



The BRIDGE Project – Hidden Systems Reconnaissance in Western Nevada

Paul Schwering, Thomas Lowry, Nicholas Hinz, Gabe Matson, Andrew Sabin, Kelly Blake, Jade Zimmerman, Steven Sewell, and William Cumming



BRIDGE = Basin & Range Investigations for Developing Geothermal Energy

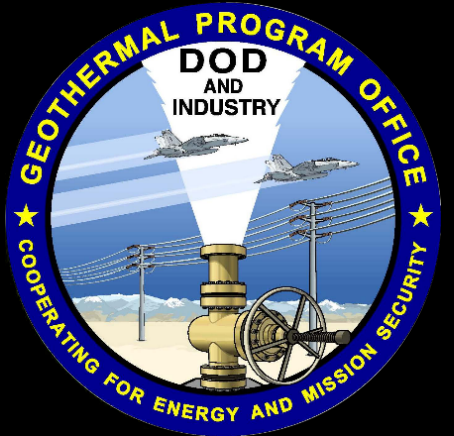


This is an overview of a multi-institution collaborative study in progress of west-central Nevada, USA funded by the Geothermal Technologies Office (GTO) of the DOE



Paul Schwering
Senior Geoscientist

**Sandia National
Laboratories**
Albuquerque, New Mexico,
USA



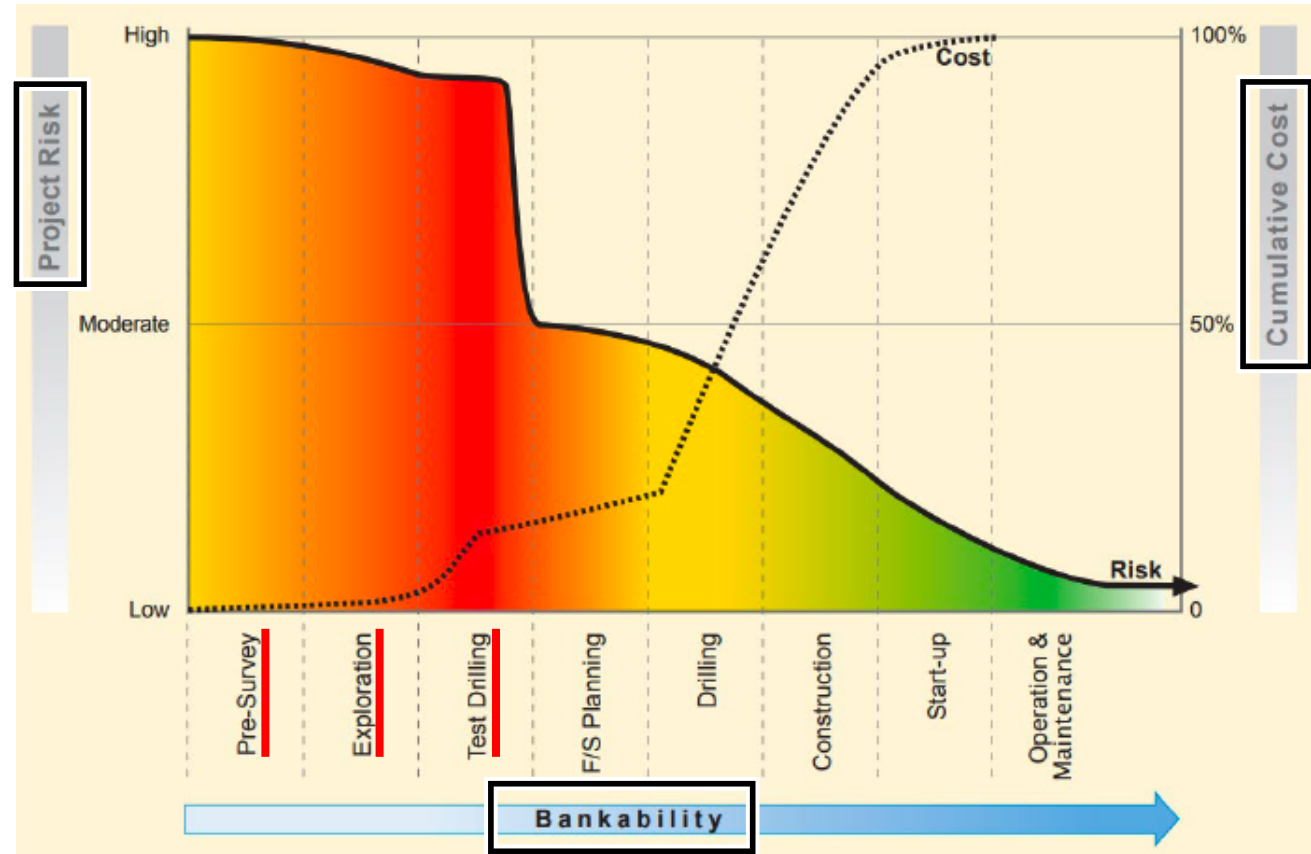
...and more to come!

Motivation – Hidden Geothermal Systems R&D



Why is this even a research & development priority?

- Project Risk – event or occurrence that may **negatively impact** the project
- Bankability – **financial obligation** to fund the project
- **Project risk is highest in the early phases!**
- **If risk too high → cost-prohibitive**



The Cost-Effectiveness Challenge

- **When my client asks if I can do it cheaper**



Gehring and Loksha, 2012 (from the DOE FOA)



Motivation – Hidden Geothermal Systems R&D

A case of the blind needing the blind

- Hidden (“blind”) resources
 - Traditionally discovered ‘by accident’
 - Numerous studies suggest prolific geothermal reservoirs lacking surface expression in the western US
 - *Need methods for intentional & successful discovery (reduce uncertainty, lower risk....)*
- What are the tools for discovery?
 - Exploration geophysics & geoscience
 - Conceptual & reservoir modelling

