

Development of a Predictive Resource Model for Bacterial Gas Systems

Phase 1: GIS catalog of known worldwide accumulations of bacterial gas

- Overall Project Goals**
1. Build worldwide bacterial gas ARC-GIS database;
 2. examine bacterial gas contribution in petroleum conventional reservoirs, coal beds and shale gas plays;
 3. collect new gas samples for detailed gas analysis;
 4. distinguished “dead” vs “alive” bacterial gas reservoirs;
 5. undertake 1st order multi-dimensional basin models to examine migration, mixing, and uplift scenarios; and
 6. develop predictive resource model for bacterial gas system.
-

Introduction

It is estimated that 20% of the hydrocarbon gases found in subsurface reservoirs consist of bacterial gases (Rice, 1993). For most petroleum explorers, bacterial gas has not been considered a major petroleum resource. However, recent discoveries around the world (e.g., Godavari Delta, east coast India, 7-10 TCF and Columbus Basin, offshore Trinidad, 20 TCF) have shown that bacterial gas can be a very important component in some petroleum systems. Gas reservoirs may consist of relatively pure bacterial gas or a mixture of bacterial and thermogenic gases. Biodegradation, which was previously believed to be primarily an aerobic process, has been identified as secondary sourced for bacterial gas under anaerobic conditions (Head et al., 2003; Larter and di Primio, 2005). Our current understanding of bacterial gas is based on old concepts and requires a fresh examination. Some key questions are:

- What is the timing of bacterial gas generation (early or late)?
 - Is reservoir bacterial gas generated in-situ (within reservoir system) or derived from external sources and migrated to the trap?
 - What are the molecular signatures (gas composition and stable isotopic values) for bacterial gas derived from different settings (gas reservoirs, from biodegraded oils, coal beds, gas shales)?
 - Which basin type and history are more likely to have major bacterial gas contributions?
 - What are the importance of methane solubility and basin tectonics on accumulation?
-

Project Plan

Phase I (6months): Build a GIS catalog and make empirical observations

1. Develop a comprehensive bacterial gas database from worldwide petroleum bearing systems (conventional reservoirs, coal beds and gas shale plays). For each accumulation the database will include (if available):
 - a. **Geological Data:**
 - Location/basin
 - Key fields
 - Reserves estimates
 - Geological setting
 - Reservoir age and depth ranges
 - Reservoir temperature
 - Possible source rock
 - Reservoir temperature
 - b. **Geochemical Data:**
 - Gas molecular compositions (hydrocarbon and non-hydrocarbon components)
 - Gas molecular stable isotopic composition ($\delta^{13}\text{C}$ and $\delta^2\text{H}$)
 - c. **Key References**
 - Electronic copies (pdf) of key references
2. Look for common basin development and biological themes.
3. Develop working predictive exploration model based on worldwide empirical observations and charge models.

Data will be obtained from:

- published studies
 - government databases
 - EGI research reports
 - available sponsor datasets
-

Phase II (12months): Develop predictive bacterial gas model

1. Collect new gas samples for geochemical analysis in properly understood regions.
 2. Distinguish “dead” vs “alive” bacterial gas systems using biomarkers;
-

Project plan, cont.

3. Undertake 1st order multi-dimensional basin models in selected regions, to examine migration, mixing, and uplift scenarios;
4. Undertake collaboration with microbiologists and geochemists from various organizations to develop a better understanding of conditions needed for formation and accumulation of economic volume of bacterial gas. Key external researchers to include:
 - Dr. Michael Whitticar, geochemist at University of Victoria, noted biogeochemist who published a number of key papers on the formation of bacterial gas in subsurface.
 - Dr. Steven Larter, geochemist at University of Calgary, well known petroleum geochemist who is an expert biospheres and bacterial alteration of oils.
5. Develop a predictive bacterial gas resource model and identify possible regions/basins worldwide for future bacterial gas exploration.

NOTE: Actual research project plan and deliverables may vary based on input from initial research project sponsors.

Phase I Deliverables

1. Area specific regional maps (Arc-GIS)
 2. Hard copy and digital summary report
 3. Geological and geochemical data for study areas
 4. Project review (MS PowerPoint) and final meeting/workshop
-

Phase I Staff

Staff	Function
Kim Manzano-Kareah	Principal Investigator/ petroleum geochemist
Michael Abrams	Senior geochemist/petroleum systems
Richardson Pitch Allen	Basin analysis-regional geology
Christopher Kessler	Data management (Arc-GIS)
Kristin Malmstrom	Literature search

**Cost estimate
for Phase 1**

Budget Item	Cost
EGI Salaries Michael Abrams Kim Manzano-Kareah Richardson Pitch Allen Christopher Kesler Kristin Malmstrom EGI student researchers	\$ 119,375
Other Costs	\$ 23,584
Total Budget	\$ 142,959

Phase I cost per sponsors (assumes 7 sponsors) = **\$20,423**

**Phase I
Schedule**

October 30, 2006: Send Phase I proposal to Corporate Associates
Dec 15, 2006: Deadline for sponsorship
Jan 12, 2007: Phase I kick off meeting
June 15, 2007: Phase I completion
July 16, 2007: Phase II proposals

EGI contact

Kim Manzano-Kareah
Energy & Geoscience Institute
423 Wakara Way Suite 300, University of Utah
Phone: 801-581-6739
E-mail: kmkareah@egi.utah.edu
