

Hugoton Asset Management Project

An Industry - University Study of Reservoir Systems in Southwest Kansas Hugoton Embayment and the Oklahoma Panhandle

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SUMMARY OF KEY INFORMATION

Name: Hugoton Asset Management Project

Location: Energy Research Center and Kansas Geological Survey (KGS); University of Kansas Center for Research (KUCR); University of Kansas (KU)

Project Co-Managers: Martin K. Dubois and Timothy R. Carr

Membership Fees:

Full Sponsor (Major Company): \$30,000 per year, renewable for additional year(s).

Associate Sponsor (Small Independent): \$10,000 per year, renewable for additional year(s).

Benefits: Joint KU/Sponsor Project
Ongoing collaboration with personnel at KUERC and KGS
Real-time interaction and resolution of technical questions

Principle Goals:

- Develop comprehensive geologic and engineering models for the Permian Council Grove (Panoma Field) and Chase Groups (Hugoton Field).
- Perform focused simulation studies on Sponsor defined problems in the Permian gas reservoirs and in regions identified as anomalous.
- Develop a web-based, dynamic catalogue of pre-Permian oil and gas pools of the Hugoton Embayment.
- Expand the Panoma (Council Grove) study to the Oklahoma Panhandle and the Hugoton (Chase Group) to the Oklahoma and Texas Panhandles.

Kansas Geological Survey technical team:

Martin Dubois	Project co-manager, petroleum geology, modeling
Timothy Carr	Project co-manager, petroleum geology;
Alan Byrnes	Core petrophysics,
Geoff Bohling	Geostatistics, programming
Saibal Bhattacharya	Petroleum engineering, simulation
John Doveton	Log petrophysics
Melissa Moore	Data management
Other KGS Personnel	Technical support

Sponsor technical team members:

Sponsors may select scientists to work collaboratively with the Kansas Geological Survey technical team in order to leverage the technical expertise of Sponsor staff for the benefit of the group, to insure appropriate and timely outcomes, as well as provide smooth technology transfer to the Sponsors.

BACKGROUND AND OUTLINE OF TECHNICAL COMPONENTS

The Hugoton and Panoma Fields (Figure 1), Permian Chase and Council Grove Groups, respectively, are premier natural gas resources and constitute the largest gas producing area in North America. Since 1928, the gas fields of southwestern Kansas, including Hugoton, Panoma, Bradshaw and Byerly, have produced 27 trillion cubic feet of gas. These reservoirs are economically important to the State of Kansas and major gas producers, including the Sponsors in this project. Even with a long history of substantial production, there is no publicly available field-wide study of how best to explore, produce, and regulate the Permian gas reservoirs. This study is designed to provide the knowledge and technical base required for intelligent stewardship, generation of new opportunities, and continued improvement in recovery strategies in the Hugoton and Panoma Fields. Results of earlier collaborative work by the Sponsors and the Kansas Geological Survey (under the Hugoton Initiative project) demonstrate that the entities work together effectively to generate useable digital data and solve technical problems (see Council Grove (Panoma) reservoir poster at <http://www.kgs.ku.edu/PRS/publication/2003/ofr2003-30/index.html>). By utilizing digital well data (tops and LAS files), cores, and core analyses organized under the auspices of the Hugoton Initiative, the Sponsors and KGS are well on their way towards efficiently and accurately modeling a very large and complex reservoir system. This earlier work involved the development of 1) extremely large set of digital data (e.g., horizon tops, pressure and production data), 2) core based facies classification scheme that is tied to petrophysical properties; 3) empirically derived, facies-constrained porosity-permeability-saturation equations; and 4) geostatistical facies prediction and processing methods, all critical input data for 3D modeling work.

In close collaboration with the Sponsors, we propose to complete the Panoma (Council Grove) reservoir model through simulation, and to leverage the knowledge gained to model the Hugoton (Chase) in a similar manner. Functional, accurate models and simulations based on sound science and engineering and should 1) answer fundamental questions regarding the continuity of the two reservoir systems that are regulated separately; 2) provide a technical basis for improved reservoir management and improved regulation; and 3) assist placement decisions for replacement and/or infill wells.

Deeper oil and gas pools of the Hugoton Embayment are also a significant and increasingly important asset to the Sponsors and the State of Kansas. For the purposes of this project, the Hugoton Embayment is defined as the 15 southwestern counties of Kansas (i.e., Finney, Grant, Gray, Greeley, Hamilton, Haskell, Kearny, Lane, Meade, Morton, Scott, Seward, Stanton, Stevens, and Wichita). While the Hugoton Embayment Permian produce 75% of Kansas gas it also yields half the annual non-Permian gas production and nearly a fourth of the oil production. The proposed catalogue of the pre-Permian oil and gas pools (Deep Pools of the Hugoton Embayment – DPHE) will provide basic production, geologic and engineering data on the deep pools of the region and serve it conveniently, online. In addition to static basic data the web-based catalogue of pools will provide dynamic maps and data visualization pages that pull data directly from the Kansas Geological Survey database in real time. The catalogue will be linked to the KGS data system providing a convenient portal to a suite of online tools available on the KGS web site. The KGS will draw on its existing tools and experience in web-based applications like those in the Digital Petroleum Atlas (see

Panoma and Hugoton Modeling and Simulation

2003	Dec. 1	Initiate project
2004	June 1	Council Grove modeling complete simulation underway. Chase geomodel under construction.
	Dec.1	Council Grove modeling and simulation completed and technical papers submitted for publication. First Chase geomodel completed. <i>Decision on whether to proceed with year two of project.</i>
2005	June 1	Second Chase geomodel completed and simulation underway.
	Dec. 1	Chase modeling and simulation complete. Technical papers submitted for publication.