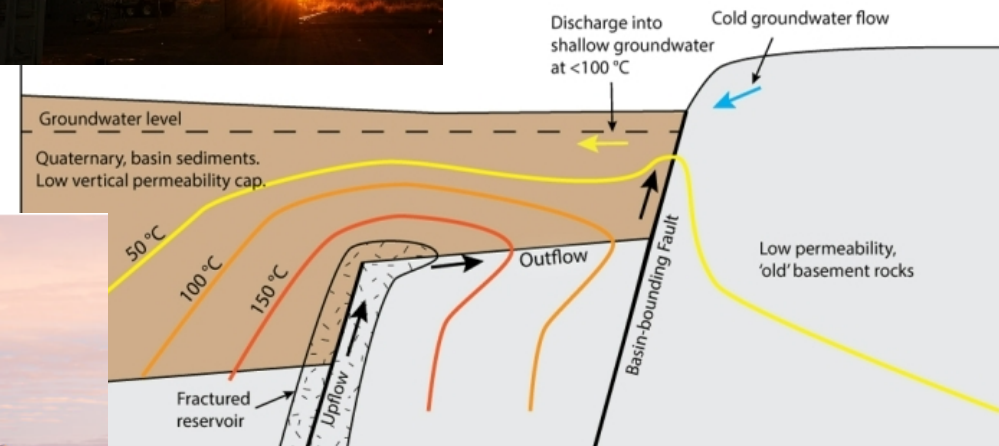


Ormat's 36 MW Don A. Campbell Geothermal Complex, Nevada, USA, a hidden system initially discovered during mineral exploration drilling

Three-Year Project Objectives

Our Purpose: reduce risk, increase success of exploration for hidden geothermal systems

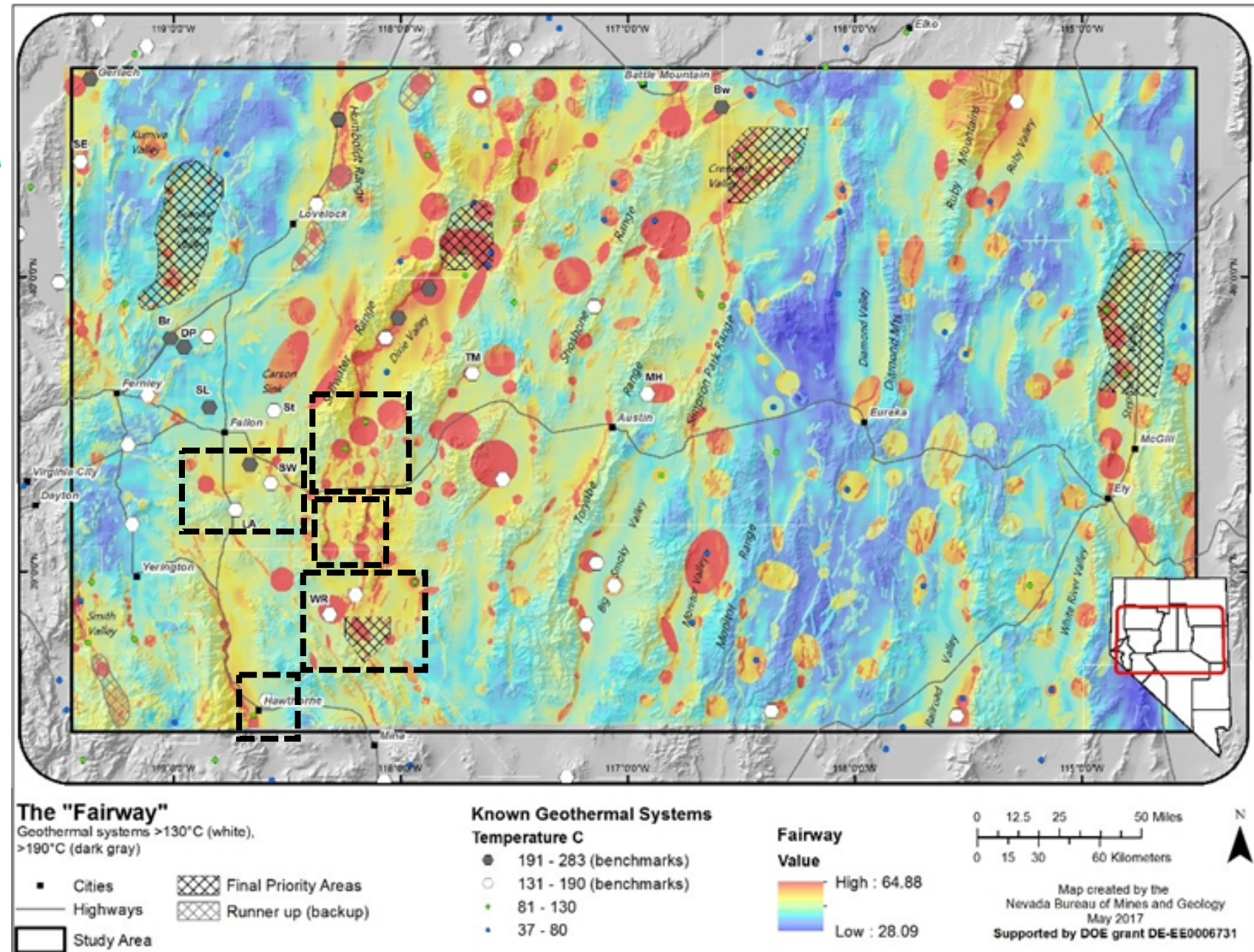
- Improved exploration technology
 - Regional prospecting
 - Statistical metrics for down-selection
- Facilitate conceptual modeling & verification
 - Data-driven resource visualization
 - Confirmation drilling of wells
- Mitigate non-technical barriers
 - Dept of Defense & Bureau of Land Mgmt territory
 - High-visibility exploration



Study Area

West-Central Nevada, USA

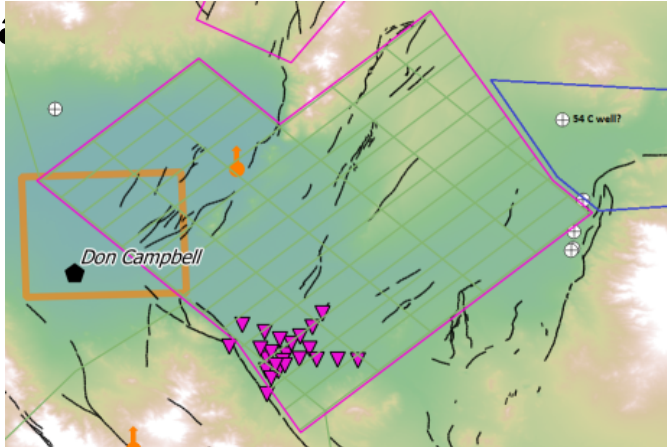
- Investigating southwestern portions of Nevada Play Fairway Analysis (Faulds et al., 2015)
- Region of both actively producing geothermal energy fields, nearly unexplored territory, and all points in-between!
- **Let's look at the methods and approach, as well as**



Methods & Approach

Phase 1: Prospect Reconnaissance

- Collate existing data from prospects highlighted by Play Fairway Analysis & other studies

