CASE STUDY: Geothermal Exploration - Fairmont Hot Springs

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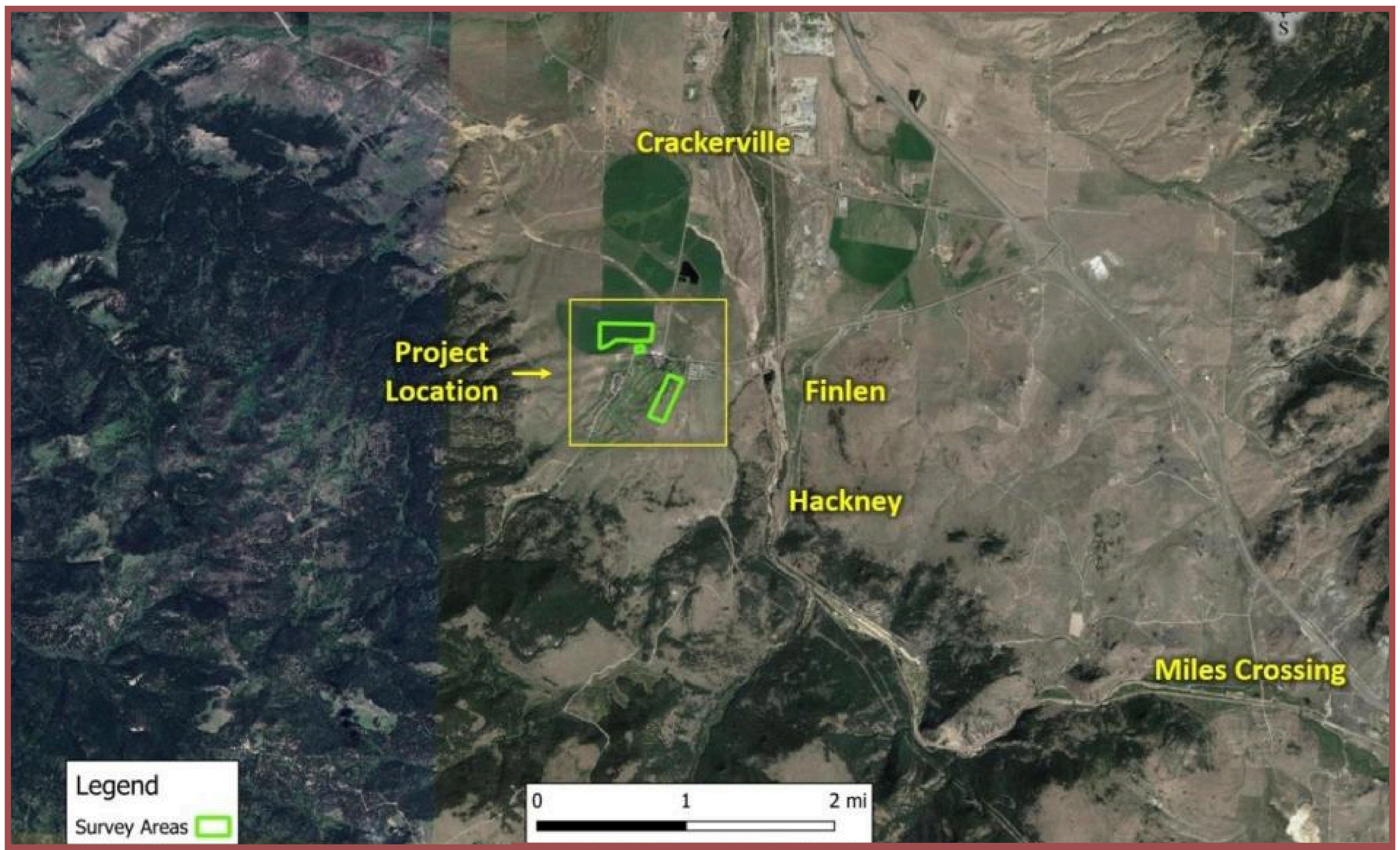
Willowstick LLC



Project Location of Fairmont Hot Springs Montana

Introduction

At Fairmont Hot Springs, Montana, a detailed geothermal investigation was conducted to characterize the fracture-controlled flow systems responsible for the site's long-standing thermal water production. The area's geothermal activity has been sustained by deep-seated faults and fracture zones that serve as conduits for high-temperature groundwater rising from depth. Understanding these structures is essential for developing sustainable production wells and expanding the existing resource while minimizing exploration uncertainty.

