

Community Supported Geothermal Projects

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ABSTRACT

Even in today's increasingly supportive social environment towards renewable energy, geothermal energy is often not included when renewable energy sources are discussed. Lack of education and communication in the general public is often identified as a source for this low visibility. So how do we engage the public to promote geothermal? The authors have been working with two distinct communities in Colorado and New Mexico, and one common feature exists between the two: the community working with Colorado School of Mines, side by side, to understand the nature of geothermal as a resource and build a business plan. This paper describes two geothermal projects that are strongly supported by the communities. Colorado School of Mines shares the resistivity results with the communities to gain support through better understanding of the available resource by the community. Geothermal exploration unfolds the mystery of hidden underground resources, and Colorado School of Mines has been sharing the joy of exploration with these two communities.

1. INTRODUCTION

Geothermal energy can exist anywhere in the world, but the usable heat sources are often deep underground and in different forms. The history of geothermal energy development has been accompanied by technology development. The challenges associated with gaining community acceptance of geothermal, however, have only been addressed in the last couple of decades. It is an increasing concern among all sectors of natural resources developers, but there have been a limited number of well-documented publications available (Brotheridge, Leniston and Ono, 2000; Popovski, 2003; Dowd, Boughen, Ashworth and Carr-Cornish, 2010; Pellizzone, Allansdottir, Franco, Muttoni and Manzella, 2015)

In 2000, Brotheridge et. al. (Brotheridge, Leniston and Ono, 2000), published a paper that describes potential environmental and social impacts when a small scale, rural geothermal development is planned. In their paper, they select the Ulumbu geothermal project as a successful example. They list the following six issues that are required to prevent and mitigate negative social impacts, and they are:

- Satisfactory and constructive negotiation on land use, acquisition and compensation,
- Assessment of sources, utilization and protection of water supply,
- Appropriate placement of project baseline,
- Health and safety standards and precaution,
- Gender and situational specific analysis of impacts on women and men and community development, and
- Consultation with local communities and special interest groups e.g. if the project has the potential to displace people.

One of the factors unique to the Ulumbu project was the fact that they used a well-respected local consultant to address the local communities with what the social concerns were and to help disseminate information about the various activities of the program.

A highly respected, local and independent specialist (Dr. Ataupah) was available specifically in an effort to ensure that project information was not conveyed in a manipulative manner. Such an approach would have defeated the purpose of consultation, which was to inform and to identify concerns and attempt, as far as possible, to ensure that the project "fit in" with the host communities.

Over the long history of involvement with this project, Dr. Ataupah has acted as a community liaison. Significant merit for the success of the consultation lies with Dr. Ataupah because of the following key reasons:

- His ease of communication with all parties (including fluency in the Manggarai language), so that the effort needed to obtain or provide information was not an impediment.

- His credibility within the region. He is viewed as not being the project proponent but a diplomat channel between the community and the project.
- The fact that when concerns were raised by the communities, they were acted upon (e.g. road by-pass of Kampug Lale and land compensation).

Those who are involved in geothermal development know it is critical to have a liaison like Dr. Taupah and document the fact in detail. But often, what is lacking in these excellent papers are the detailed descriptions as to how exactly Dr. Taupah communicated with the community. For this reason, Nakagawa has decided to share his personal experience with the help of his geothermal team. He is convinced that many things this paper describes are already in practice in successful projects; however, there are so many (and increasingly more) projects that are failing not because of technical deficiencies but the inability to recognize the needs of communities.

The geothermal research group lead by Nakagawa at Colorado School of Mines has been involved in two geothermal projects that have been supported by the community since 2009; first in a small town called Rico located in the southwest corner of Colorado, and later a small town called Tohatchi in the largest American Indian Nation, Navajo, in New Mexico. A very brief summary of the uniqueness that the team attributes for these two successful projects to date is given below. More detailed background information will be shared at the time of presentation of this paper and throughout the workshop.

2. UNIQUENESS OF RICO GEOTHERMAL PROJECT

The Rico geothermal project started as a sustainability project for a small town that has a long history of boom-and-bust mining development. In response to the first geothermal workshop Nakagawa organized, the community of Rico approached Nakagawa with their willingness to share their perspectives of geothermal resources in Rico. Rico always had (and has, even today) a choice between mining and alternative ways to boost their local economy. For almost two years, Nakagawa exchanged views, invited the whole town to his classes and visited Rico with his geothermal team, without discussing detail about geothermal resources other than the published record of Rico known as the second highest heat flow geothermal resource in Colorado. Through this two year period, it became clear that what Rico needed was not so much of a need to develop the geothermal resource, but the strong need to develop their local economy. Nakagawa and the team spent the next few years planning that to happen.

