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Exploration Case Studies on OpenEI

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INTRODUCTION

Detailed exploration case studies, such as Beaumont and Foster (1990, 1991, 1992), which were completed for oil and gas plays, will give operators an accessible portal for gathering clean, unbiased information with which to explore for geothermal drilling prospects. Providing a database of these case studies with each case study broken down into queriable properties makes this information even more powerful in planning future exploration efforts in new areas.

The goal of this effort is to develop a template for geothermal case studies in a crowd-sourced platform to allow for contributions from the entire geothermal community. Information collected for the case studies includes historical information regarding exploration and development in an area and current information about reservoir characteristics and facility production. The initial focus is on populating case studies for developing and operational geothermal areas throughout the world that can then be used as a basis for discovering new areas, and guiding efficient exploration and development of those areas.

METHODS

In developing the methodology for completing case studies, the objective was to create a process that could be used in the future by students completing these case studies. We wanted to be able to develop consistently accurate, queriable case studies, with input from geothermal experts who knew the areas well, but with minimal impacts on the experts' schedules.

A case study template and user input form has been developed through iterative modifications based on input from student interns populating the case studies and expert review of these studies and templates. This template and form is continually updated as additional feedback is received from the user community. Though the pre-developed Open Energy Information (OpenEI) template for the case studies may seem restrictive at first, adhering to it allows for gathering of consistent information for each geothermal area, and for querying of information across areas. The template includes:

For the data to be easily accessible, it was important to create a template (and associated form) on the OpenEI website (http://en.openei.org/) to solicit crowd-sourced information sharing. Some of the advantages of cataloging this information on OpenEI include the ability to:

1. Crowd-source information
2. Easily search for the information needed
3. Query information to compare various techniques
4. Link these data to other databases on OpenEI (e.g., the NEPA database, Exploration database).

STUDENT CONTRIBUTIONS

This project has drawn heavily on student involvement. Although NREL has been instrumental in the design and implementation of the OpenEI template, the content has been populated through different student vehicles.

- 2013 – Three student interns developed case studies for ten geothermal areas.
- 2014 – The student Case Study Challenge (http://en.openei.org/wiki/CSC) allowed students from across the country to compete. The top three student entries were featured in the GRC Poster Session, where students showcased their work and were presented with awards from DOE.
- 2015 – NREL is working with technical communications departments at universities to incorporate contributions to geothermal case studies into their future curriculum.
- 2015 – NREL is discussing the project with the GRC Student Committee the potential to continue to offer the Case Study Challenge in the future.
- 2014, 2015 – NREL has worked with students from the Student Undergraduate Laboratory Internship (SULI) program to develop research projects that contribute data and analysis to these case studies. These internships have resulted in two published papers (one each year).