Guardian/Willowstick Technologies applied its proprietary Micro-Seismic Resonance (MSR) method to delineate these subsurface pathways. Unlike traditional drilling-based exploration, which provides only localized information, MSR allows for non-invasive detection of stress-relief zones such as sub-vertical fractures and porous gravel layers at depths exceeding 2,000 feet. These stress-relief features are critical in geothermal systems, as they define the architecture of the reservoir and control both temperature and yield.

The results were substantial—achieving a production flow exceeding 600 gallons per minute (GPM) at 180 ˚F (82 ˚C)—demonstrating the success of advanced geophysical methods in geothermal resource development.

SUMMARY

LOCATION

Fairmont, Montana, USA

CHALLENGE

Locating productive geothermal fractures within complex terrain can be uncertain and costly without precise subsurface imaging.

SOLUTION

Guardian/Willowstick applied MSR and gamma surveys to map fracture zones showing the strongest tidal resonance, revealing the most active geothermal conduits.

BENEFIT

The process reduced drilling risk and cost while ensuring access to high-yield, high-temperature zones.

Investigative Approach

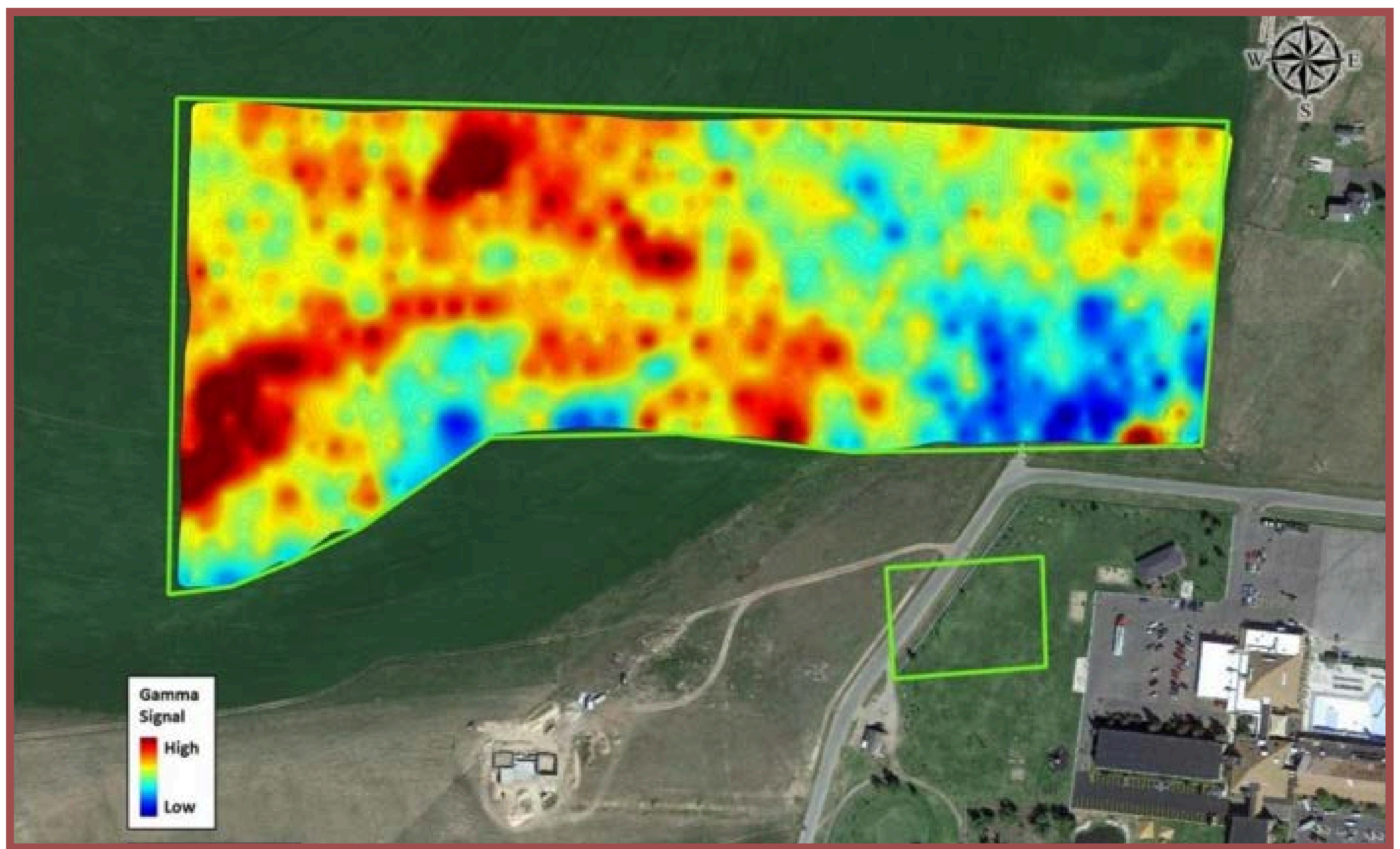
The investigative program began with a regional desktop review to compile existing geological, structural, and thermal gradient data. Fault trace mapping and lineament analysis were performed using high-resolution LiDAR and satellite imagery to determine key fracture trends controlling fluid movement. Publicly available well records and geothermal gradient data were also reviewed to establish context for reservoir depth and recharge dynamics.