Rico had help from many different entities, including the National Renewable Energy Laboratory, the Colorado Governor's Energy Office, and neighboring mountain communities; however, for Nakagawa and his team, the pivotal point came about when Rico made a set amount of funding available from their foundation, the Rico Center. With this modest funding, Rico has established itself as a supportive community for developing a geothermal-driven local economy, and welcomed CSM students, local and international visitors that were invited by Nakagawa's team. For Nakagawa, Rico has become a safe field where his student teams can visit and conduct geothermal exploration, and most importantly, to learn how to communicate with the community as they do exploration. Rico is a field laboratory where students can learn how to explore a geothermal resource in a very complex geological setting. Nakagawa's team has been supported every summer for the last two years to conduct resistivity, geochemistry and thermoluminescence studies, and has found out ways to use these exploration opportunities to build the community's trust.

3. UNIQUENESS OF NAVAJO GEOTHERMAL PROJECT

The Navajo Project started with a short visit by Nakagawa and two of his geothermal students (Dunnington and Barron shown in the picture) in late 2015. The invitation came from Sam Woods at the Navajo Transitional Energy Company (NTEC). NTEC is a new company with the following mission: to be a reliable, safe producer of coal, while diversifying the Nation's energy resources to create economic and environmental sustainability for the Navajo people, and to develop and operate an energy company that values the Navajo Nation, its people, and its resources, now and in the future.

During our initial visit, we were introduced to a couple of old, abandoned oil wells that produce warm water and have been doing so for several decades. The usage of the water was limited to suppressing dust for construction projects, and also used for animal consumption and agricultural purposes. The well near the town of Tohatchi was selected to become part of a GeoPark vision. The vision of a GeoPark project was developed through one of Nakagawa's graduate courses at CSM and the report was presented to NTEC. Sam Woods and Lindsay Holiday from the Navajo Nation were engaged with the class and made constructive suggestions to give a better focus on the GeoPark. In the report, geological interpretation of the Tohatchi area, cultural sensitivity, and educational development were studied. As to the usage of geothermal warm water, a cascading greenhouse construction was recommended, together with a small bathing facility.

As part of trust-building activities, Nakagawa took a small delegation of four indigenous students from Bolivia to visit Tohatchi to exchange views on culture and energy for the indigenous population in Bolivia and Navajo. There are many common challenges between the two indigenous population groups thousands of miles apart and there was strong consensus that these were some of the most urgent issues that needed to be addressed at a much larger scale among the indigenous population. This exchange project was supported by the U.S. Department of State.

The historic event took place during our engagement with Tohatchi. Almost 700 acres of land was dedicated to the GeoPark project for feasibility studies. This allows Nakagawa's team to conduct surface exploration in the area of interest. The GeoPark project was approved and funded by NTEC in 2016. The picture below is a group photo of the geothermal team with several Navajo community leaders and a medicine man. The project opened with the blessing of a Navajo medicine man in the summer of 2016.



2. GEOTHERMAL SURFACE EXPLORATION TO GAIN TRUST

The two projects introduced in this paper are unique in that one of the surface exploration methods, resistivity measurement, was used to engage the community and build trust between the geothermal student team and the local community. One of the common risks with geothermal resource development is the high cost of drilling. Until the drilling phase of resource exploration, all results are inferred, i.e., inferred results with geologic uncertainties and non-uniqueness in the data inversion processes. It is a common belief that it is almost impossible to gain enough trust from the community with just the exploration data so that the community can approve the developer to move forward to the next step, which is actual drilling. Potential investors do not wish to finance the drilling activities where they see strong possibilities of oppositions from the communities. It is true that the cost for drilling is high. It is true that the uncertainty remains high. Within those boundaries, how can we gain enough trust from the community so that the community can accept and allow the development move forward?

Nakagawa's team insists on having total transparency in all aspects of geothermal exploration. When the geothermal team visits Rico, Navajo, and any other potential sites, they first distribute a flyer a few weeks before they arrive. On the first morning of exploration, the team invites the community for a briefing. At the meeting, the team introduces each member and informs the community of the activities planned. Those who are interested in knowing how resistivity measurements work are encouraged to follow the team as the team performs the work. Occasionally, community members share the labor by carrying the cables and other equipment. They are also encouraged to follow a geochemical sampling team. Occasionally, we have high school volunteers who accompany the geochemistry sampling team. This real-time training of community members are particularly effective in gaining more trust as those who show up to follow the team are the ones who are not sure about the technology or potential environmental impact.

The community members are informed of where the team is staying and that the team is accessible for any questions that they may have. Another practice is to have a check-out briefing. On the day before the team leaves the site, an informal gathering is arranged to inform what was found and what the next step would be. When the exploration lasts longer than a week, we usually designate the middle day as a Community Day to do different activities for the community, including activities with children in the community. In Rico, for example, for the last two years, we were fortunate enough to have participants from universities and government institutions in Japan. Thus, cultural events were planned on the Community Day to share activities from the Japanese culture.

