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Current Understanding of Geothermal Resources across the State of Hawaii (USA)

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Abstract

Still today very little is known about the extent of geothermal resources across the State of Hawaii. This presentation will review the US Department of Energy funded Hawaii Play Fairway project, which took place from 2014-2020, produced the first statewide geothermal resource assessment since the 1980s, and culminated with slim-hole drilling of the deepest well off of Hawai'i Island on the caldera rim of Lanai volcano. The presentation will also provide an update of ongoing projects led by the Hawaii Groundwater and Geothermal Resources Center related to geothermal resource characterization, as well as a current project characterize downhole conditions in terms of carbon storage potential in the ~3.5 km deep Hawaii Scientific Drilling Project (HSDP) well in Hilo Hawaii.

1 INTRODUCTION

Hawai'i spends over $5 billion (U.S. dollars) per year importing fossil fuels (DBEDT 2015, 2022.) and residents pay approximately three times the national average for electricity (Hay, 2025; U.S. Energy Information Administration, 2025), yet surprisingly little is known about the state's geothermal resource potential. The now completed Hawai'i Play Fairway (PF) project (2014 through 2022) was the most comprehensive statewide geothermal resource assessment to date, and the first to consider statewide potential since 1985 (Thomas, 1985).

The Hawai'i PF project was funded over 3 phases. The results of the first two phases are described in detail across four publications in the journal Geothermics (Lautze et al., 2017a, 2017b, 2020; Ito et al., 2017). In Phase 1, the project team introduced a Bayesian statistical methodology to integrate data relevant to Hawai'i's geothermal resources into a statewide resource probability map (Lautze et al., 2017a, 2017b; Ito et al., 2017). In Phase 2 we i) analyzed new groundwater samples collected statewide, ii) performed geophysical surveys on Lāna'i, across the southwest rift of Haleakalā Volcano on Maui, and surrounding Mauna Kea Volcano on Hawai'i Island and iii) integrated these new data into an updated resource probability map (Lautze et al., 2020). The main task in Phase 3 was to execute an exploratory drilling project on Lāna'i Island, which confirmed a presence of heat on this volcanically older (~1Ma) island (Lautze et al., 2024).

A traditional hydrothermal resource requires subsurface heat, fluid, and permeability. Our published maps for each island in the State of Hawai'i from PF project Phase 1 established the probability of a Resource (Pr_R) to be calculated as the product of three individual probabilities Heat (Pr_H), Fluid (Pr_F), and Permeability (Pr_P). Each individual probability was calculated via a complex methodology that involved existing data and expert elicitation (Ito et al., 2017). With each individual probability being a value between 0 and 1, any value of Pr_H, Pr_F, Pr_P less than one, when multiplied together, contributed to a reduction in Pr_R. As such, the calculated Phase 1 resource probabilities (Pr_R) were low, e.g. less than 10% across most of the state and 45% at the state's only proven resource, Puna Geothermal Venture (PGV). We prided ourselves on the conservative nature of this approach during project Phase 1, however including because of encouraging data in terms of resource potential during Phases 2 and 3 of the Play Fairway project, now consider the Phase 1 resource probability map likely to be ***too*** conservative.

This talk will introduce important final considerations of the Hawai'i PF project after the conclusion Phase 3 drilling on Lanai. I will provide new rationale for considering the probability of fluid at resource depths as 1 (PrF = 1), permeability at resource depths as unconstrained, along with updated calculations on the probability and confidence of Heat supported by each earlier project phase. I will show why using our final probability of heat, and confidence in this probability, should to drive the next phase of exploration. As well as discuss the latest results of quite significant, and ongoing projects.

To avoid any current or future copyright issues in regards to peer-reviewed journal publications, I refrain from adding more detail here, however look forward to in-person questions and discussions. ☺