Integrated Chemical Geothermometry System for Geothermal Exploration

May 18, 2010

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Track Name

Mandatory Overview Slide

- Timeline
  - Start FY10, Q2
  - End FY12, Q1
  - Just started (<1% complete)
- Budget
  - Total project funding: $450K
  - DOE share: $450K
  - Awardee share: N/A
  - Funds received for FY10: $43K
  - Funding for FY10: $216K
- Barriers: Site Selection
  - (A) Site Selection & Resource Assessment
  - (B) Site Characterization
- Partners
  - None

Relevance/Impact of Research

Project Objective

- Develop practical and reliable system to predict geothermal reservoir temperatures from integrated chemical analyses of spring and well fluids

Impacts

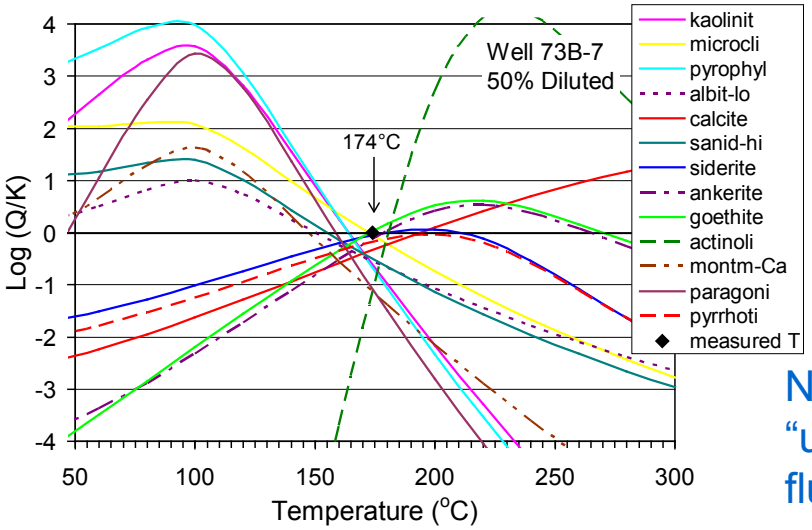
- See through near surface processes (e.g., dilution, gas loss, etc.), that mask the chemical signatures of deep reservoir temperatures
- More reliable assessment of target reservoir temperature (compared to classical chemical geothermometer interpretations)
- Reduce exploration and development costs

Innovation

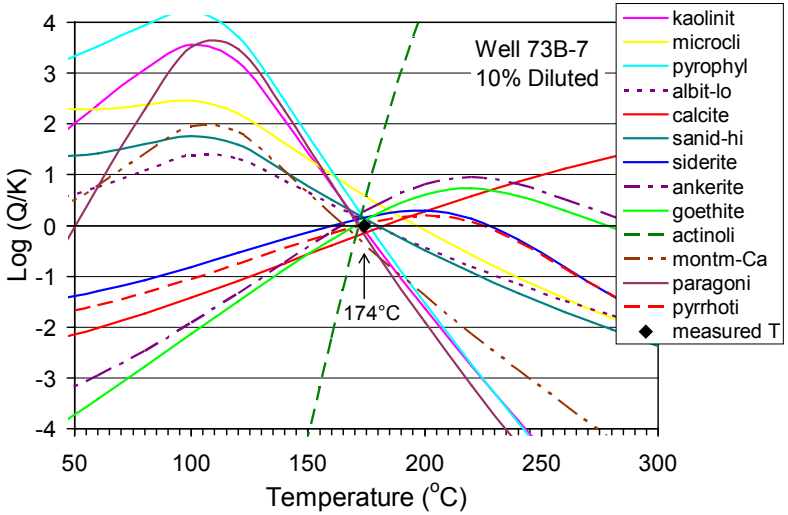
- Numerical optimization of multicomponent chemical geothermometry at multiple locations
- Integration with sophisticated geochemical and reactive transport modeling simulations

Scientific/Technical Approach

- Select/evaluate area for study (e.g., Dixie Valley, Nevada)
- Multicomponent chemical geothermometry with data from single features (springs, wells)
  - Evaluate geochemical trends in terms of dilution, gas loss and water-rock equilibration temperature (Reed and Spycher, 1984)



Numerically "undilute" the fluid



Example: effect of dilution
(Dixie Valley water)

Scientific/Technical Approach

- Optimize method for multiple locations
  - Multiple regression of multiple water analyses to yield:
    - Common reservoir temperature
    - Dilution factor and compositions of any mixing endmembers
    - Sink/source terms due to mineral precipitation/dissolution and gas loss
  - Rely on existing parameter estimation software such as iTOUGH2 (Finsterle, 2007) or PEST (Doherty, 2008)
- Reactive transport simulations
  - Evaluate mixing and reaction effects upon fluid ascension to surface for "synthetic" and real cases
- Test optimization system
  - "Synthetic" waters (from a hypothetical reservoir at a known T)
  - Real data sets (e.g., Dixie Valley)
- Implementation of optimization system into a useful software tool

Accomplishments, Expected Outcomes and Progress

- Progress to date
  - Just started FY10, Q2
  - Selected a target area – Dixie Valley, Nevada – Using geochemical data from Goff et al., 2002
  - Started on reviewing site hydrochemical data
  - Preliminary multicomponent chemical geothermometry runs
  - Started setup of reactive transport model
- Expected Outcomes
  - Publications (method and application to different geothermal systems)
  - Geothermometry software for application at various sites
- Team Qualifications
  - Long experience in hydrochemical data analysis, development and application of geothermometers, and geochemical/reactive transport model development and application

Project Management/Coordination

- Project Management:
  - PI: Nic Spycher, overall responsibility for project
- Schedule:

Tasks	FY10 Q2	FY10 Q3	FY10 Q4	FY11 Q1	FY11 Q2	FY11 Q3	FY11 Q4	FY12 Q1
1 Select target area	X							
2 Initial data evaluation	X	X	X					
3 RT Simulations		X	X	X				
4 Develop optimization		X	X	X*				
5 Testing/validation				X	X	X		
6 Finalize system/code							X	X*

- Progress report (FY11, Q1)
- Final report (FY12, Q1)

Project Management/Coordination

- Application of resources and leveraged funds/budget/spend plan:
  - Task 1: Evaluation and integration of geochemical Dixie Valley data (10%)
  - Task 2: Application of Reed and Spycher (1984) approach (30%)
  - Task 3: Incorporate reactive transport models (30%)
  - Task 4: Develop optimized tool (30%)

Mandatory Summary Slide

- New **integrated** chemical geothermometry system
- Relies on optimization of a **multicomponent** geothermometer using data from **multiple locations**
- Integration with sophisticated **geochemical and reactive transport** modeling simulations
- Implement method into a **practical software** tool
- M**ore reliable** assessment of target reservoir temperature than classical chemical geothermometers
- **Reduce costs** of geothermal exploration and development