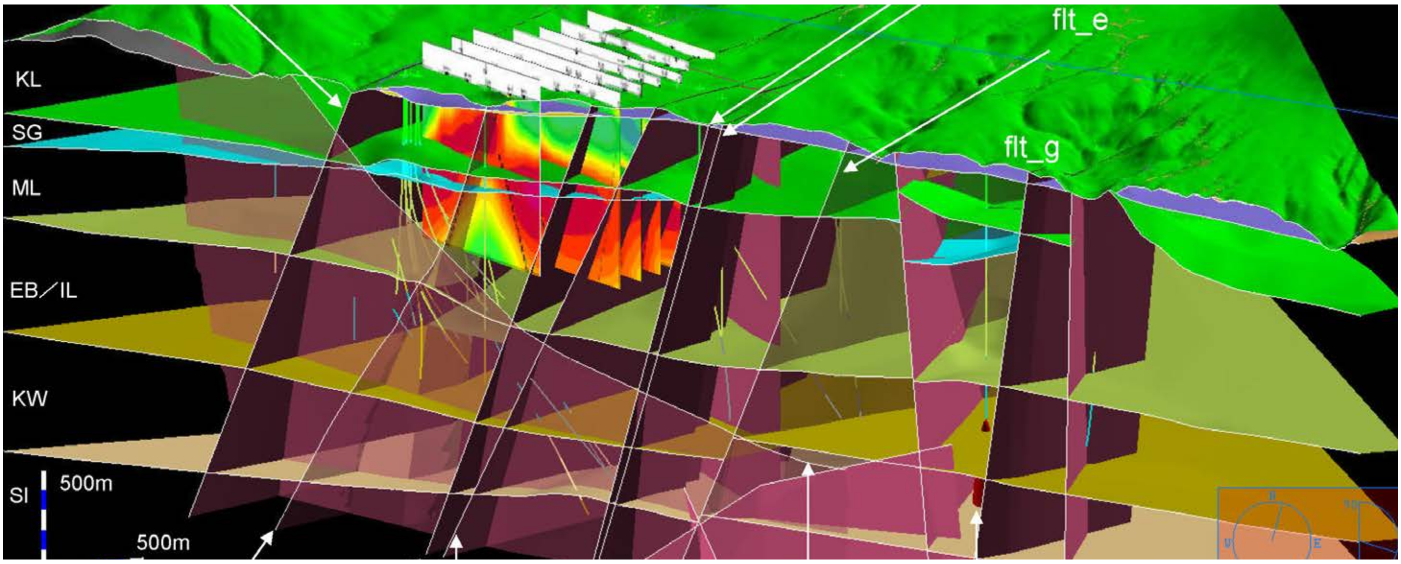
MAPTEK™ Vulcan™

Vulcan guides exploration best practice

Maptek™ Vulcan™ provides the ideal 3D modelling environment when exploring deeper into geothermal resources.



Exploration best practice should aim to reduce the resource risk prior to significant capital investment. For the geothermal energy industry, the high cost of proving the resource is a key challenge.

Understanding subsurface geological structures is critical for planning drilling programs and developing a new geothermal area. Nittetsu Mining used Maptek™ Vulcan™ to build a comprehensive database and model data from the Ogiri geothermal field for 3D analysis.

Nittetsu Mining Co., Ltd was established after separating from the mining division of the former Japan Iron & Steel Co., Ltd (now Nippon Steel & Sumitomo Metal Corporation, Ltd) in 1939. Nittetsu uses Vulcan for managing a copper mine in Chile, project evaluation and data analysis in exploration.

The Ogiri field is situated in the West Kirishima geothermal area, at an elevation of 700-900m on the western flank of Kirishima volcano on the Japanese island of Kyushu.

The Cretaceous basement rock is composed mainly of sandstone and shale, unconformably overlain by Quaternary andesitic lavas and pyroclastic flow deposits with minor interbeds of lacustrine sediments.

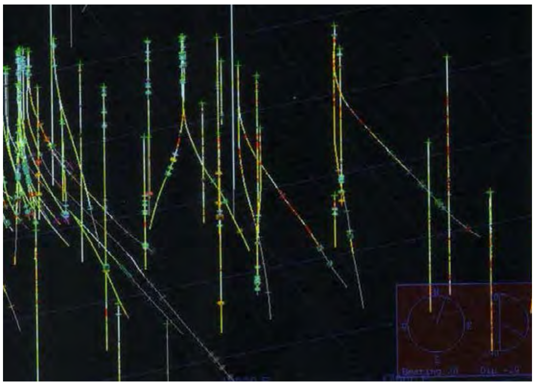
Geothermal signs

Surface geothermal indicators such as fumaroles, hot springs and related alteration zones are generally aligned ENE-WSW and NW-SE. This matches relatively well with the key regional lineaments and indicates that deep fracture systems may control the formation of the geothermal activity and alteration zones.

