



Monitoring and mapping of hydrogen sulphide emissions across an active geothermal field: Rotorua, New Zealand

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Abstract

Hydrogen sulphide (H₂S) is one of a number of gaseous species associated with geothermal activity in the Taupo Volcanic Zone (TVZ), New Zealand. The city of Rotorua is located within Rotorua Caldera in the TVZ and is one of the few urban areas in the world where a large population (>60,000 people) is frequently exposed to geothermal emissions. In order to evaluate the health hazard from long-term exposure to H₂S being emitted from the Rotorua geothermal field, a passive sampler has been developed to measure concentrations of H₂S at many locations across the city simultaneously. In contrast to other passive or pump-based samplers, the sampler is inexpensive, easily mass-manufactured, and involves the reaction of H₂S with silver halide contained in treated photographic paper. H₂S-exposed paper shows a distinct colour change from white to dark brown as H₂S concentrations increase and is sensitive to concentrations between $\ll 30$ and around 1000 ppb. Rotorua city can be divided into three regions—an area of low H₂S concentration in the west, a ‘corridor’ of high concentrations running north–south through the city centre where H₂S is being emitted, and an area of medium concentration to the east which is influenced by the prevailing wind direction, creating a plume from the central corridor. The data give new insight into the subsurface routes of degassing in the Rotorua geothermal field, by showing the surface expression of the main upflow zone and the direction of the conjectured faulting below.

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1. Introduction

Hydrogen sulphide (H₂S) is a corrosive gas known to be acutely toxic in high concentrations. It is one of a number of gaseous species (including HCl, SO₂, CO₂ and H₂O) associated with geothermal activity in the

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Taupo Volcanic Zone, New Zealand. The city of Rotorua is located within the active Taupo Volcanic Zone, and is one of the few urban areas in the world where a large population (>60,000 people) is frequently exposed to geothermal emissions. The geysers, hot pools and warm ground have been exploited for centuries and are a world-renowned tourist attraction.

Little is known about the chronic long-term health effects of breathing low concentrations of H₂S. A medical study carried out in 1998 by a local health authority, Eastbay Health, for the New Zealand Ministry of Health, on the long-term health effects of H₂S on the Rotorua population required a map of H₂S concentrations across the city. In this paper, we give details of a year-long study established to map H₂S concentrations across Rotorua city. The results

give valuable insight into the subsurface routes of degassing in the Rotorua geothermal field.

1.1. Geological setting

The Taupo Volcanic Zone (TVZ) in the central North Island, New Zealand (Fig. 1), is the continental margin segment of the Tonga–Kermadec–New Zealand subduction system associated with subduction of the Pacific Plate beneath the Australian Plate. The region is distinguished by anomalously high heat flow (4200 ± 500 MW, Bibby et al., 1995), some 20 mapped geothermal systems (Giggenbach, 1995) and eruption of voluminous rhyolite ignimbrites from at least eight calderas over a 2-Ma time span (Houghton et al., 1995; Wilson et al., 1995).

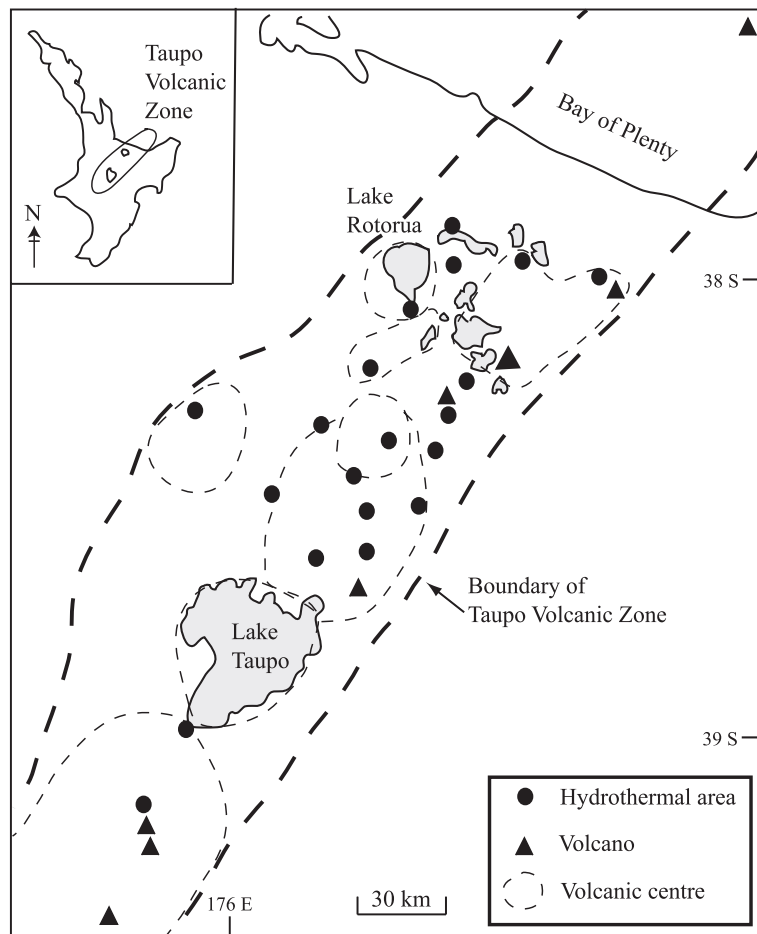


Fig. 1. Map of Taupo Volcanic Zone showing volcanic centres and geothermal areas.

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