

Geodiversity of geothermal fields in the Taupo Volcanic Zone

Ashley D. Cody

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Ashley D. Cody

Geothermal consultant, Rotorua

ABSTRACT

High-temperature geothermal fields and the surface features they produce are some of the rarest geological features on earth. The geothermal fields of the Taupo Volcanic Zone (TVZ), North Island, New Zealand, exhibit a wide range of geothermal phenomena including hot and boiling springs and streams, geysers, silica sinter deposits, mudpools, fumaroles, hot and steaming ground, altered ground and hydrothermal eruption craters. A number of these fields have been developed for heating, industrial and electricity generation purposes, so that many of their associated geothermal features have been damaged or destroyed. Flooding by hydroelectric lakes, and activities such as farming and forestry have also led to damage or loss of features. The remaining geothermal features have been assessed and ranked on the basis of their variety and naturalness to provide a systematic comparison across the fields in an objective and transparent manner. This work involved the collation of detailed information on each geothermal field (including the range of geothermal features present, their physical and chemical characteristics and conditions, and extent of modification); the collation of details on the variety of geothermal features present in each field; and the ranking of each field based upon the features present and their qualities. These data were collated into three spreadsheets. As the pressure to develop geothermal fields is continuing, the ranking can be used to help assess the fields' geodiversity, and inform decisions on what should be conserved and what development should be allowed.

Keywords: geothermal fields, geothermal features, geodiversity, conservation, development, Taupo Volcanic Zone, New Zealand

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1. Introduction

Geodiversity is the natural diversity of geological, mineral, landform and soil features, and the processes that have formed them. Geomorphological and geological conservation—increasingly referred to as ‘geoconservation’—is concerned with the protection, active management or interpretation of geodiversity for its intrinsic, ecological and geoheritage values.

Geoconservation is complementary to biological conservation, as it seeks to conserve the non-living aspects of the natural environment as well as directly conserving habitats. The geoconservation values of significant phenomena can be degraded by human activities that either change the significant and valuable features of a site, or change the natural processes controlling the existence or continuing development of the feature.

1.1 GEOTHERMAL GEODIVERSITY

Some of the rarest geological features on earth are high-temperature geothermal fields and the surface features they produce. High-temperature geothermal fields occur in places where magma (molten rock) is able to move close to the earth’s surface. Deep faults, rock fractures and pores allow groundwater to percolate down from the earth’s surface towards the heat source, where it becomes heated to high temperatures (> 300°C). Because hot water is less dense than cold water, it tends to rise back towards the surface, where it may form natural features such as boiling springs, geysers, mudpools, etc. The hot water may also form underground reservoirs that can be drilled to provide hot water and steam for electricity generation (e.g. Wairakei Power Station, which has now been operating for almost 50 years) or other industrial and heating applications. The geothermal fields of the Taupo Volcanic Zone (TVZ) are shown in Fig. 1.

The natural features associated with high-temperature geothermal fields include hot and boiling springs and streams, geysers, silica sinter deposits, mudpools, fumaroles, hot and steaming ground, hydrothermal eruption craters, and altered ground. These features are very susceptible to damage from activities associated with all forms of land modification, but particularly farming, forestry and mining (e.g. for sulphur). They can also be damaged or destroyed by extraction (through wells) of water and steam from the underground reservoir. Another threat in the TVZ has been flooding by lakes formed behind dams constructed for hydroelectricity generation.

At present, a number of geothermal fields in the TVZ are being used for heating, industrial and electricity generation purposes; many of the natural features associated with these have been damaged or destroyed (e.g. the former Geysers Valley at Wairakei). Other fields have some degree of protection from development (e.g. Waiotapu), and some have not been developed and are not protected. There is an increasing demand for geothermal energy development in the TVZ and a corresponding need to identify those geothermal fields and features that need to be protected to ensure that a representative array of geothermal geodiversity is preserved.

