first digital national coal-resource assessment. Coal beds and zones were assessed in five regions that account for more than 90 percent of the Nation's coal production—(1) the Appalachian Basin, (2) the Illinois Basin, (3) the

Gulf Coastal Plain, (4) the Colorado Plateau, and (5) the Northern Rocky Mountains and Great Plains. The purpose of this report, USGS Professional Paper 1625–F, is to present a tabulation and overview of the assessment results, insight into the methods used in the NCRA, and supplemental information on coal quality, economics, and other factors that affect coal production in the United States. The USGS Professional Paper is available at: http://pubs.usgs.gov/pp/1625f/downloads/ChapterA.pdf . For all the chapters for this professional paper, The National Coal Resource Assessment please visit page 11.

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GEOCHEMISTRY AND GEOPHYSICS
http://energy.usgs.gov/gg.html
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A Practical Primer on Geostatistics

Most geological phenomena are extraordinarily complex in their interrelationships and vast in their geographical extension. The objective of geostatistics is the characterization of spatial systems that are incompletely known, systems that are common in geology. A key difference from classical statistics is that geostatistics uses the sampling location of every measurement. Unless the measurements show spatial correlation, the application of geostatistics is pointless. Ordinarily the need for additional knowledge goes beyond a few points, which explains the display of results graphically as fishnet plots, block diagrams, and maps.

This primer offers stochastic solutions to common problems in the characterization of complex geological systems and can provide an understanding of the theoretical foundations of geostatistics. The USGS Open-File Report is available at: http://pubs.usgs.gov/of/2009/1103/ .

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HUMAN HEALTH AND ENVIRONMENT:
http://energy.usgs.gov/healthenviron.html
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PODCAST: USGS Corecast, Episode 103 Coal and Human Health
USGS Energy Resources Program Coordinator Brenda Pierce discusses an emerging area of study called "medical geology" and the connections between natural resources and human health. Also featured are USGS scientists Bill Orem and Calin Tatu, who are researching links between coal and a kidney disease, called Balkan endemic nephropathy (BEN) in the Eastern Europe Balkan areas. The podcast is available online at: http://energy.usgs.gov/healthenviron.html .

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NATIONAL OIL AND GAS ASSESSMENT:
http://energy.cr.usgs.gov/oilgas/noga
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Oil and Gas Development in Southwestern Wyoming -- Energy Data and Services for the Wyoming Landscape Conservation Initiative (WLCI)

This report explores current oil and gas energy development in the area encompassing the Wyoming Landscape Conservation Initiative (WLCI). The WLCI is a long-term science-based effort to ensure southwestern Wyoming's wildlife and habitat remain viable in areas facing development pressure. Wyoming encompasses some of the highest quality wildlife habitats in the Intermountain West. At the same time, this region is an important source of natural gas. Using Geographic Information System technology, energy data pertinent to the conservation decision making process have been assembled to show historical oil and gas exploration and production in the region. In addition to historical data, estimates of undiscovered oil and gas are included from the 2002 USGS National Oil and Gas Assessment in the Southwestern Wyoming Province. This report is meant to facilitate the integration of existing data with new knowledge and technologies to analyze energy resources development and to assist in habitat conservation planning. The well and assessment data can be accessed and shared among many different clients, including, but not limited to, an online web-service for scientists and resource managers engaged in WLCI. The USGS Digital Data Series is available at: http://pubs.usgs.gov/ds/437/ .

Gas, Oil, and Water Production from the Wasatch Formation, Natural Buttes Field, Uinta Basin, Utah

Gas, oil, and water production data were compiled from 38 wells, with production commencing during the 1980s from the Wasatch Formation in the Greater Natural Buttes field, Uinta Basin, Utah. This study is one of a series of reports examining fluid production from tight gas reservoirs, which are characterized by low permeability, low porosity, and the presence of clay minerals in pore space. The general ranges of production rates after 2 years are 100–1,000 thousand standard cubic feet per day for gas, 0.35–3.4 barrels per day for oil, and less than 1 barrel per day for water. The water: gas ratio ranges from 0.1 – 10 barrels per million standard cubic feet, indicating that free water is produced along with water dissolved in gas in the reservoir, typical of a wet gas system. Neither gas nor water rates show dependence upon the number of perforations, although for low gas-flow rates there is some dependence upon the number of sandstone intervals that were perforated. Over a 5-year time span, gas and water may either increase or decrease in a given well, but the changes in production rate do not exhibit any dependence upon well proximity or well location. The USGS Open-File Report is available at: http://pubs.usgs.gov/of/2009/1049/ .

Gas, Oil and Water Production in the Wind River Basin, Wyoming:

Gas, oil, and water production data were collected from the Fuller Reservoir, Cooper Reservoir, Frenchie Draw, Cave Gulch, and Madden fields in the Wind River Basin, Wyoming. These fields produce from the Mississippian Madison Limestone, the Upper Cretaceous Cody Shale and Mesaverde Formation, and the Paleocene lower unnamed member and Shotgun Member of the Fort Union Formation.