Building upon this groundwork, Guardian/Willowstick's field team conducted detailed surveys integrating both Micro-Seismic Resonance (MSR) and Radiometric Gamma data. Gamma readings were collected systematically across targeted transects to measure variations in natural radioactivity—an indicator of lithologic change and fracture permeability. These data were recorded with sub-meter GPS accuracy to ensure reliable spatial correlation with MSR results.

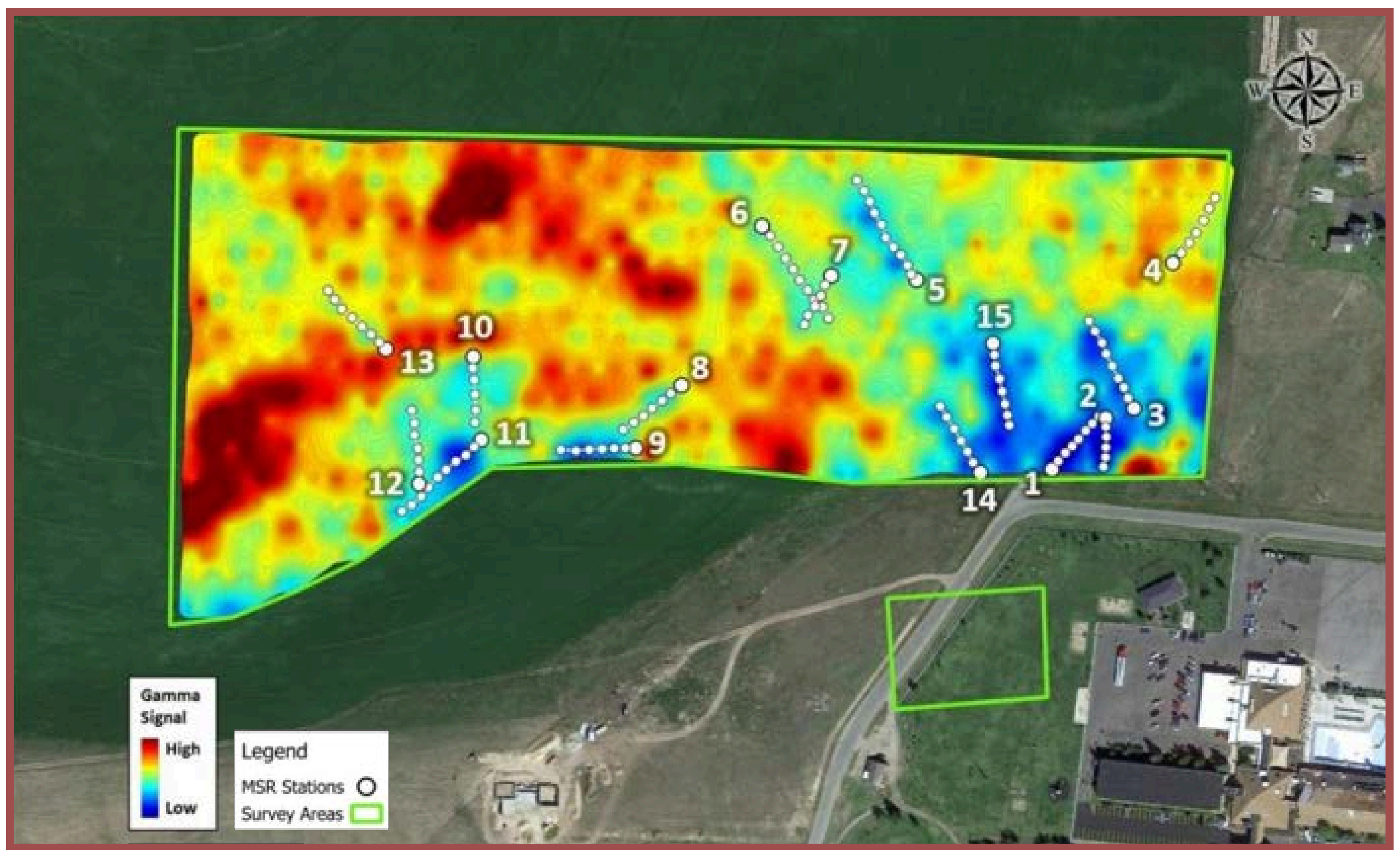
MSR measurements were then acquired along a network of survey lines positioned to intersect major structural features identified during the desktop study. The MSR process detects natural micro-seismic vibrations generated by tidal stress acting on the Earth's crust. When these subtle oscillations interact with subsurface stress-relief zones, they produce resonance signatures that reveal the geometry and connectivity of active fracture systems.

All collected data were integrated into a geo-spatial database and processed using Guardian/Willowstick's proprietary modeling algorithms. The resulting 3D model delineated multiple high-resonance corridors trending northwest–southeast—interpreted as the primary geothermal conduits feeding the Fairmont system. These findings guided drilling efforts toward the most active fracture zones, leading to the successful recovery of high-temperature fluids and confirming the model's accuracy.

