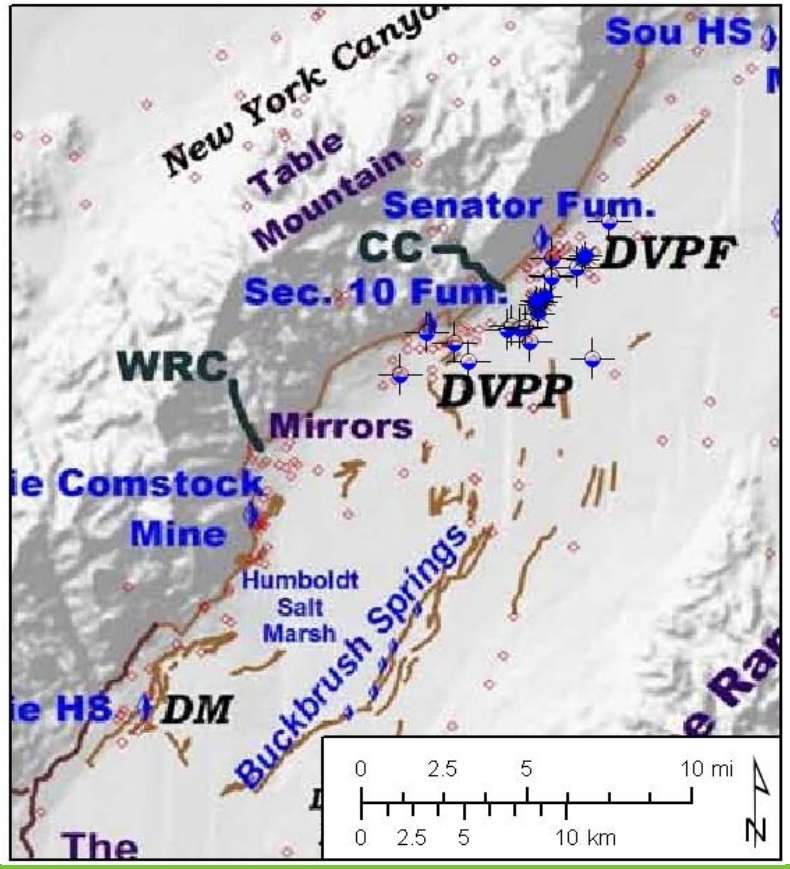
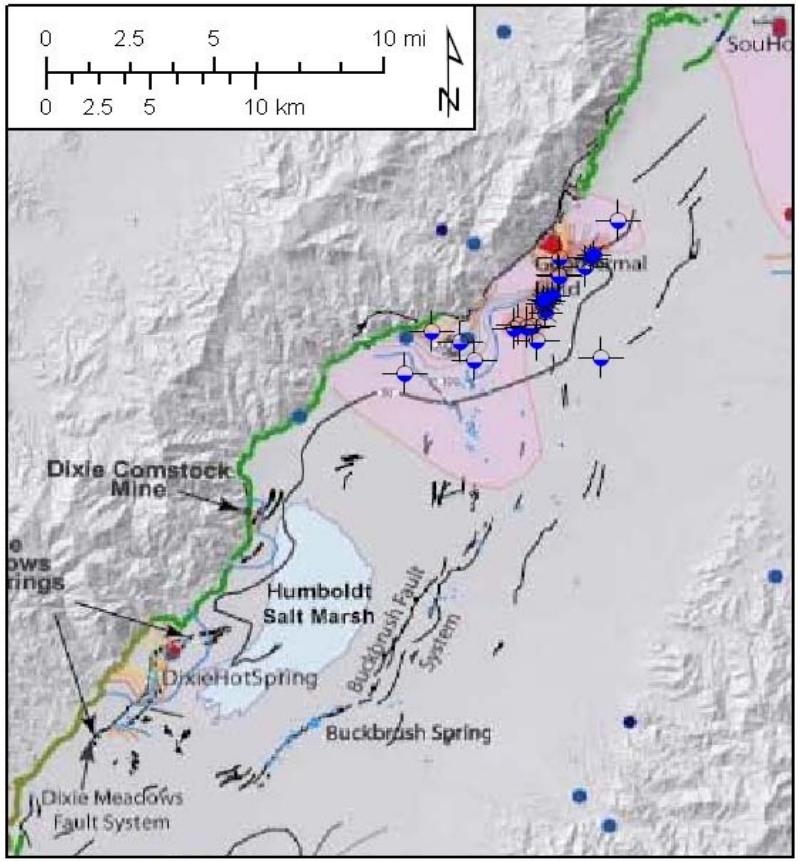