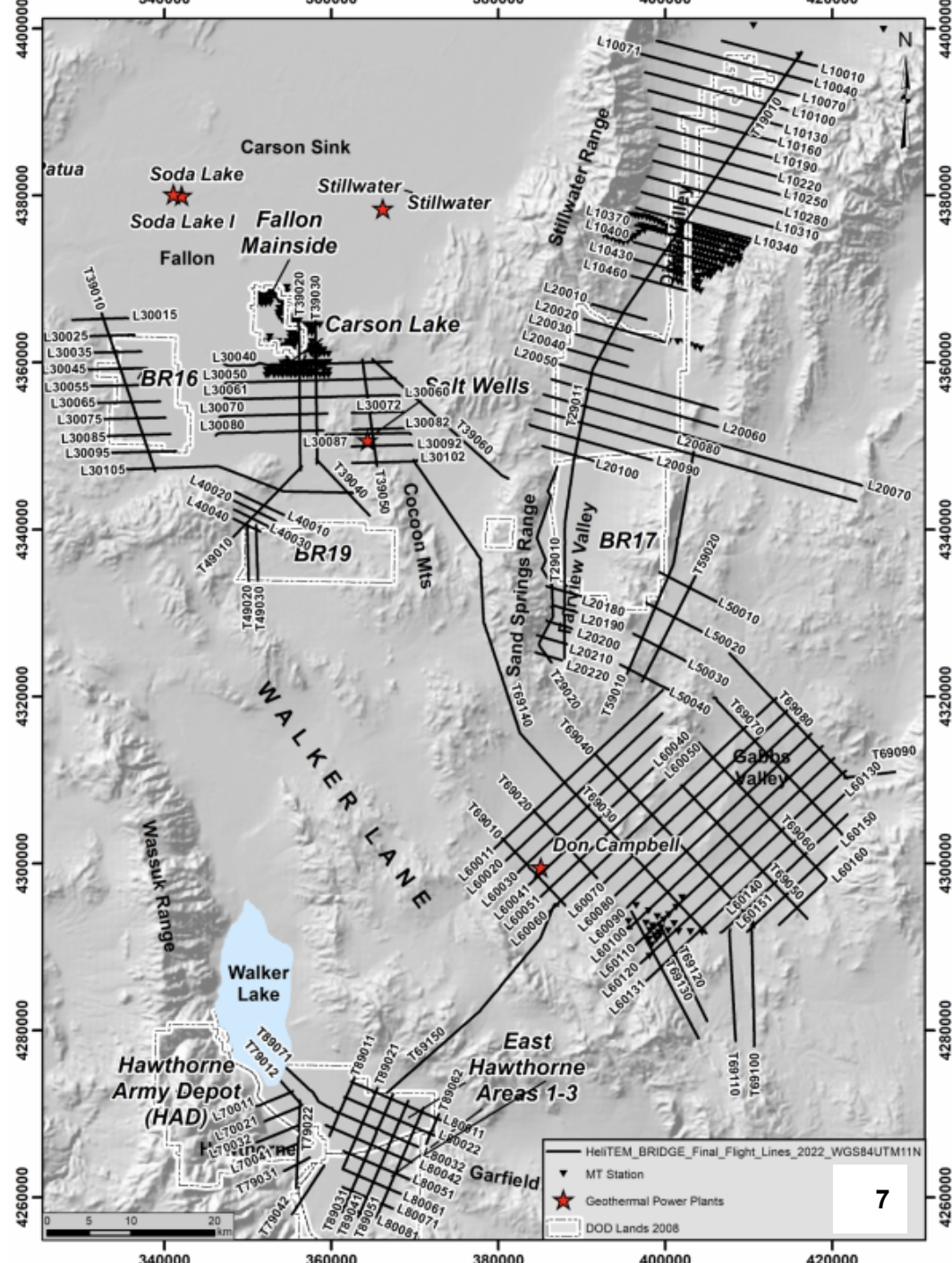


GIS review of existing data

- Helicopter time-domain elec surv

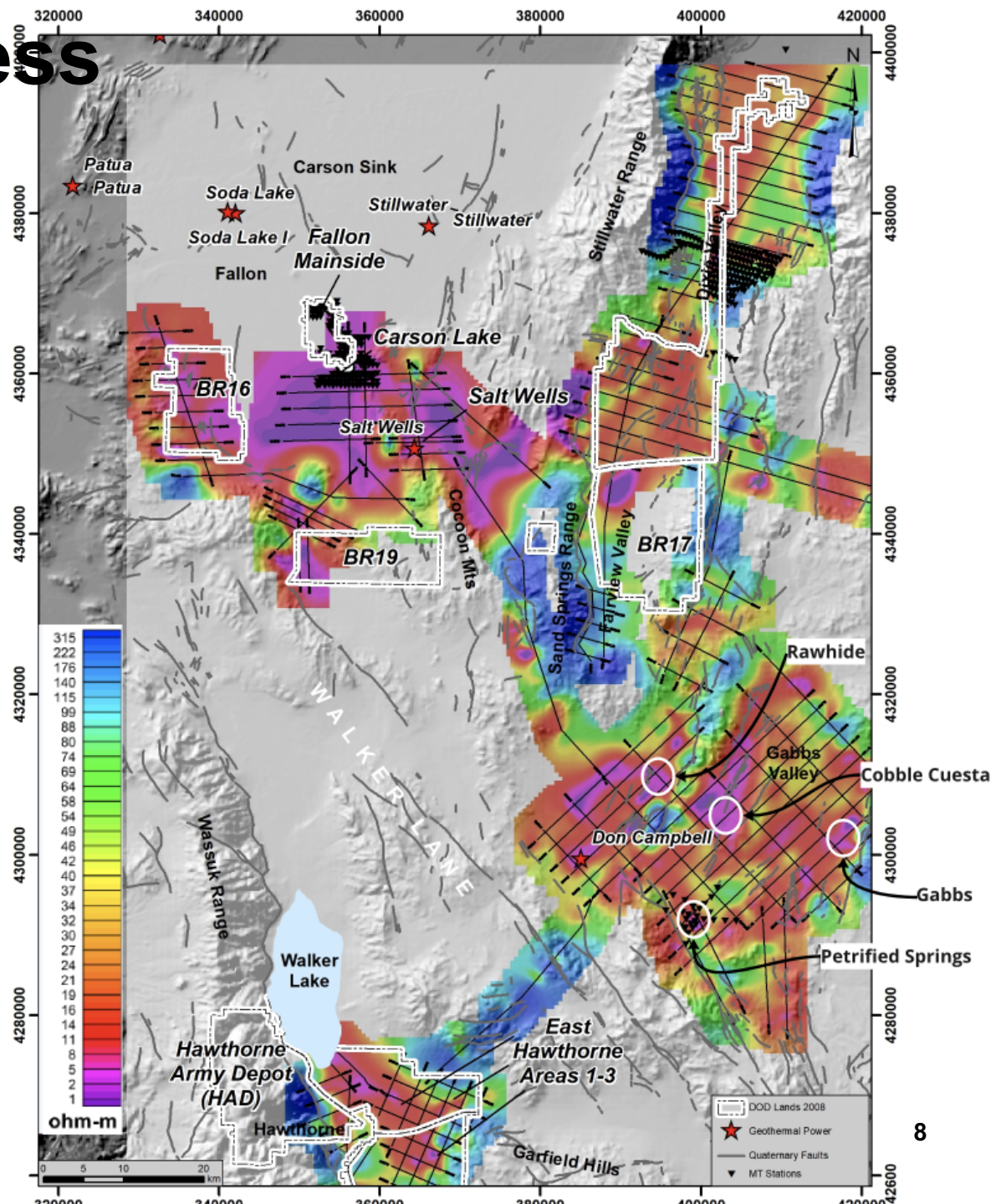
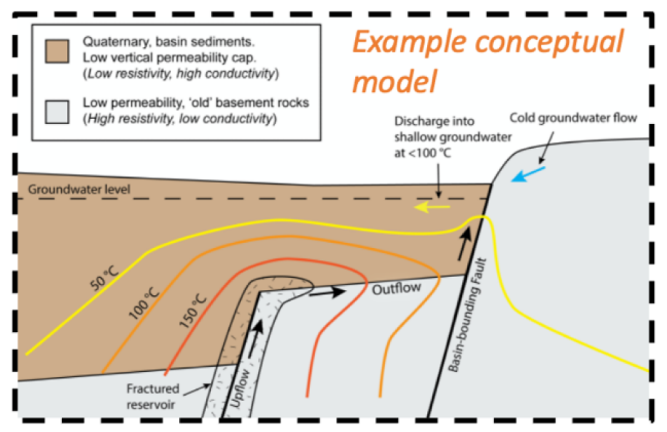
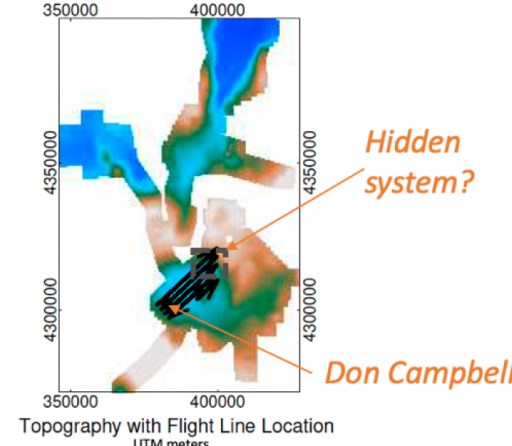
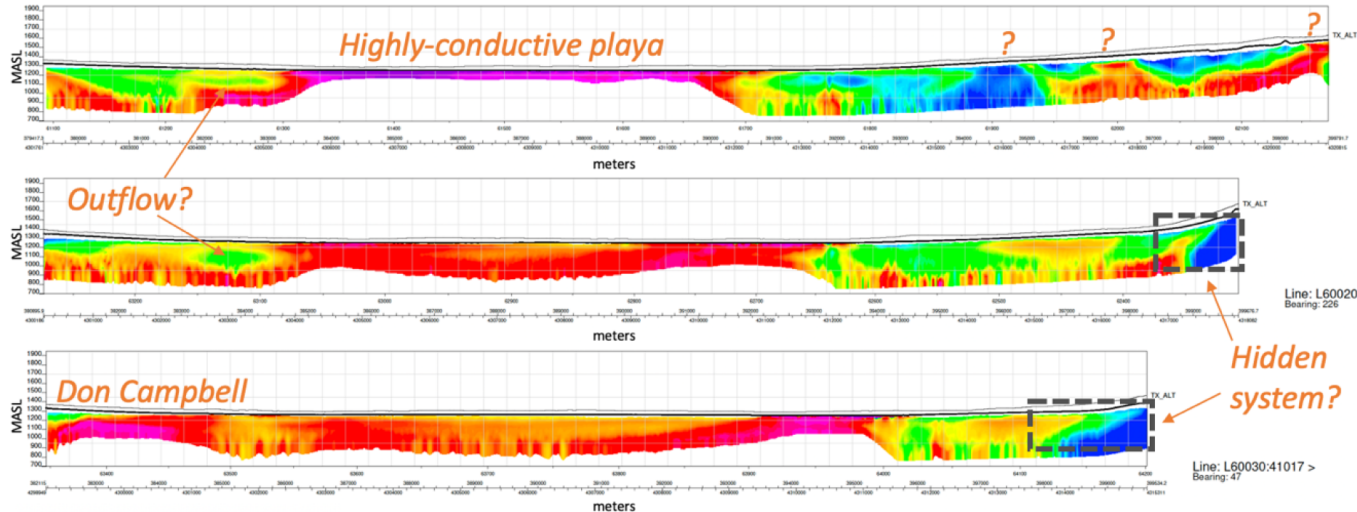


Xcalibur's HeliTEM™ system lift-off



Methods & Approach - Progress

Phase 1: Prospect Reconnaissance



- 1,877 line-km of HeliTEM™ collected by Xcalibur!