Site Map of Study Areas



Gamma Survey Results with Surface Lineaments Comparison



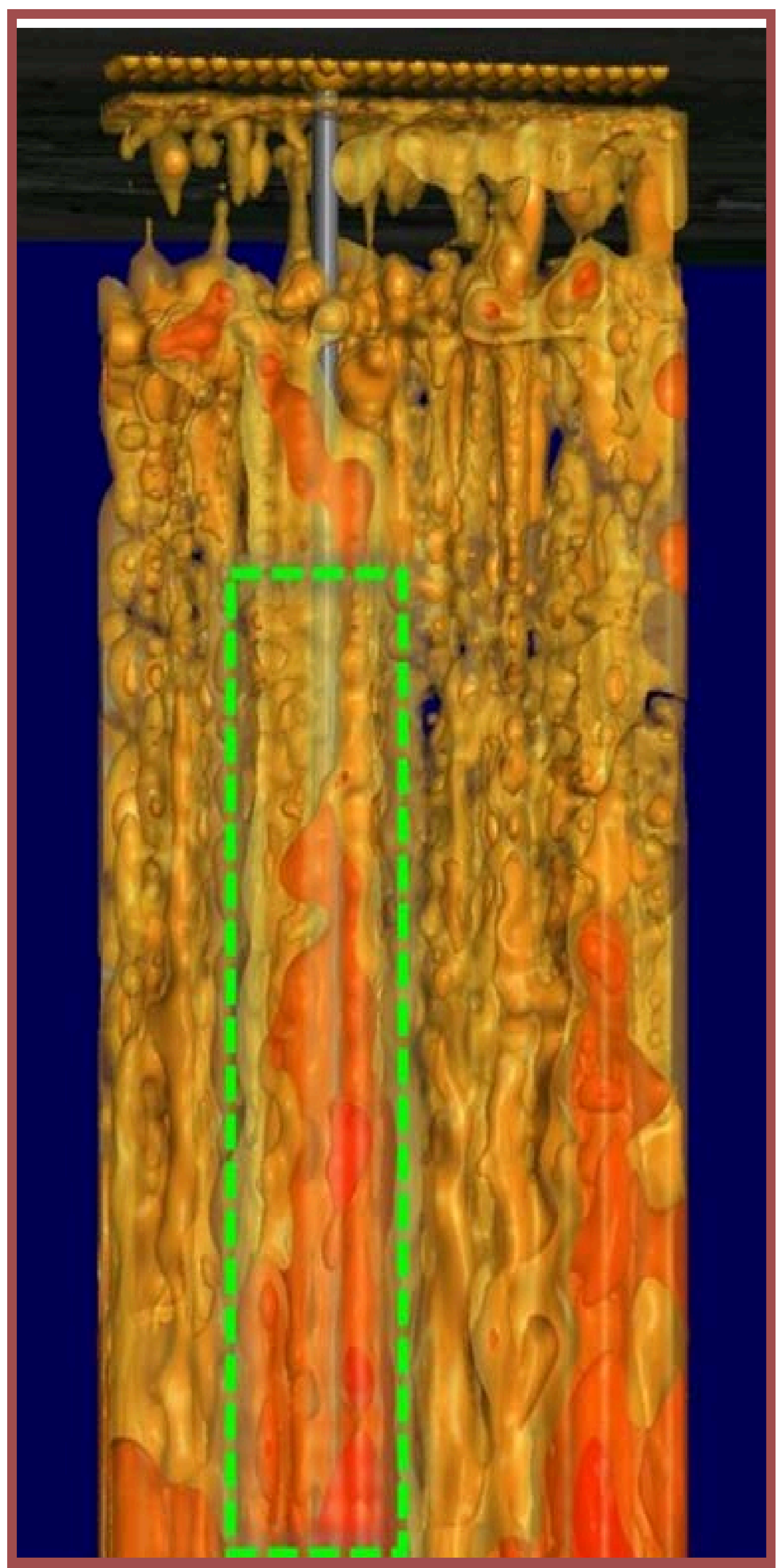
2D MSR Line Locations

Conclusion

This study combined the use of Micro-Seismic Resonance (MSR) and Radiometric Gamma analysis in conjunction with traditional geologic and lineament studies to narrow down and pinpoint drill targets within the Fairmont Hot Springs project area. The approach focused on identifying natural fracture networks that could significantly enhance wellbore reach, particularly within sub-vertical open fracture zones known to support above-average geothermal flow.