Development of Exploration Methods for Engineered Geothermal System through Integrated Geoscience Interpretation

May 19, 2010,

Joe Iovenitti

AltaRock Energy Inc.

Tracer and Technologies

This presentation does not contain any proprietary confidential, or otherwise restricted information.

Overview

Project Timeline

Start Date	End Date	Percent Complete
May-10	Dec-12	0

Budget

Total Project	DOE Share	AltaRock Energy Inc.
$1,975,640	$1,449,712	$525,928

- *Funding Received in FY09:* $ 0
- *Funding for FY10 (4-30-2012):* $1,450,120

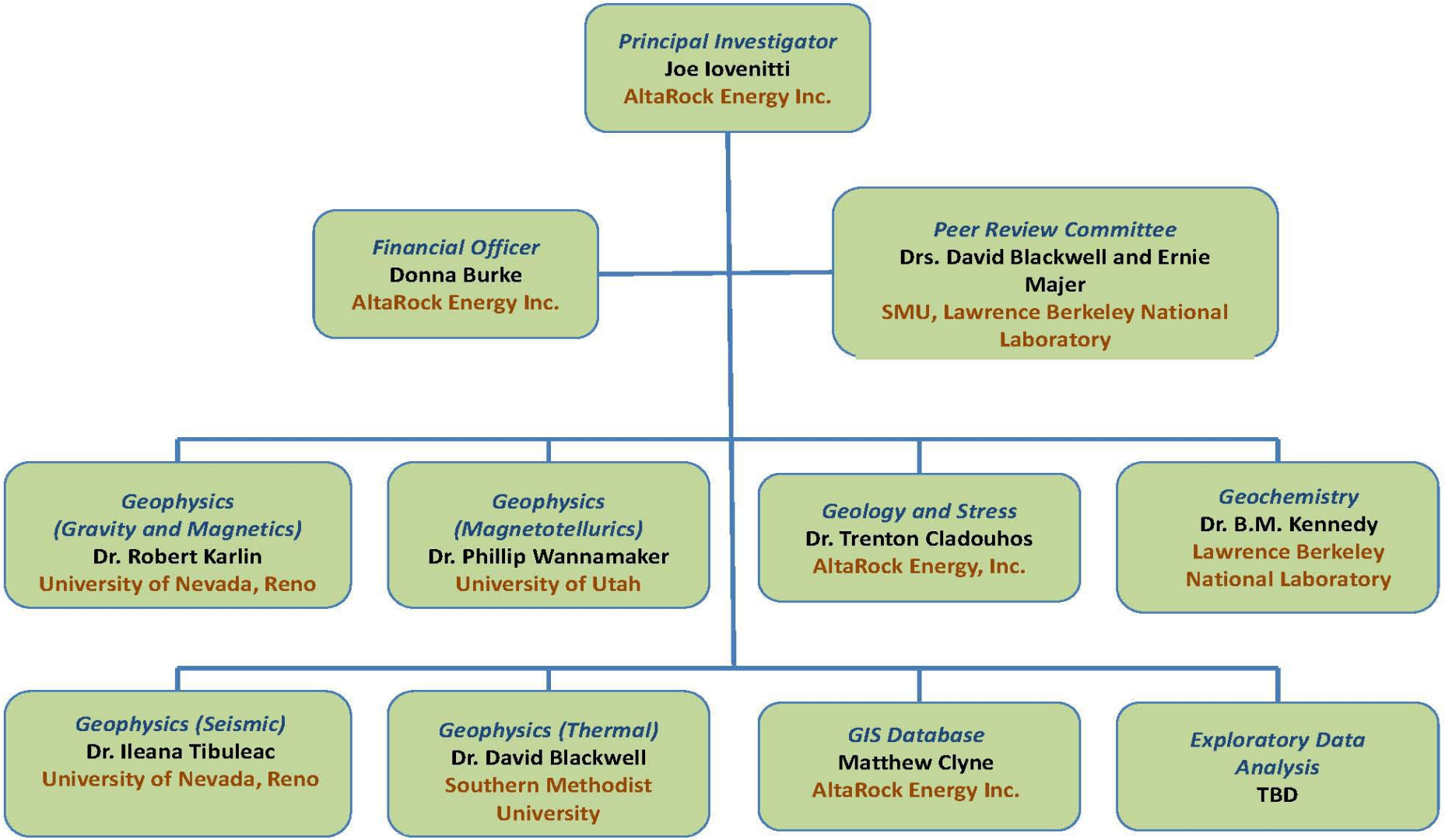
Barriers

- Negotiate performance end date from 2-2012 to 12-2012 due to when funding was received
- Obtaining BLM NEPA Determination Timely
- Fair weather for field work

Partners

University of Nevada, Reno	Univeristy of Utah	Southern Methodist University
Lawrence Berkeley National Laboratory		

Organizational Chart



Relevance/Impact of Research

PROJECT OBJECTIVES

- *Cost Impacts*—Exploration costs will decrease, probability of meeting drilling objectives will increase
- *Innovative Aspects*
  - Developing interdisciplinary method for synthesizing, integrating, and evaluating geoscience data
  - Demonstrating new seismic techniques based on ambient noise
    - Technique does not require local earthquake data
    - Inexpensive method to image subsurface
  - Extending 2-D MT modeling and mapping to 3D and generating a – derived temperature map
  - Jointly inverting gravity, magnetic, seismic, and MT data to reduce non-uniqueness of geophysical data
  - Coupling He-data with other geochemical measurements to generate a subsurface temperature map

Scientific/Technical Approach

- **Deploy, Test and Calibrate Non-invasive EGS Exploration Methodology** integrating geoscience data to predict temperature and rock type at a scale of 5km x 5km at depths of 1-5km
- **Use Statistical Methods** to minimize the uncertainty and non-uniqueness associated with the interpretation