Figures 1 and 2 show the map of Rico with colored lines indicating the locations where SP and resistivity measurements were conducted in 2010. Since then we have included more lines for resistivity measurements as well as data from an emerging method called thermoluminescence to locate deep heat sources. Fig. 2 shows one of the resistivity data. The team shares data like this with the community members and provides different interpretations of the results. Often times, the team's interpretation improves because of the "living knowledge" of the geology of the local people. The team only provides unbiased scientific data so that the community can use them to plan for the future.

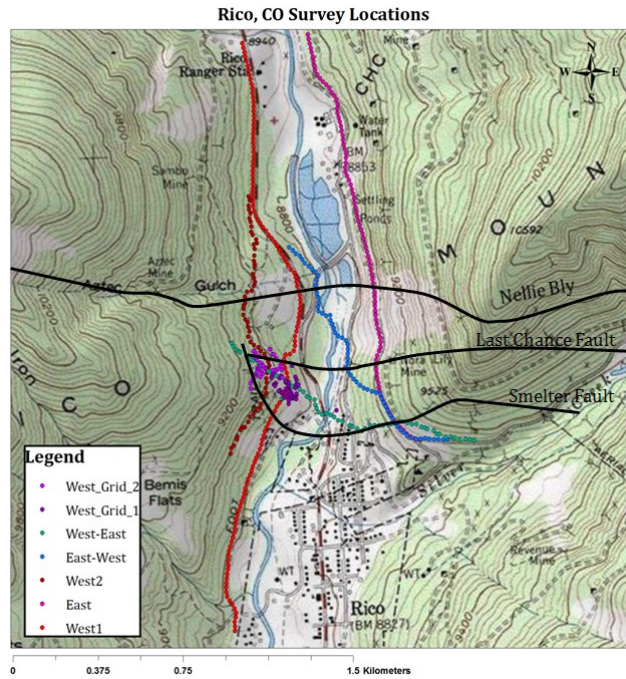


Figure 1. Map of Rico with lines indicating locations for SP and Resistivity measurements.

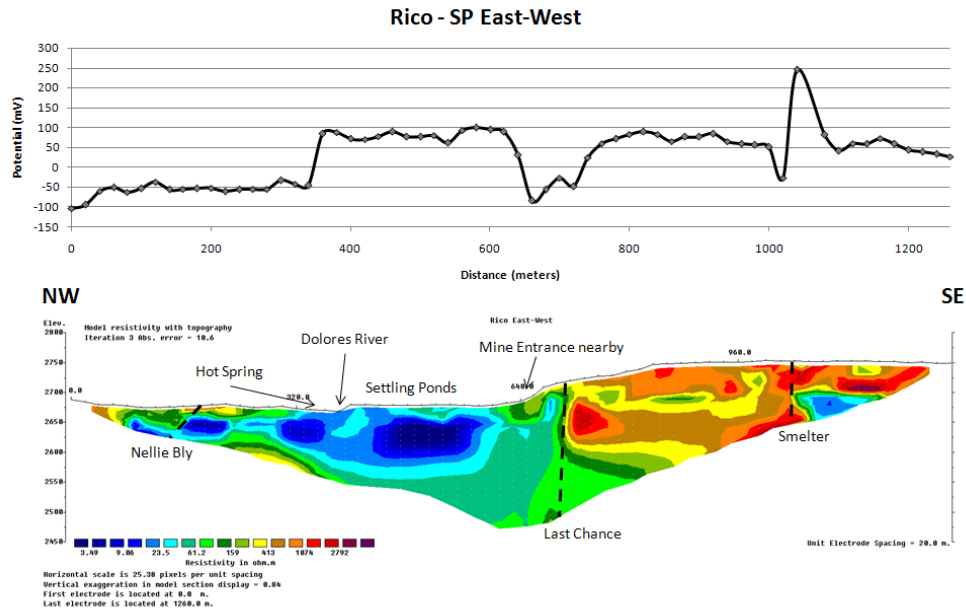


Fig. 2 SP and Resistivity data for the blue line across the Dolores river shown in Fig. 1.

4. CONCLUSIONS

Geothermal projects in Rico and Navajo may become an interesting business-educational model for academic institutions and students who are interested in sustainable development of geothermal and other natural resources. Nakagawa’s geothermal team, as an academic entity with limited financial resources, have used every step of the exploration phase to provide students field experience that includes community engagement. In general, communities are more eager to talk with students. In these places, students can “feel” the needs of the communities, reflect, and implement those needs in their activities as much as they can. This often requires modifications and may

limit their activities, but also provides the opportunity to engage with the community members. It is rare for a university geothermal program to be able to provide a field laboratory of this nature. Nakagawa's geothermal field camp in Rico and Navajo has attracted students from local and national universities, researchers from National Renewable Energy Laboratory, government officials from the Colorado Governor's Energy Office, students and faculty members from Tohoku University in Japan, and researchers from the Fukushima Renewable Energy Institute in Japan. With support from the communities, Nakagawa's geothermal field camp continues to welcome participations from interested organizations from different parts of the world, and reach out to geothermal programs in Peru, Bolivia, Chile and other central and South American countries.

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