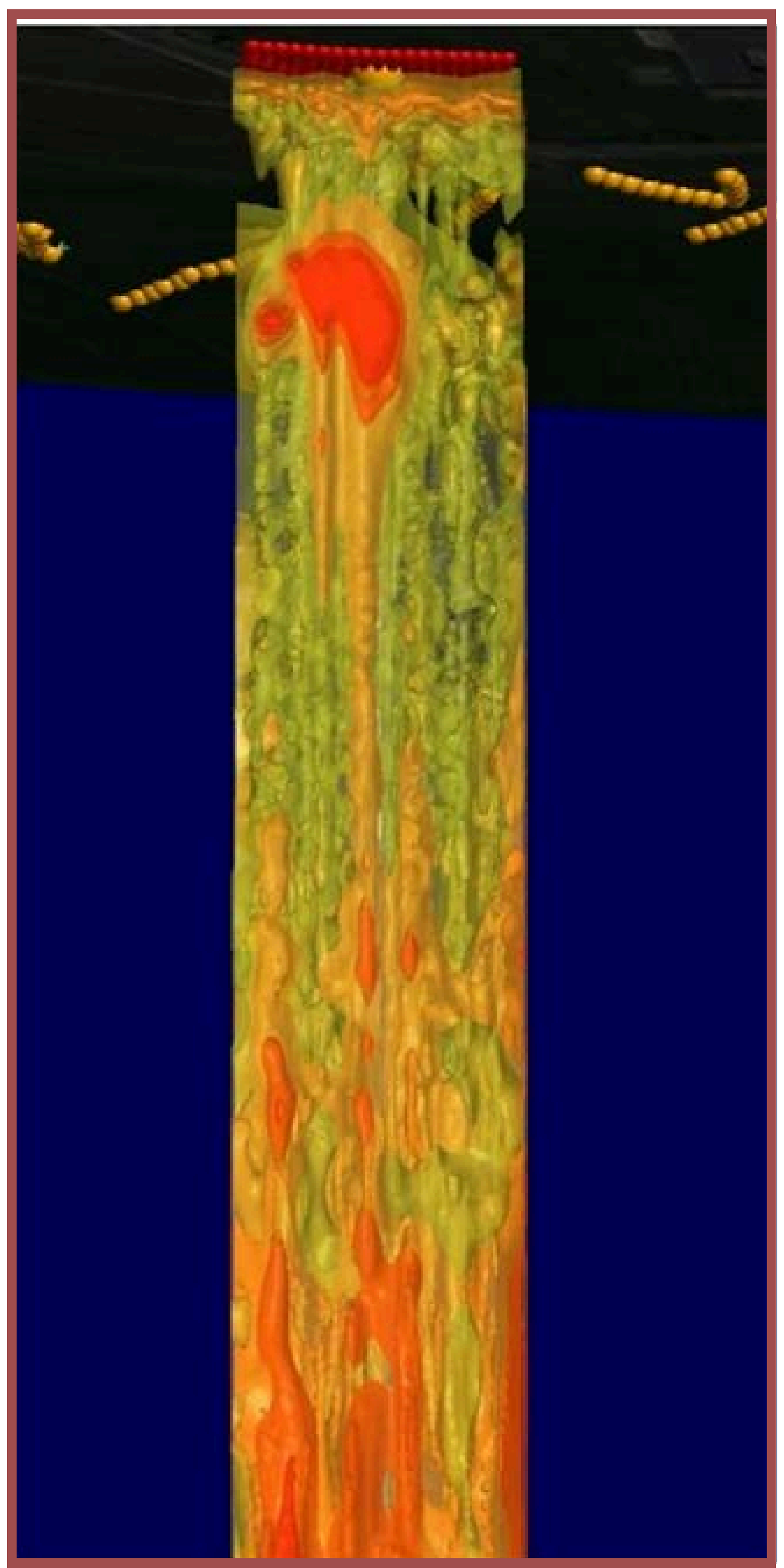
Guardian/Willowstick's experience has shown that targets exhibiting both the MSR and Gamma signatures described in this study tend to yield higher flow rates than typical boreholes, making them strong candidates for productive geothermal development. While these tools provide valuable insight into subsurface conditions, they cannot directly prove or guarantee groundwater production or water quality. An experienced driller remains essential to evaluating formation response and avoiding undesirable zones, particularly when considering regional drilling history and hydrochemical variability.

Line 6-7 3D numerically modeled resonance of MSR grid



Grid Line 16 3D numerically modeled resonance of MSR grid

CT2 Target 3D numerically modeled resonance of MSR grid



HT2 Target 3D numerically modeled resonance of MSR grid

Conclusion Cont.

By integrating MSR, Gamma, and structural lineament data, the investigation successfully narrowed the study area to several highly prospective drill locations. The ultimate goal of this integrated approach is to reduce the inherent risks of geothermal drilling, enabling clients to make informed, data-supported decisions that balance exploration efficiency with operational certainty.

Recommended Drill Targets & Coordinates

GUARDIAN RESOURCES

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