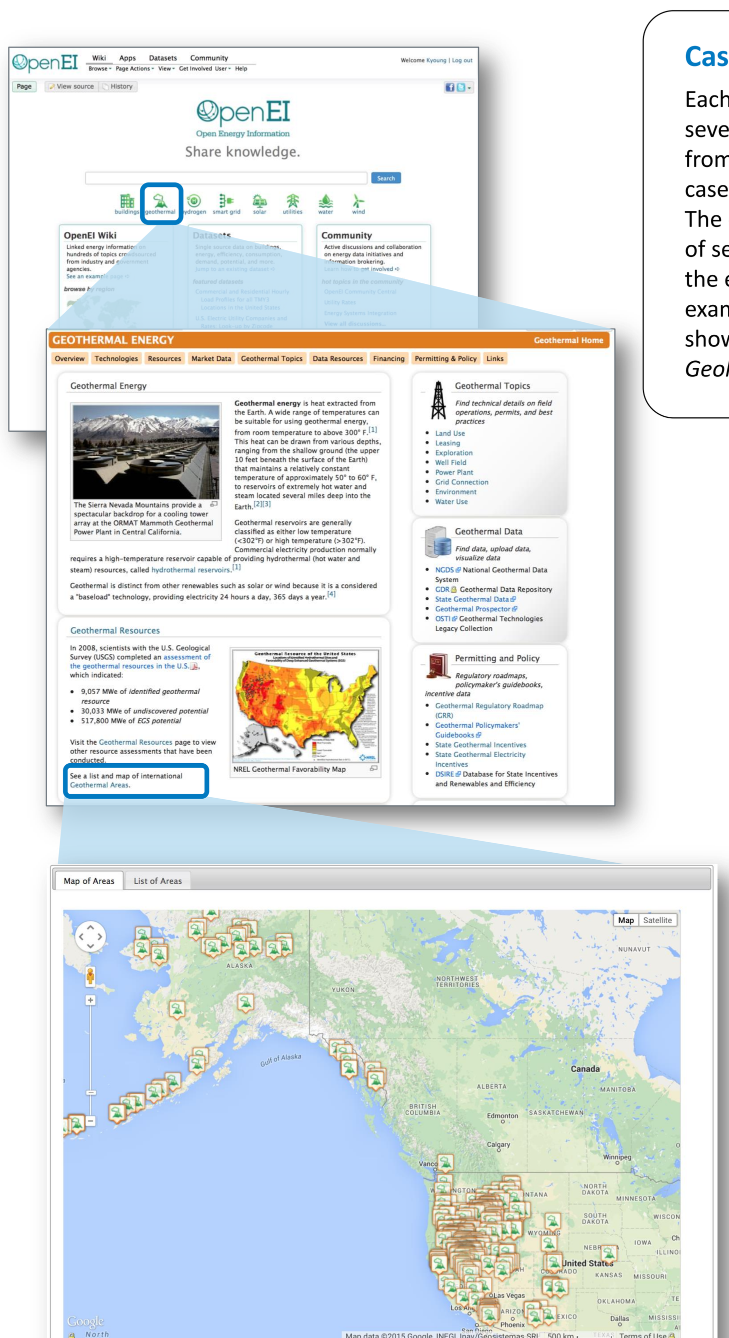
FUTURE WORK

Geothermal resources can be examined using any number of properties, such as temperature, structural control, geothermal region, or occurrence model. As an example, a property of "Brophy Occurrence Model" (Williams et al. 2001) has been assigned in OpenEI to over 75 operating systems worldwide. Analyses can be conducted for areas of the same model looking at exploration histories, data, and exploration plans to identify successful methods for exploring a similar resource.

The OpenEI template can be easily updated and modified as new information and classification schemes are developed. For example, a more formal catalog of play types is currently planned for development by the International Geothermal Association's (IGA) Resources and Reserves Ad Hoc Committee. This catalog could easily be incorporated into the current template, and data uploaded with a script to allow the information to be available for use in a query.

The goal of assembling these case studies is to be able to explore and analyze exploration data and information in a variety of areas to identify correlations between successful exploration programs for areas with similar geologic occurrence models and to guide efficient exploration of new systems.