- Preliminary resistivity maps/profiles for initial interpretations
- Select lines of interest being inverted (1D, laterally constrained)

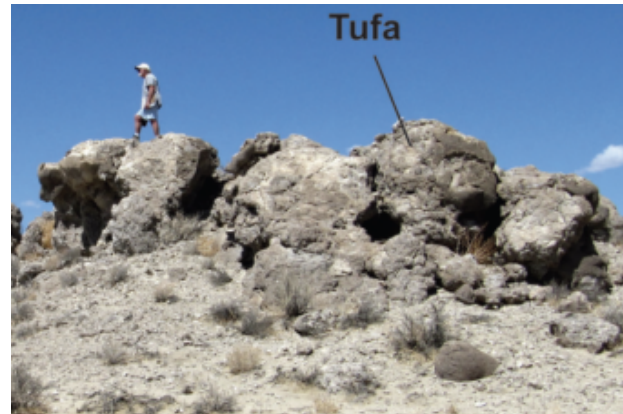
Methods & Approach

Phase 2: Prospect Exploration

- Surficial field data acquisition and mapping, i.e. geologic mapping, geochem sampling, and recon magnetotelluric (MT) & two-meter temperature (2M) surveys
- Drilling & logging of shallow (~150 meter) temperature-gradient (TG) wells

