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Deep geothermal energy

New Frontiers – Exploring A Geothermal Resource in Alaska

New Frontiers - Erkundung einer geothermischen Ressource in Alaska

Guy Oliver & Marcus Oesterberg[1], Moamen Gasser[2]
[1] Ignis Energy Inc.
[2] Texas A&M University

Mount Augustine is an active stratovolcano situated on Augustine Island in the Cook Inlet, Alaska, approximately 110 kilometers southwest of the city of Homer on the Kenai peninsula. Closely monitored by the Alaska Volcano Observatory (AVO), Mount Augustine is believed to have significant geothermal potential due to its predicted shallow magma chamber. Alaska's volcanos, positioned along the Pacific Ring of Fire, make them a prime candidate for geothermal energy exploration.

In the summer of 2023, an extensive geophysical survey was conducted, comprising AMT data from 28 sites and gravity data from 205 locations. Additionally, 20 rock samples were collected from cliff sections along the island's southern margin, primarily from the outcropping Naknek Formation. Building on these findings, a new Magnetotelluric (MT) survey was carried out in the summer of 2024, with 40 MT stations installed across the entire southern part of the island. In addition, catalogue seismic data provided by the AVO, including P and S wave arrive times recorded by 15 permanent stations deployed on the southern flank of the volcano between January 2001 and December 2017, were incorporated into the subsurface understanding.

The combined geophysical data, including the recent MT survey, suggest that the island hosts a substantial hydrothermal system. Analysis of P and S wave velocities revealed a high geothermal potential on the southern flank, likely due to a brittle zone where degassed fluids have formed fractures. Additionally, the Upper Jurassic silts and sands exhibit higher VP and VS, suggesting a thermally altered clay layer acting as a seal between the fractured, fluid-saturated basement and the overlying sediments. In addition, the MT data indicates several laterally extensive shallow low resistivity zones overlying potential hydrothermal fluids. Finally, a large low resistivity geo body extending from a depth of 2 km to 7 km has been identified, underlying the central and southern area of the island, which is likely to represent a large magmatic heat source. The Naknek Formation likely underlies much of the southern island, effectively preventing the emergence of typical geothermal surface features. Consequently, we classify the Mount Augustine resource as an atypical blind geothermal system, likely featuring a more horizontal circulation pattern. An initial evaluation indicates that this system could potentially support up to 100 MW of energy production. A similar blind system can be observed at the Cerro Pabellón geothermal power plant in northern Chile, which has an installed capacity of approximately 80 MWe.

Any development efforts, particularly in such a remote location, require significant capital and operating expenditures to address geohazards and other challenges associated with the site. These efforts are guided by a business plan based on carefully considered assumptions, which are used to evaluate the internal rate of return (IRR) and net present value (NPV).

This paper will detail the exploration efforts on Mount Augustine in Alaska to this date, offering insights into the potential production capabilities based on the collected data. It will also address the technical and financial challenges of harnessing geothermal energy in such a remote location, situated hundreds of miles from the nearest grid system.