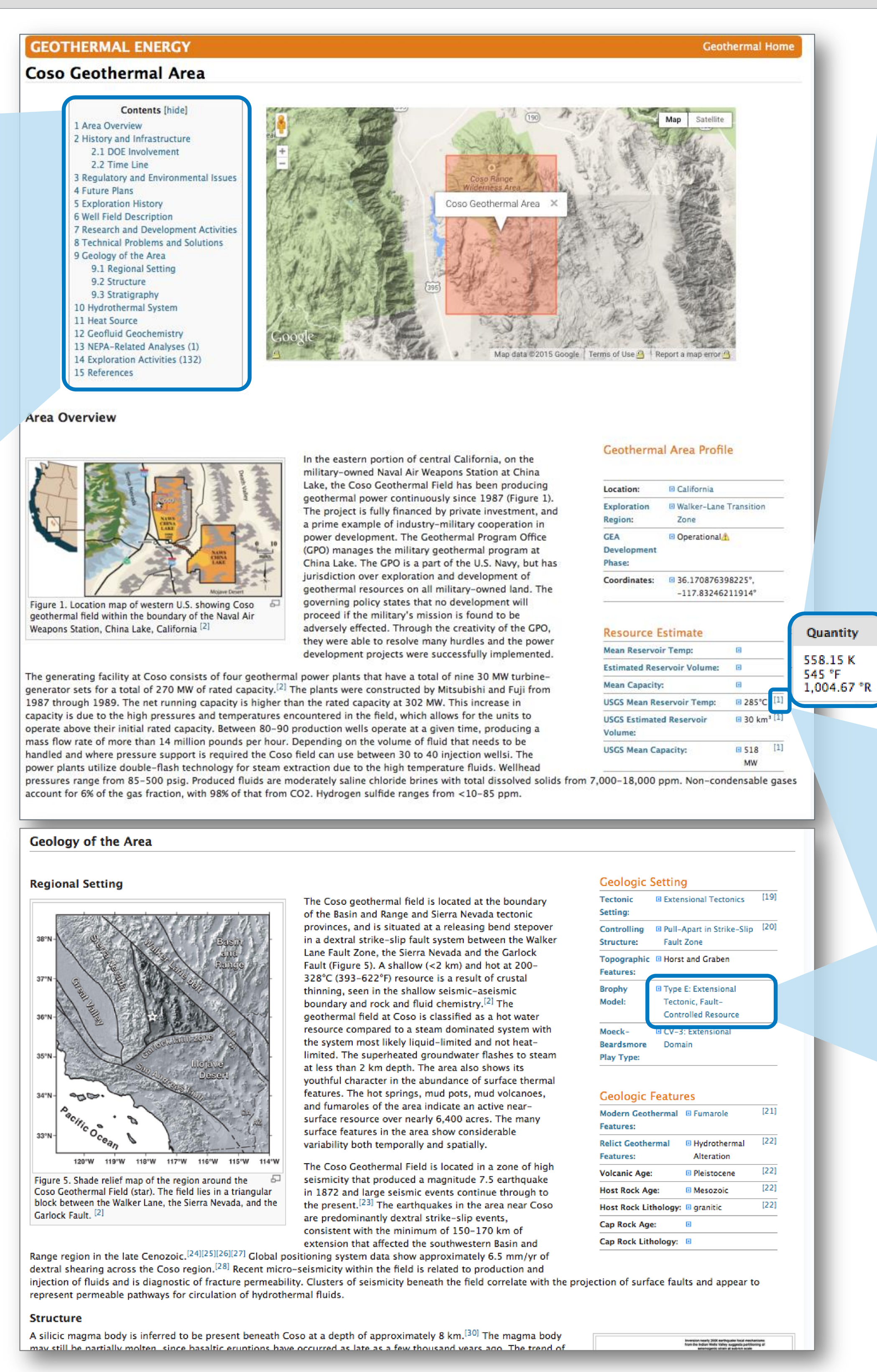
FEATURES



To access the case studies from the OpenEI landing page (http://en.openei.org) , click on the *Geothermal Gateway*, then *Geothermal Areas* for a map of areas in the database.

Case Study Sections

Each case study consists of several sections. Screen shots from the Coso Geothermal Area case study are presented here. The case studies are composed of several sections, as shown in the example in **Contents**. Two example sections are also shown: *Area Overview* and *Geology of the Area*.