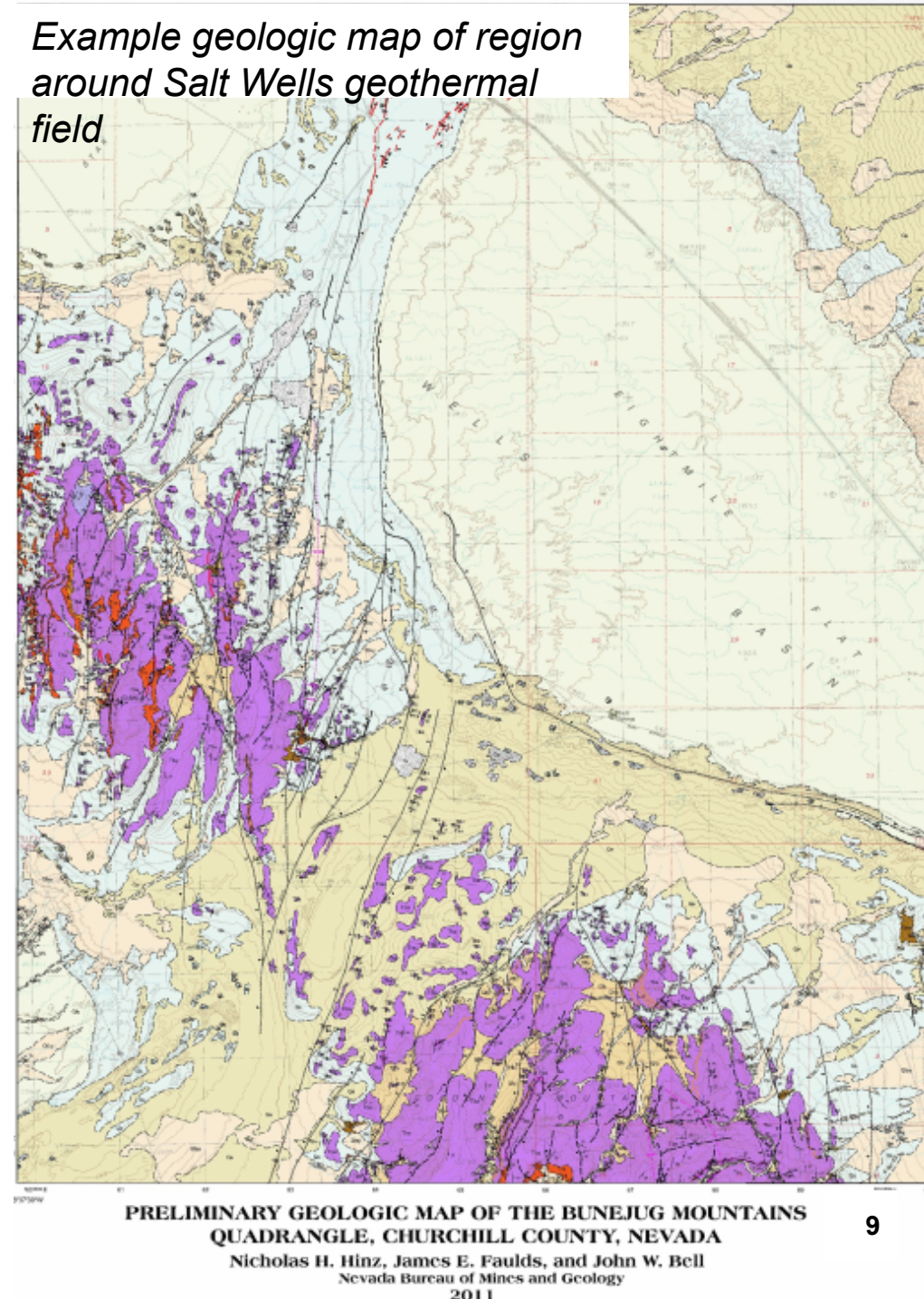


Example 2M field survey (image credit: Great Basin Center for Geothermal Energy)



