Supplement of Sci. Dril., 33, 67–88, 2024
https://doi.org/10.5194/sd-33-67-2024-supplement

Scientific Drilling
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Supplement of

CALDERA: a scientific drilling concept to unravel Connections Among Life, geo-Dynamics and Eruptions in a Rifting Arc caldera, Okataina Volcanic Centre, Aotearoa New Zealand

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Technique	Main findings	Reference
Mapping, dating	~625 ka of effusive and explosive activity but history prior to ca. 340 ka is poorly defined due to scarce exposure. Up to four caldera-forming ignimbrite eruptions have occurred: two definite collapses (ca. 322 ka Matahina and ca. 45-61 ka Rotoiti/Rotoehu) and two possible collapses (ca. 557 ka Utu and ca. 33 ka Mangaone/Kawerau).	Manning (1996), Nairn (2002), Leonard and Begg (2010), Cole et al. (2010, 2014)
3-D geological model	3-D geological model of the basement top surface based on the geology map, active fault map and gravity inversion.	Carson et al. (2022)
Whole-rock chemistry: major, trace ± isotopes	Compositions and mineralogies of the Rotoiti and post-Rotoiti magmas are well-characterised. Older eruptions characterised in varying detail.	Schmitz and Smith (2004), Smith et al. (2005, 2006), Deering et al. (2011), Rowe et al. (2021)
Estimates of magma storage conditions	Pressure, temperature and oxygen fugacity estimates available for the Rotoiti and all subsequent rhyolitic eruptions (and some basaltic), plus some older units.	Hughes et al. (2023), Smith et al. (2005), Deering et al. (2008)
Rock samples with various parameters measured	Over 620 rock samples in the PETLAB public database.	GNS Science (2004)
LiDAR, active fault mapping	Numerous faults outside the OVC, but no fault nor graben structures that could be associated with shallow arrested dikes intra-caldera.	GNS Science (2004), Villamor et al. (2011)
Paleoseismology	World-class (48 paleoseismic trenches), with clear examples of volcano-tectonic interactions and of ruptures that do not coincide with eruptions.	Villamor et al. (2011, 2022), Berryman et al. (2022)
Multi-geophysical inversions	Main intra-caldera magma location defined from MT aligns with subsidence of 10-15 mm/year by InSAR, the -60 mGal gravity low and numerous earthquake hypocenters.	Bannister et al. (2022), Bertrand et al. (2022), Hamling et al. (2022), Miller et al. (2022)
Gravity (terrestrial and lake) data at ~500 m spacing	Delineate the overlapping and nested structural boundaries of collapse events.	Miller et al. (2022)
Aeromagnetic data	Delineate solidified magma feeder structures beneath the caldera, infilling lava domes and small areas of hydrothermal alteration.	Miller et al. (2022)
3D magnetotelluric inversions to 20 km depth from ~2 km station spacing	Image the main upwelling of magma and hydrothermal fluids under Makatiti dome, and secondary upwellings towards the caldera margins.	Bertrand et al. (2022)

InSAR, Geodetic data	InSAR images for the last 20 years and GNSS geodetic stations show subsidence across the OVC and surrounding areas of up to ~15 mm/yr.	Hamling et al. (2022)
Seismicity	Illuminates active faults and inferred deep dike intrusion. Seismic anisotropy shows complex stress directions near the caldera, contrary to rift-aligned directions in-between calderas.	Bannister et al. (2016, 2022), Illsley-Kemp et al. (2019), Benson et al. (2021)
Fluid geochemistry	Fumarole, spring, and shallow groundwater chemistry.	Databases: Geonet, GGW. Stucker et al. (2016, 2023), White and Leonard (2023)
CO_2 flux surveys	Multiple soil and lake CO_2 flux surveys across the caldera show that magmatic gases reach the surface along highly heterogeneous pathways.	Mazot et al. (2014), Hughes et al. (2019), Yang et al. (2023)
Groundwater	Hydraulic conductivity, groundwater quality and age were measured in three <100 m-deep groundwater wells to support a groundwater flow model of the Tarawera Lake catchment assessing land use and nitrogen discharge.	Bruere and White (2016), White and Leonard (2023)
Geothermal exploration well	The RM1 well drilled to 1498 m (in 1995, no longer accessible) suggested vertical and lateral flows of both hydrothermal fluids and groundwater.	Bromley and Nairn (1995)
Natural hazard monitoring by GeoNet	Near-real-time, publicly available data from 13 GNSS stations and short-period seismometers, two strong-motion sensors, two springs for water temperature and level, and annual fluid chemistry from eight springs and one fumarole.	Geonet
Multi-disciplinary surveys of the lakes	Bathymetry, gravity, magnetics, heatflow, water column measurements.	Caratori Tontini et al. (2016, 2023), de Ronde et al. (2016), Tivey et al. (2016), Walker et al. (2016)
Biosphere: physical, chemical, and microbial biodiversity	Diverse microbiota have been identified through extensive sampling of hot springs in the TVZ. The genus *Venenivibrio* (phylum Aquificota) appears to be endemic to Aotearoa-New Zealand.	Sharp et al. (2014), Ward et al. (2017), Power et al. (2018, 2024), Sriaporn et al. (2021)

Supplementary material Table 1: Summary of datasets collected in the OVC region and their main findings.

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