- **Employ Subject Matter Experts** to synthesize and interpret the information into a conceptual EGS model that can be used to infer temperature, rock composition, and stress at the depths of interest.
- **Project Tasks and Milestones** – straight-forward and logical
  - Task 1—Collect and Assess Existing Public Domain Data
    - Compile and assess the data relevant for the project
  - Task 2—Design and Populate a GIS Database
    - Produce a GIS database populated with relevant data
  - Task 3—Statistically Assess Public Domain Data (from Task 1)
    - Statically robust data set and development of baseline calibrated model and baseline EGS favorability map

Scientific/Technical Approach

- Task 4—Collect "New" Field Data to Improve Model Resolution
  - High-resolution dataset merged with existing (baseline) dataset

Go/No-go Decision: Based on the analysis of the existing and newly acquired data, is it appropriate to go forward

- Task 5—Develop Enhanced Conceptual Model
  - Calibrated enhanced conceptual model, enhanced EGS favorability map, an assessment of the methodology used and degree of improvement between the baseline and enhanced conceptual models/favorability maps
- Task 6—Project Management and Reporting
  - Maintain schedule, publications/presentations at geothermal and scientific meetings, Decision Point Topical Report, and Final Report

Technical Feasibility

- AltaRock is teamed with Subject-Matter Experts (SMEs), most have worked in the study area, and are
  - Knowledgeable about existing data, methodologies, and improvements in the "state-of-the-art" to meet the Objectives

Scientific/Technical Approach

- Pre-proposal submission consensus among SMEs on the technical approach
- Project requires a coordinated effort to obtain data that can be compared and analyzed collectively
- GIS database will be prepared to retrieve, visualize, analyze, compare, and integrate the data