Tufa outcrop inside Hawthorne Army Depot

Example geologic map of region around Salt Wells geothermal field

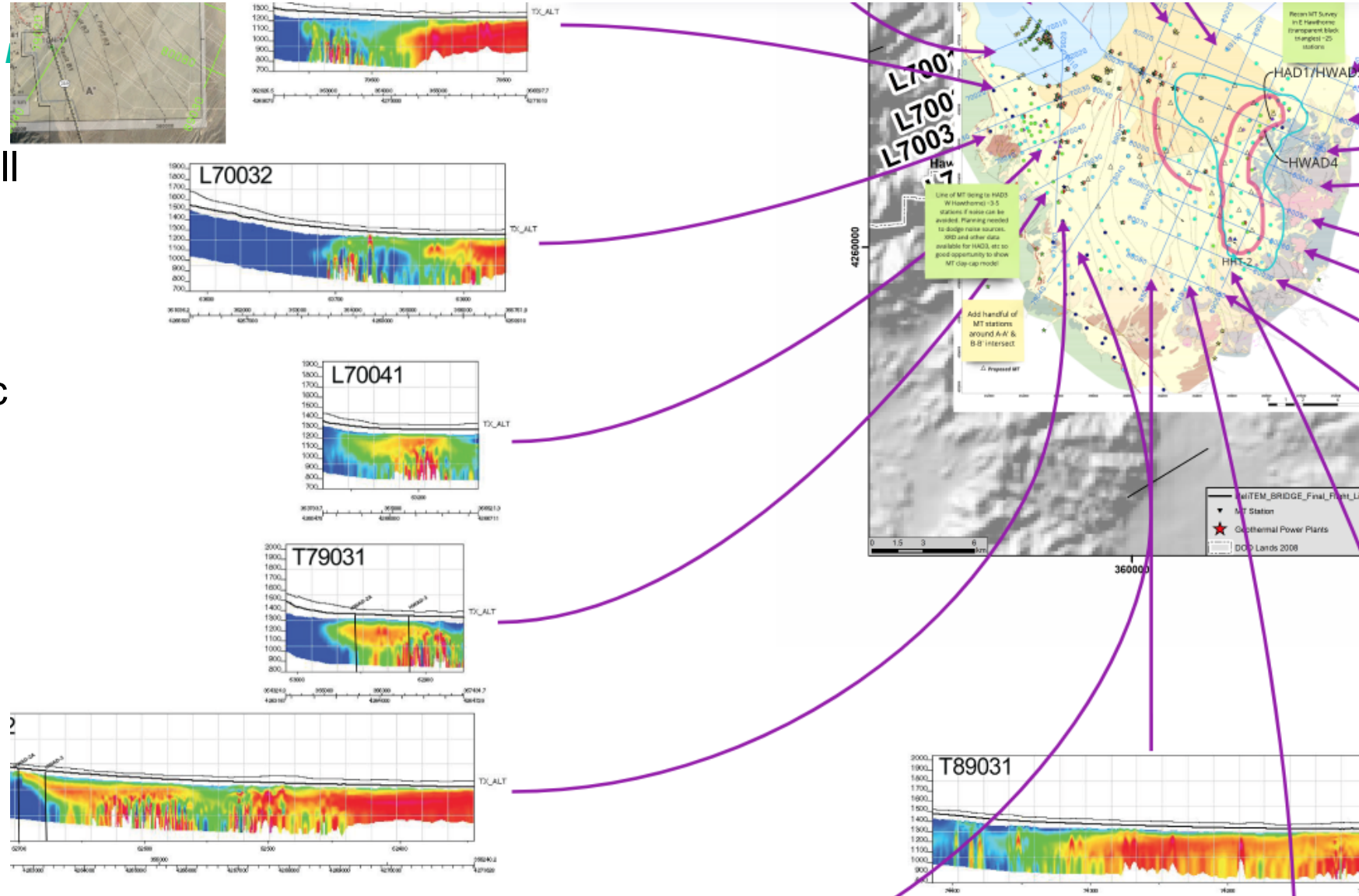


Methods & Approach - Progress



Phase 2: Prospect Exploration

- Problem: How can we take all of this HTEM data and incorporate it with so many other data sets from geologic maps, well logs, geophysical surveys, etc. to plan next exploration steps?
- Solution: “Online infinite whiteboard” collaborative illustration tool! The future is pretty cool =)



Annotated geologic maps and HTEM sections using Miro™ Board

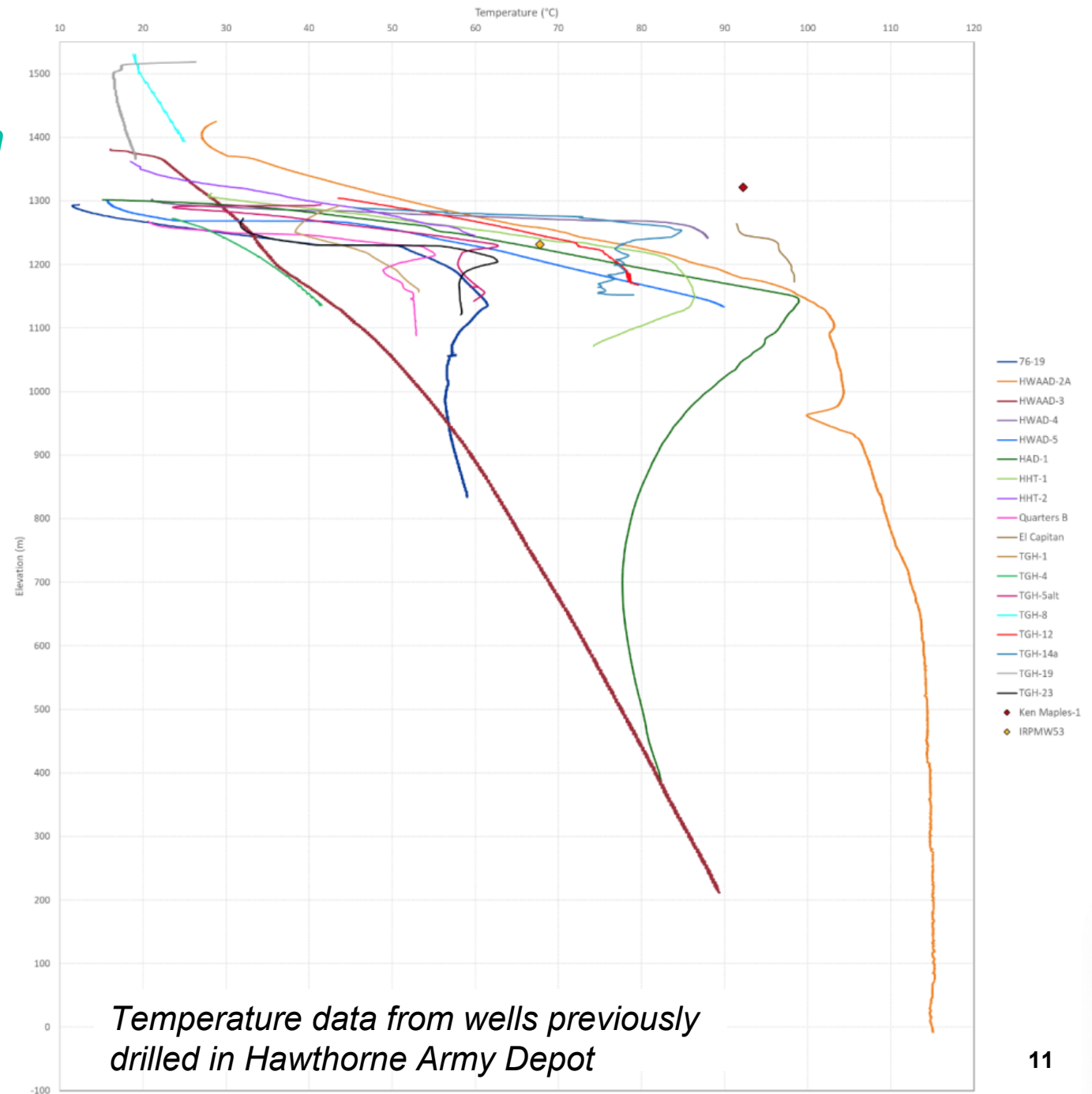
Methods & Approach

Phase 3: Prospect Characterization

- Magnetotelluric (MT) & gravity surveys
- Inversion of HTEM, MT, & gravity data; joint inversion HTEM/MT
- Drilling & logging of deep (~450 m) gravity gradient well (TG)