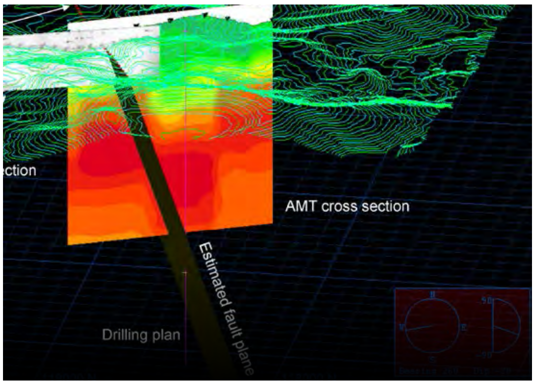
Active geothermal features are evidence of an existing geothermal system on some scale, although not proof of suitability for power generation. The first step in field exploration is to locate and characterise all existing geothermal features within the project area.

A THOROUGH UNDERSTANDING OF THE GEOLOGY OF THE PROJECT AREA AND HOW IT FITS INTO THE SURROUNDING REGIONAL GEOLOGICAL AND TECTONIC SETTING IS CRUCIAL.

Extensive surface geological surveys, electrical and electromagnetic geophysical surveys, and drilling were undertaken by both company and government explorers. From 1973 to 2012, 22 exploration wells, 14 production wells and 10 reinjection wells were drilled.



Contact with fault planes and lost circulation points represented as disks on the well trajectories indicating alteration rates



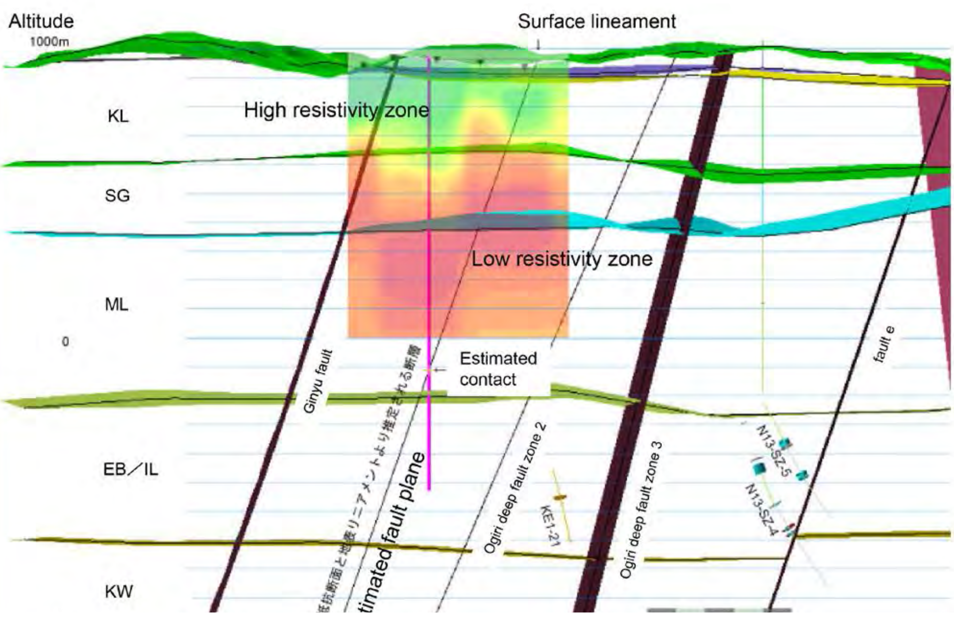
Targets for drilling with cross-section showing resistivity

The location of existing drillholes, geological boundaries, fault plane contacts, downhole lithologies, silica formation temperatures, homogenisation temperatures of fluid inclusions, estimated equilibration temperatures, and magnetic susceptibility data were collected and compiled.

Microseismic monitoring data with interpolated hypocentre locations from surrounding geothermal fields were also collated.

Vulcan CAD tools were used to import existing mapping data, drillhole locations and attributes, enter new points, contours and lines in 3D and join them to form planes and curvilinear surface models of subsurface geology and fault structures.

Geophysical data imagery, including cross-sections showing resistivity and seismic reflections were registered in 3D.



A section view showing distribution of hydrothermal minerals on the well trajectory. In this case alkaline altered minerals. Projection width is 50m from front and back wall to the section line.

Targeting reservoirs

The distribution of hydrothermal alteration strength and mineral distribution is key to targeting prospective geothermal reservoirs. This non-numerical data was coded into range bands and added to the database. Alteration minerals were classified in each alteration zone as acidic, acidic to neutral, neutral or alkaline. This data was compiled into a Vulcan database for modelling.

Contours imported from survey data were modelled to provide a terrain surface model which provided context when visualising the modelled well drilling, geological and geophysical data.

Drillhole observations of lost circulation during drilling and faulted ground are potential indicators of geothermal fluid traps. Their spatial locations were displayed using scaled disks.

Modelling identified a 1.3 km linear zone where no drillholes existed. This was targeted with magnetotelluric geophysical surveys to determine the orientation and inclination of the prospective zone.

An exploratory drilling program was planned to intersect the 70° dipping fault plane at depth. The drillholes successfully intersected a geothermal reservoir at the predicted location.

This result indicates the value of conducting rigorous 3D modelling in Vulcan for efficient management of geothermal data for resource development.

Further work is planned to use Vulcan data interpolation functions to build block models of temperature distribution and resistivity of the geothermal reservoir. This is expected to lead to identification of additional prospective exploration targets for future geothermal development.

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