Diagrams of water and gas production from tight gas accumulations in three formations in the Madden field show that (1) water production either increased or decreased with time in all three formations, (2) increases and decreases in water production were greater in the Cody Shale than in either the Mesaverde Formation or the lower unnamed member of the Fort Union Formation, (3) the gas production rate declined more slowly in the lower part of the Fort Union Formation than in the Cody Shale or the Mesaverde Formation, (4) changes in gas and water production were not related to their initial production rates, and (5) there appears to be no relation between well location and the magnitudes or trends of gas and water production.

To explain the apparent independence of gas and water production in the Cody Shale and Mesaverde Formation, a two-step scenario is proposed: (1) gas was generated and emplaced under the compressive stress regime resulting from Laramide tectonism, and (2) fractures formed during a subsequent period of stress relaxation and extension. Gas is produced from the pore and fracture system near the wellbore, whereas water is produced from a larger scale system of extension fractures. The distribution of gas and water in the lower Fort Union resulted from a similar scenario, but continued generation of gas during post-Laramide extension may have allowed its more widespread distribution. The USGS Scientific Investigations Report is available at http://pubs.usgs.gov/sir/2008/5225/ .

Regional Stratigraphy and Petroleum Systems of the Illinois Basin, U.S.A.

This publication combines data on Paleozoic and Mesozoic stratigraphy and petroleum geology of the Illinois Basin, U.S.A., in order to facilitate visualizing the stratigraphy on a regional scale and visualizing stratigraphic relations within the basin. Data are presented in eight schematic chronostratigraphic sections arranged approximately from north to south, with time denoted in equal increments along the sections, in addition to the areal extent of this structural basin. The stratigraphic units shown are colored according to predominant lithology in order to emphasize general lithologic patterns and to provide a broad overview of the Illinois Basin. For the purpose of comparison, three columns show schematic depictions of stratigraphy and interpreted events in the Illinois Basin and in the adjacent Michigan and Appalachian Basins. The USGS Scientific Investigations Map is available at: http://pubs.usgs.gov/sim/3068 .

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OIL SHALE

http://energy.cr.usgs.gov/other/oil_shale/

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Intertonguing of the Lower Part of the Uinta Formation with the Upper Part of the Green River Formation in the Piceance Creek Basin During the Late Stages of Lake Uinta

During most of middle Eocene time, a 1,500-mi^2 area between the Colorado and White Rivers in northwestern Colorado was occupied by the Piceance lobe of Lake Uinta. This initially freshwater lake became increasingly saline throughout its history. Sediments accumulating in the lake

produced mostly clay shale, limestone, and dolomite containing varying concentrations of organic matter. At the time of the maximum extent of the lake, the organic-rich Mahogany bed of the Green River Formation was deposited throughout the area. Fluctuation of the shoreline resulted in the intertonguing of the stream sediments of the lower part of the overlying Uinta Formation with the lacustrine sediments of the upper part of the Green River over a distance of about 40 mi; construction of regional stratigraphic cross sections show the pattern of intertonguing in considerable detail.

The data utilized in this study, which covered parts of Rio Blanco, Garfield, and Mesa counties, were derived from geologic mapping of thirty-four 7 ½-minute quadrangles (scale 1:24,000) and stratigraphic studies by geologists of the USGS, and shale-oil assay information from numerous cores.

Middle Eocene strata above the Mahogany bed in the northern part of the study area are dominantly coarse clastics of the Uinta Formation. The sedimentary sequence becomes more calcareous and organic-rich to the south where, in a 400-mi^2 area, a 250 ft- thick sequence of oil shale above the Mahogany bed contains an average of 16 gallons of oil per ton of shale and is estimated to contain 73 billion barrels of oil. The USGS Scientific Investigation Report is available at: http://pubs.usgs.gov/sir/2008/5237/ .

Nahcolite Resources in the Green River Formation, Piceance Creek Basin, Northwest Colorado

The USGS recently completed an assessment of in-place nahcolite resources that are present in the oil shale deposits of the Parachute Creek Member of the Eocene Green River Formation in the Piceance Basin, northwestern Colorado. Nahcolite is present as disseminated aggregates and nodules, bedded units of disseminated brown crystals, and white crystalline beds associated with dawsonite and halite. The nahcolite-bearing facies are divided into an unleached part containing the nahcolite and halite, which is estimated to be as much as 1,130 ft thick, and an upper leached part several hundred feet thick containing minor nahcolite aggregates and nodules.

USGS assessed the nahcolite resources in the lower and middle parts of the Parachute Creek Member in the north-central part of the basin.

In some areas, nahcolite is economically minable as a separate commodity. However, because most of the nahcolite forms in variable sized aggregates scattered through oil shale beds, in most areas it is subeconomic unless recovered as a coproduct of oil shale extraction. Oil shale zones R–3, R–4, L–4, and R–5 in the Parachute Creek Member, from 150 to about 370 ft thick, contain the largest amounts of nahcolite by weight; in-place estimates are shown by township. Total amount of in-place nahcolite in the member, as extrapolated from the estimated mineral contents of 58 core holes, is about 43.3 billion short tons. The USGS Fact Sheet is available at: http://pubs.usgs.gov/fs/2009/3011/ .

