Radon activity around active faults in a geothermal environment

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Variation in radon gas concentration has been associated with faults and faulting processes at several locations globally. The Central Taupo Volcanic Zone (TVZ) is an active volcanic rift which hosts more than 20 geothermal fields. The geothermal activity is only occasionally associated with fault traces visible at surface, however it is possible that many active faults have been buried by recent volcanic deposits (blind faults). In order to detect these faults and their prospectivity for geothermal energy, soil gas Radon surveys have been proposed over areas potentially hosting blind faults.

We surveyed soil gas around the Rehi fault and the Paeroa fault, both substantial faults (i.e. slip rates 0.5-1.5 mm/yr) in the TVZ, with the purpose of showing the relationship between soil gas Radon activity and active faults. We used a electrostatic precipitation Radon detector (Durridge RAD7) to measure Radon activity of two Radon Isotopes (^{220}Rn and ^{222}Rn) in soil gas sampled at 1m depth. We also collected several soil samples at the location and depth of the gas measurements, for further testing of Radon emanation potential in a laboratory setting.

Our data show a clear relationship between faults and Radon activity at several locations. However, the isotope activity ratios and the laboratory testing show that this activity variation is in most cases due to shallow and local soil processes, not faulting processes This leads us to conclude that in the TVZ measuring Radon activity in soil gas may not be a reliable technique for detecting faults in the sub-surface.

Exceptionally high Radon activity for ^{220}Rn and ^{222}Rn isotopes was however recorded in steam vents around the Waikite geothermal spring, a boiling bicarbonate spring which flows at ~60 l/s at the base of the Paeroa fault scarp. Preliminary data support the idea that the Radon isotopic ratio can be used to determine the travel time and flow path of steam from the source to the detector. These Radon isotopes constrain the flow model for the Waikite geothermal spring and could be used in envrionmental and hydrological studies of other bicarbonate geothermal springs.

Characterization of Baddeleyite Oxygen Isotopes and Microstructure

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The oxygen isotopic composition of Precambrian mafic and alkaline rocks is often difficult to determine by conventional methods due to overprinting by hydrothermal alteration or metamorphism. Baddeleyite (ZrO_2) is a uranium-bearing accessory phase in these rocks, and due to improved extraction and *in situ* techniques is increasingly targeted for U-Pb geochronology. We have investigated the $\delta^{18}O$ composition of baddeleyite from various settings to assess its suitability for recording primary $\delta^{18}O$ values, potentially creating a valuable tool for tracing magma petrogenesis through time.

SIMS oxygen isotope analyses of potential mineral standards (baddeleyite megacrysts from Phalaborwa and Mogok) have uncovered various analytical complexities relating to matrix and orientation effects between baddeleyite and the incoming ion beam.

Here we present oxygen isotope data from metamict and thermally annealed baddeleyite. We have characterised the degree of metamictization using Raman spectroscopy, cathodoluminescence imaging and EBSD analysis. With the crystallographic information, we show how crystal orientation and degree of metamictization affect the instrumental mass fractionation during SIMS analysis, and how these affects can potentially be mitigated.

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