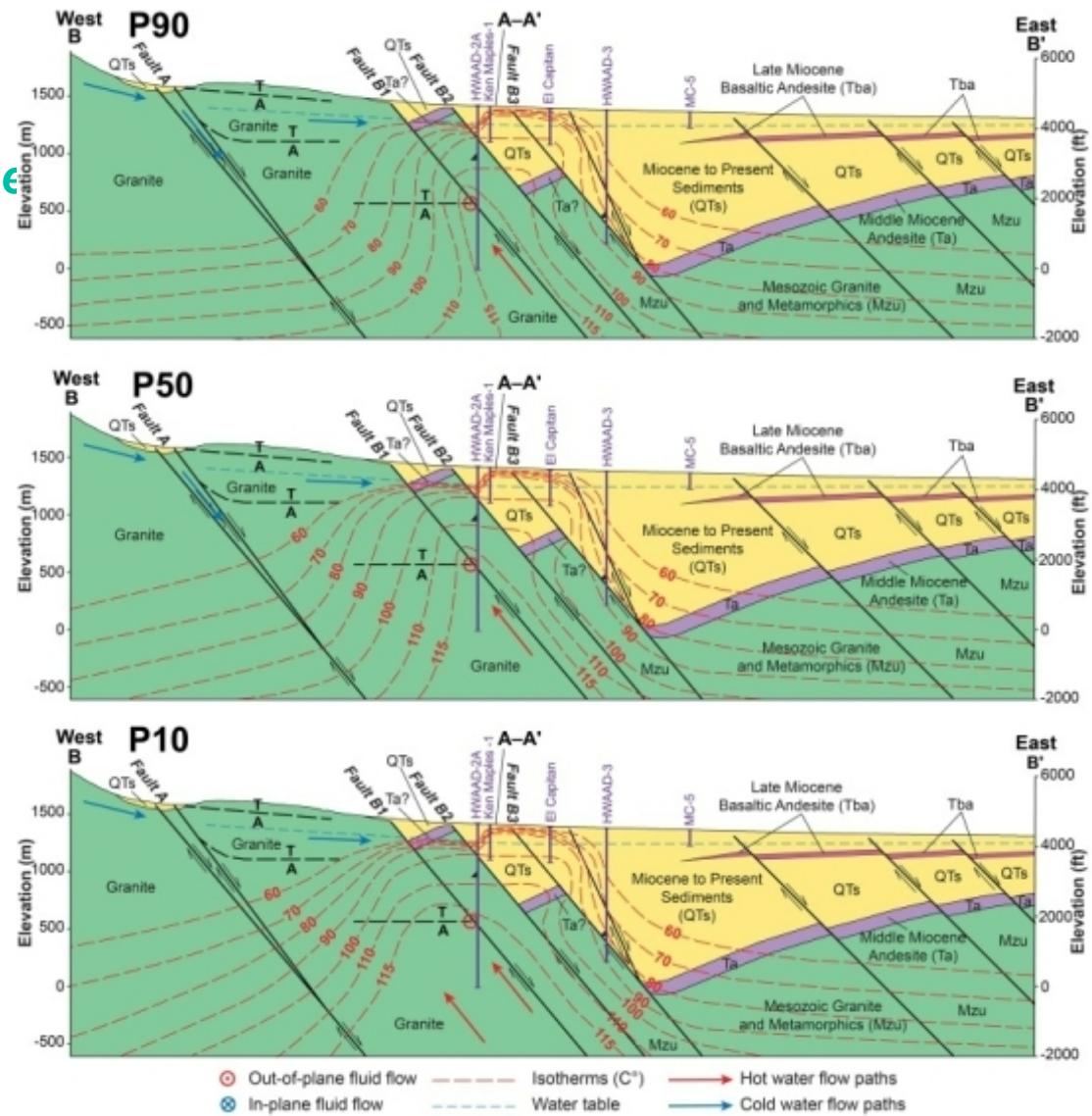
Former UNR graduate student using a gravimeter



Methods & Approach

Phase 4: Conceptual Modelling & Reservoir Test

- Conceptual models will be the basis for characterizing and ranking prospects
 - Generate Probability of Success and P10-50-90 MWe capacity estimates
- Drilling, logging, geochemical sampling, and injection testing of slim-hole wells
 - Subject to feasibility, test efficacy of advanced drilling tech (e.g., coiled tube drilling)



Probability of Success conceptual models from Hawthorne Army Depot (Ayling & Hinz, 2020)

BRIDGE Expected Outcomes

Pump test at Fallon's
88-24 (Kelly Blake)



- ❑ Demonstrate use of airborne and surface methods to identify hidden geothermal prospects
- ❑ Develop and demonstrate exploration methodology for identifying and characterizing hidden systems
- ❑ Develop and demonstrate system for ranking hidden geothermal systems
- ❑ Assessment & demonstration of CTD to reduce slim hole drilling cost (if feasible)
- ❑ Development and application of joint inversion (HTEM/MT)
- ❑ Drill verification and testing of resource
- ❑ Development of a hidden geothermal prospect portfolio within the study area
- ❑ Final conceptual models and resource capacity estimates (MWe potential) for a hidden system, including recommended next steps in exploration
- ❑ Integration with contemporary studies (e.g., Earth MRI, INGENIOUS) & stakeholders (e.g., power plants, DoD)
- ❑ Delivery of a hidden systems playbook entry and contribute data to the Geothermal Data Repository
- ❑ ***Reduced risk, increased success for hidden system exploration and development***