Deep Pools of the Hugoton Embayment

2003	Dec.1	Initiate project; Morrow pools
	June 1	Prototypes completed and online
	Dec.1	All Morrow pools completed and online <i>Decision on whether to proceed with year two of project.</i>
2004	Dec. 1	Other deep pools completed

Technical Products

Specific technical end products provided by the KGS for both the **Council Grove and Chase modeling** and simulation are anticipated to include:

- 1) Core-based digital rock classification scheme and digital rock catalogue.
- 2) Core analyses (conventional and special) database from collected and internally generated sources.
- 3) Empirically derived equations tied to lithofacies for porosity-permeability and porosity-saturation transforms.
- 4) Artificial intelligence facies prediction models (neural network in Kipling.xla) and batch processing software.
- 5) Geologic/stratigraphic framework to the formation/member scale for the entire Hugoton-Panoma area and free water level map for both fields.
- 6) Complete geologic and petrophysical data sets, transform equations, facies biasing maps, and parameters required for 3D geomodeling and simulation.
- 7) Three-dimensional, stochastic cellular models with facies, porosity, permeability and saturations that are appropriately upscaled for simulation studies.
- 8) Simulation studies for areas and at scales selected by Sponsors and the KGS.

Specific technical end products provided by the KGS for the **Deep Pools of the Hugoton Embayment**, a web-based dynamic catalogue of all deep (pre-Permian) pools having in excess of one MBOE ultimate recovery, will include the following:

- 1) General data in static format including, but not limited to, discovery well and date, reservoir parameters (e.g.: thickness, average porosity, permeability, BHT and water resistivity), fluid analysis (water, oil, gas), general well and pool drilling completion and production practices, and core and thin section images.
- 2) Dynamic links to production data and associated display tools.
- 3) Dynamic well profiles with standard log curves as well as other data when available.
- 4) Dynamic well location and geologic maps.
- 5) Dynamic cross sections.
- 6) Other visualization and data assembly tools as they become available.
- 7) Convenient links to other applications, data and visualization tools on the KGS web site.

Interaction and Reporting

An important aspect of the project is collaboration between the Sponsor(s) and the KGS and unfettered access to the people doing the project work at the KGS. This is crucial in the short term for refining and executing the project plan. In the longer term both Sponsor(s) and KU/KGS personnel benefit from interaction. Since the proposed study is a truly collaborative effort, data transmission and direct communication will be ongoing as needed. More formal meetings will be scheduled as follows:

- 1) Regularly scheduled (bi-monthly) conference calls between technical team members.
- 2) Work session meetings where technical team member(s) travel to the other's site as required for effective collaboration and transfer of ideas and data.
- 3) Bi-annual meetings of technical team and other interested parties from KGS and Sponsors will be scheduled either in Dallas, Houston or Lawrence.

Technical Publications

Ongoing reports will be made public through paper and poster and presentations at professional society technical meetings. Submission of article(s) to scientific journals is anticipated.

Budget

Sponsor(s) cost for the project, excluding their own personnel, outside consultant fees, and any additional data purchased, is \$365,000.

KGS Personnel and Infrastructure

KGS researchers involved have broad petroleum geology and computer experience and have a long track record of addressing geological, geophysical, petrophysical and petroleum related question in Kansas and the Hugoton-Panoma area. A large number of the key personnel have extensive practical petroleum industry experience. Individual resumes are available on request.

The Kansas Geological Survey and KU Energy Research Center have an extensive computer network with all the necessary hardware and software to successfully undertake the project. A complete list of all computing assets and other technical equipment available to the project is available on request.

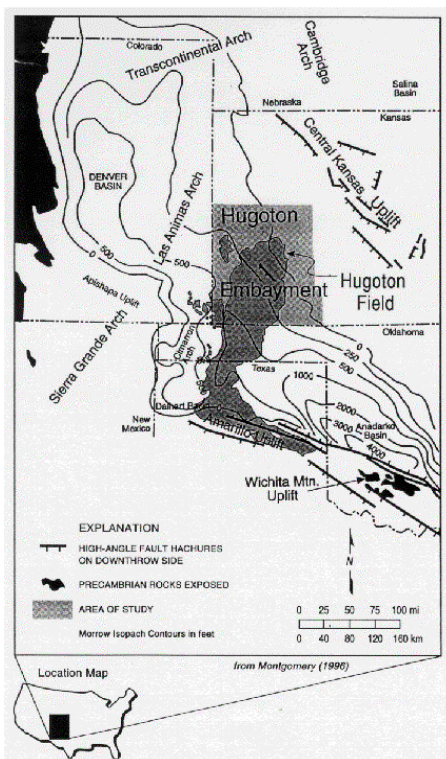


Fig. 1 – Regional tectonic map of the Hugoton Embayment of the Anadarko Basin. The Kansas portion of the Hugoton-Panoma Modeling Project is light shaded. Darker shading covers the entire Hugoton-Guymon-Panhandle Fields (KS, OK, and TX)