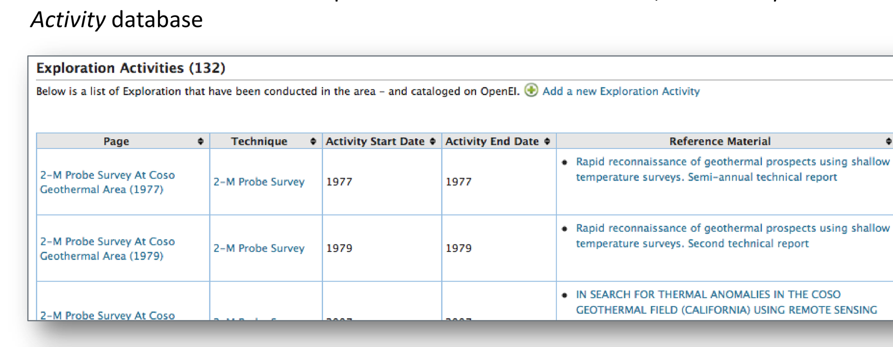


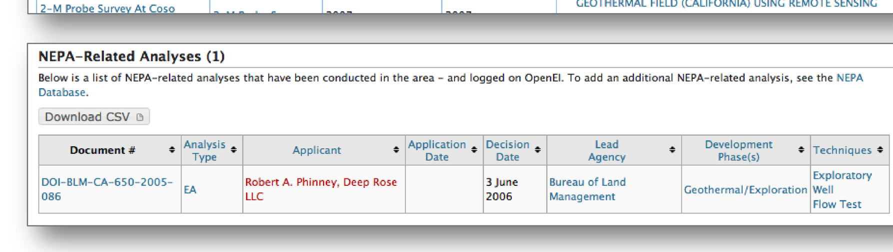
Unit Conversion

Data stored in common units (such as ºC) are semantically interpreted into classifications (like "Temperature") that automatically translate their values into a predetermined set of relevant units (such as ºF and ºK). The result is that the data are accessible via queries in any unit the user desires. Hovering over the value will also display the value in multiple conversions, as shown in Figure 1b. The impact of this new feature is to increase the accessibility, reusability, and scientific relevance of data on OpenEI.

Links to Other Databases on OpenEI

Many other databases created for other projects exist on OpenEI that can be linked to these case studies. Two examples include the *NEPA Database*, and the *Exploration Activity* database





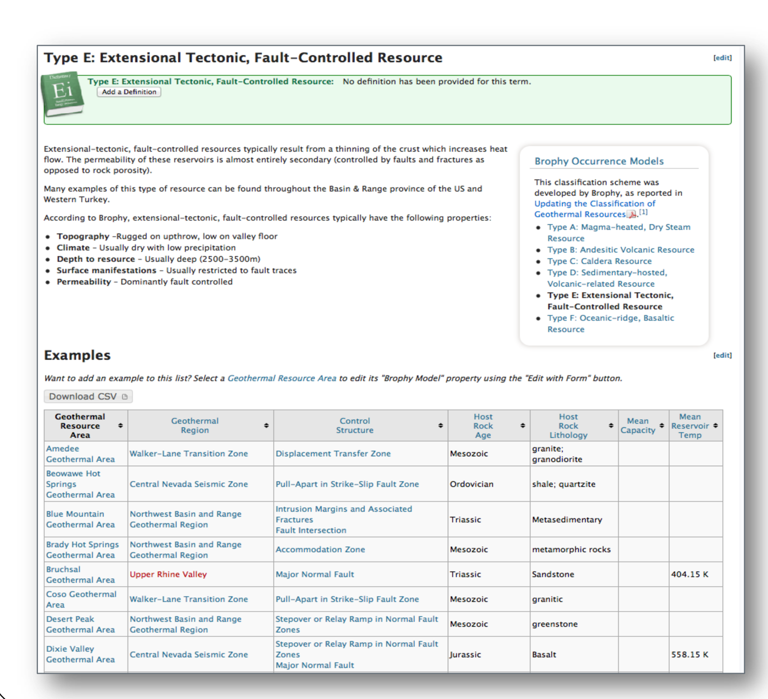
Citation of Data

Wiki platforms have never allowed for direct citation of data. Because Semantic MediaWiki's key advantage over normal wiki pages is the semantic linking of page properties, the ability to provide citations for these properties is key to validating the accuracy of the information. The OpenEI team developed a methodology for adding user-friendly data citation capabilities to forms and back-end syncing of citations to data points.

For example, the Coso Geothermal Area page (which can now be cited as Williams et al. 2008) has a property for Mean Reservoir Temperature = 285ºC. The result is that the Case Study templates on OpenEI now allow for the referencing of individual data points (e.g., all data in tables now have unique references), as shown in Figure 1a. The impact of this new feature is to increase the credibility of cited data in all of the geothermal wiki pages on OpenEI, including Exploration Techniques, Geothermal Resource Areas, and Energy Generation Facilities pages.

Querying on Specific Data

Click on any of the blue links to access more detailed information about the topic, and a list of Geothermal Areas with that same attribute.



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