Accomplishments

- None at the time of this submittal

Team Qualifications

- Interdisciplinary team with expertise in all Project elements provides a high likelihood of Project success
  - *UNR (gravity, magnetic, & seismic)* - facilities for laboratory tests (if required), capabilities in field work, internal staff actively researching analytical, modeling, and field measurement techniques
  - *University Utah (MT)* - experience in survey design, exploring geothermal resources within the Basin and Range, and developing "state-of-the-art" quantitative MT resistivity inverse models
  - *SMU (thermal)* - extensive thermal characterization and modeling experience along with an extensive geoscience database on ixie Valley
  - *LBNL (geochemistry)* –extensive geothermal geochemistry and isotopic expertise

Project Management/Coordination

- **PI** has overall responsibility and accountability for the administrative, budget, technical, schedule, and reporting components of the project
- **Financial Officer** is responsible for financial tracking and reporting (e.g., SF-272 and SF-269A forms)
- **Peer Review Committee** is responsible for reviewing team progress, Decision Topical Report and Final Report and independent assessment of the scientific validity of work conducted
- **Task Leaders** are responsible for specific subject matter areas in their area of expertise; see organizational chart
- **Student Participation** in tasks with an University affiliation

Project Management/Coordination

- **Scientific/Technical Direction** coordinated through the PI
- **Publications** coordinated through the PI who has final authority
- **Intellectual Property Rights** remain with AltaRock, a qualified small business
- **Communication Plan**
  - PI will be the AltaRock single point of contact for DOE and will update DOE PM in a manner and frequency to be identified
  - Bi-weekly meetings between PI and the Task Leaders
    - Communication by e-mail and telephone calls, as required
    - Project staff will maintain a project notebook (electronic) to log activities and findings
- **Dispute Resolution** a tiered approach with disputes addressed at the lowest level, and if unsuccessful, then disputes will be escalated to the PI who has final authority

Project Management/Coordination

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- **Project Duration**: 2 years+

Task ID No.	Description	Duration
1	Collect/Assess Exisiting Public Domain Data	5/10 - 7/10
2	Design and Populate GIS-database	5/10 - 9/10
3	Statistically Assess Exisiting Public Domain Data	8/10 - 10/10
4	Improve Model Resolution at Dixie Valley	10/10 - 2/12
Go/No Decision		
5	Develop Enhanced Conceptual Model	2/12 - 7/12
6	Project Management and Reporting	4/30 - 12/18

Project Management/Coordination

Spend Plan

Task ID	Description	Budget
1	Collect/Assess Exisiting Public Domain Data	$238,914
2	Design and Populate GIS-database	$188,941
3	Statistically Assess Exisiting Public Domain Data	$39,809
4	Improve Model Resolution at Dixie Valley	$1,014,926
Go/No Decision		
5	Develop Enhanced Conceptual Model	$167,977
6	Project Management and Reporting	$325,481

Future Directions

- FY10
  - Task 1. Collect and Assess Existing Public Domain Data
  - Task 2. Design and Populate GIS Database
  - Task 3. Statistically Assess Existing Database
  - Task 4. Improve Model resolution at Dixie Valley (initiate)
- FY11
  - Task 4. Improve Model resolution at Dixie Valley
- Key Milestones
  - Geo-referenced, statistically valid database for the existing public domain (baseline) data
  - Baseline calibrated EGS conceptual model
  - Baseline EGS favorability map

Supplemental Slides

GTP Goals not outlined in MYRD&D

EGS EXPLORATION R&D

- Develop a comprehensive, interdisciplinary approach using existing (baseline) coupled with subject matter experts (SMEs) and baseline + newly acquired geoscience exploration data coupled with SMEs (enhanced) to determine the data combination(s) demonstrating the greatest potential for identifying EGS drilling targets using non-invasive techniques.
  - Proposed methodology expected to increase spatial resolution and reduce non-uniqueness inherent in geoscience data, thereby reducing uncertainty in the primary EGS selection criteria.
  - Statistical methods used to analyze uncertainty, non-uniqueness, and data inconsistencies, and assess the prediction capability of variables extracted from the data. SMEs will interpret available information into a conceptual EGS model with the goal of inferring temperature, rock composition, and stress at a scale of 5km x 5km at depths of 1-5km.
  - Comparative analysis Baseline and Enhanced EGS favorability maps to determine degree of improvement