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SOCIAL MEDIA

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Follow Us On Twitter!
We are now on Twitter. Get latest news, recent publications, data releases, website updates, upcoming events and much more by following us at http://twitter.com/usgsenergy.

Announcing EnVision: A New Energy Geospatial Webmap Portal
EnVision, a state-of-the-art online interactive mapping application, was recently released; it provides map-based access and single point-of-entry to our collection of maps and geospatial data assets. Based on the latest Web2.0 technologies, EnVision is flexible and scalable, works on all computer platforms and browsers, and is expanding as needed to include new tools, data types, and energy commodities. Highlights include:

- Improved Web2.0 design
- High-performance
- Enhanced navigation
- Easy-to-use interface design
- Customizable based on your specific interests.

We are currently working to improve the content, capabilities, and functionality of EnVision. The current release (Build 06.30.2009) features some of the following content and functionality:

http://tinyurl.com/nk2jdg -- Single click assessment summary and access to domestic conventional and continuous oil and gas assessments as well as access to the recently released geothermal assessment. Select one of the commodities from the dropdown menu provided and click on a feature to get assessment values.

http://tinyurl.com/mgsefm -- Access to global surficial geologic maps provided in support of the 2000 World Petroleum Assessment. Access to metadata, a map legend, and map transparency functionality is gained by clicking on the "Layer Details" and "Layer Transparency" toggles within the map list widget.

http://tinyurl.com/nvuzxf -- U.S. Historical Oil and Gas Production

http://tinyurl.com/n4eh5a -- Wyoming Landscape Conservation Initiative

Stay informed about new releases, system status, new content and more by following EnVision using the Energy Program Twitter profile (http://twitter.com/usgsenergy) and the #erpenvision hashtag.

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WORLD PETROLEUM

http://certmapper.cr.usgs.gov/rooms/we/index.jsp

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Assessment of Undiscovered Petroleum Resources of the Barents Sea Shelf

In 2009 the USGS completed an assessment of potential undiscovered, technically recoverable crude oil, natural gas, and natural gas liquid resources in the Barents Sea Shelf. These resources are assumed to be recoverable regardless of the presence of sea ice or depth of water. As with other areas assessed in the USGS Circum-Arctic Oil and Gas Resource Appraisal, this area shares important characteristics with many Arctic basins, such as sparse data, high geologic uncertainty, substantial petroleum-resource potential, and technical barriers that impede exploration and development.

The assessment resulted in estimated mean volumes of a probability distribution of approximately 11 billion barrels (1,750 million cubic meters, equivalent to 1,500 million metric tons) of crude oil, 380 trillion cubic feet (11 trillion cubic meters) of natural gas, and 2 billion barrels (320 million cubic meters, equivalent to 270 million metric tons) of natural gas liquids. Most undiscovered petroleum is estimated to be in the East Barents Basins Province. A USGS Fact Sheet summarizing the results is available at: http://pubs.usgs.gov/fs/2009/3037/ .

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RECENT PUBLICATIONS

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National Coal Resource Assessment, Chapter B, *in* **The National Coal Resource Assessment Overview**
U.S. Geological Survey Professional Paper 1625-F
http://pubs.usgs.gov/pp/1625f/downloads/ChapterB.pdf

An Introduction to Coal Quality, Chapter C, *in* **The National Coal Resource Assessment Overview**
U.S. Geological Survey Professional Paper 1625-F
http://pubs.usgs.gov/pp/1625f/downloads/ChapterC.pdf

Coal Resource Availability, Recoverability, and Economic Evaluations in the United States - A Summary, Chapter D, *in* **The National Coal Resource Assessment Overview**
U.S. Geological Survey Professional Paper 1625-F
http://pubs.usgs.gov/pp/1625f/downloads/ChapterD.pdf

Coal Marketability: Current and Future Conditions, Chapter E, *in* **The National Coal Resource Assessment Overview**
U.S. Geological Survey Professional Paper 1625-F
http://pubs.usgs.gov/pp/1625f/downloads/ChapterE.pdf

National Coal Resource Assessment: Estimates of Uncertainty, Chapter F, *in* **The National Coal Resource Assessment Overview**
U.S. Geological Survey Professional Paper 1625-F
http://pubs.usgs.gov/pp/1625f/downloads/ChapterF.pdf

Estimation of Coal-Cleaning Costs: A Spreadsheet-Based Interactive Software for Use in the Estimation of Economically Recoverable Coal, Chapter G, *in* **The National Coal Resource Assessment Overview**
U.S. Geological Survey Professional Paper 1625-F
http://pubs.usgs.gov/pp/1625f/downloads/ChapterG.pdf

Production and Depletion of Appalachian and Illinois Basin Coal Resources, Chapter H, *in* **The National Coal Resource Assessment Overview**
U.S. Geological Survey Professional Paper 1625-F
http://pubs.usgs.gov/pp/1625f/downloads/ChapterH.pdf