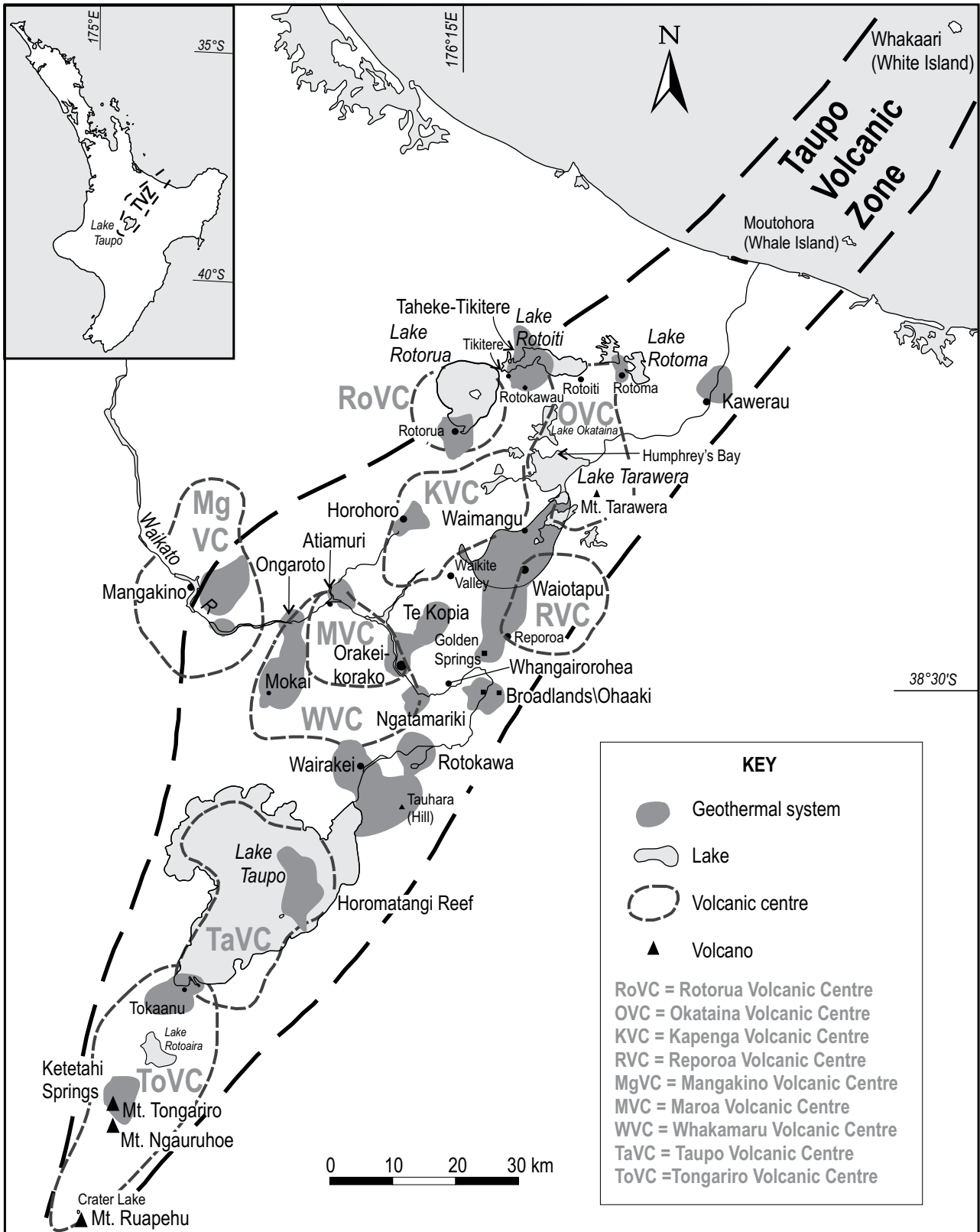


Figure 1. Map of Taupo Volcanic Zone showing location of geothermal fields. Source: Environment Waikato Regional Council. Map by L. Cotterall.