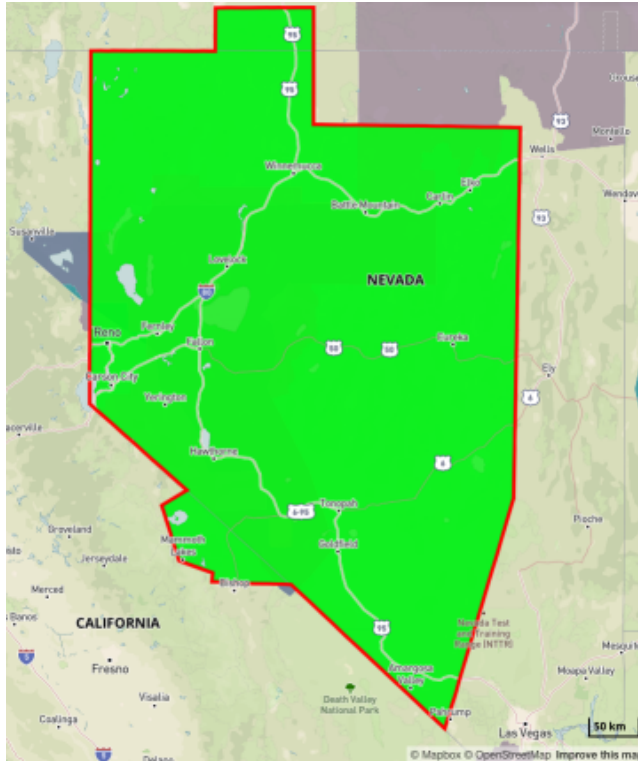


Dixie Valley
Geothermal Plant

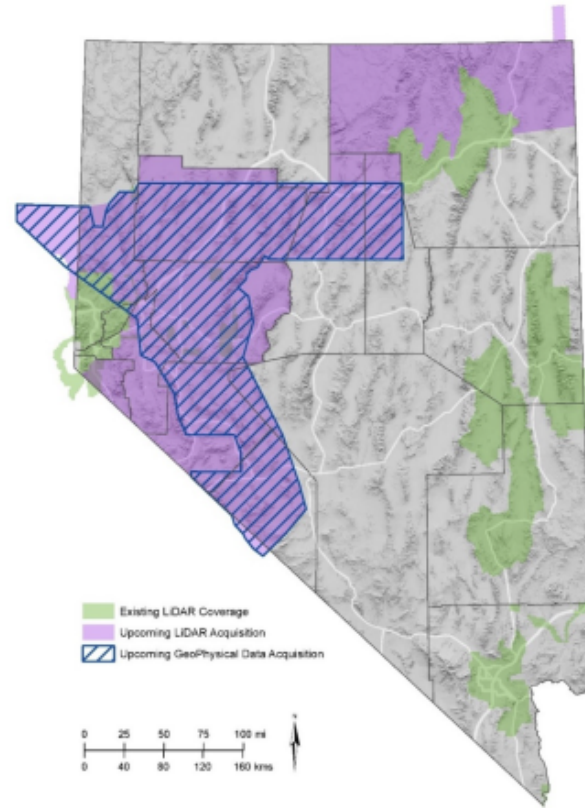
Contemporary Projects



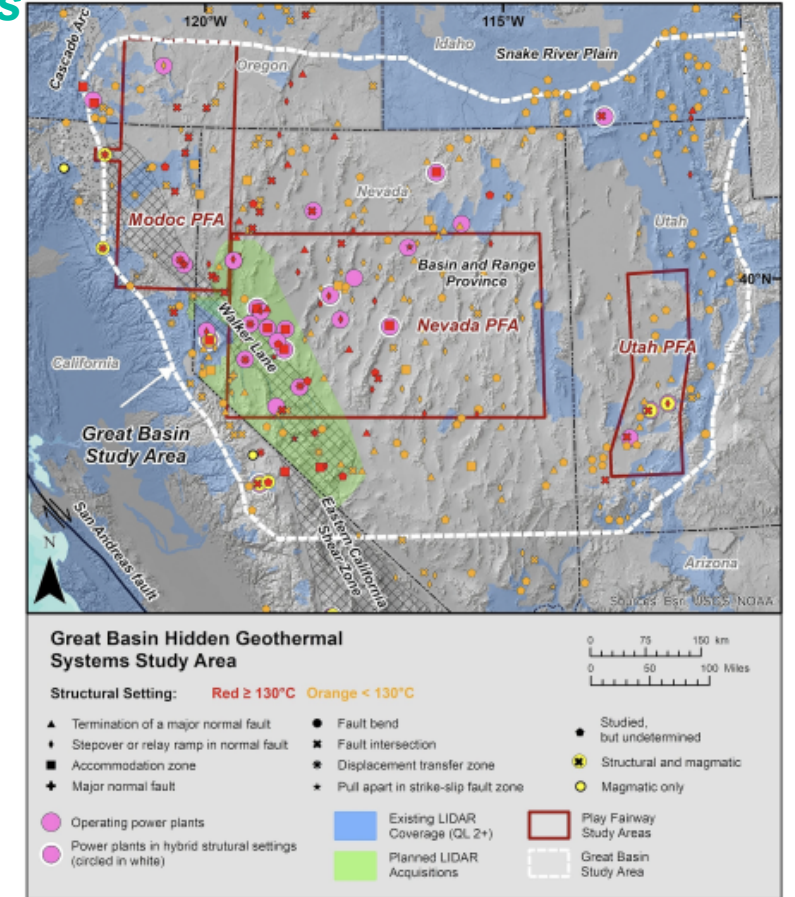
We are not alone... the Basin & Range data rush is on!



Earth MRI – airborne EM to be collected at ~5km spacing (USGS lead)



GeoDAWN – airborne LiDAR & magnetic data (USGS lead)



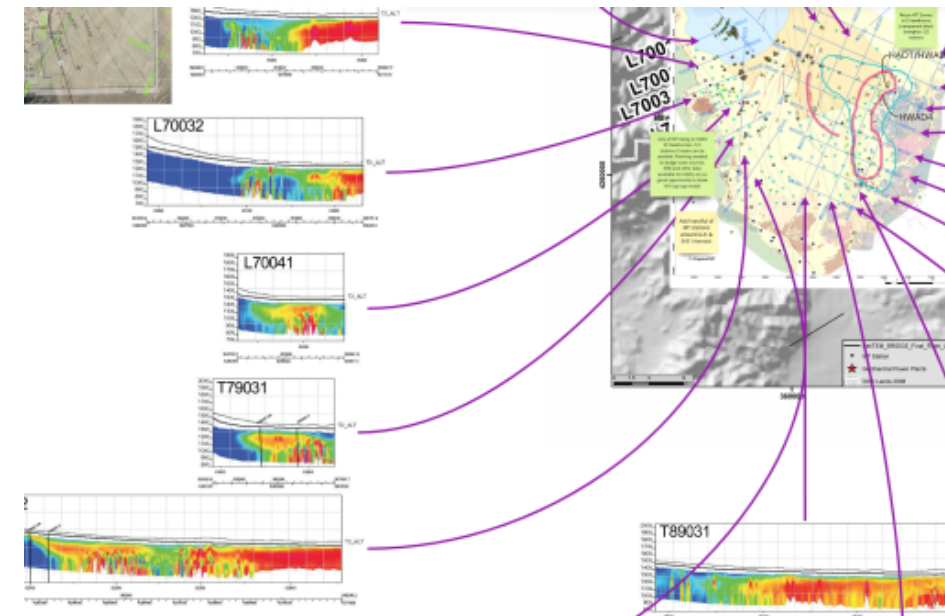
INGENIOUS – larger-scale hidden systems prospect identification project (UNR/GBCGE lead)

All overlap with each other... and with BRIDGEH

Summary & Impacts

BRIDGE – Basin & Range Investigations for Developing Energy

- Applied research & development is crucial to advancing the state-of-the-art, reducing risk, and increasing success of geothermal resource exploration
- Preliminary results from HTEM are being evaluated, along with pre-existing data, to delineate hidden systems prospects for characterization
- Conceptual modelling is an essential and iterative component of prospect assessment/ranking & drilling validation
- Our data, results, and workflow recommendations will be made publicly available to leverage for follow-on and analogous resource exploration and guiding contemporary/future resource development opportunities





References, Acknowledgements and Disclaimers

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- **References** Please refer to our article in [GRC Transactions, Vol. 46, 2022](#).
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Thank You!



Questions?

The Geothermal Good Life, as viewed from the air

