Testing efficacy of zircon ($^{238}U/^{230}Th$) + (U-Th)/He and radiocarbon dating methods on the New Zealand late Quaternary tephras

MARTIN DANIŠÍK[1,2*], PHIL SHANE[3], AXEL K. SCHMITT[4], ALAN HOGG[5], GUACIARA M. SANTOS[6], NOREEN J. EVANS[2,7], SONJA STORM[3], KEITH FIFIELD[8], JAN LINDSAY[3]

[1]The University of Waikato, Hamilton, New Zealand, m.danisik@waikato.ac.nz (* presenting author)
[2]John de Laeter Centre for Isotope Research, Curtin University, Perth, Australia
[3]University of Auckland, Auckland, New Zealand, pa.shane@auckland.ac.nz, s.storm@auckland.ac.nz, j.lindsay@auckland.ac.nz
[4]University of California Los Angeles, Los Angeles, USA, axel@oro.ess.ucla.edu
[5]Radiocarbon Laboratory, University of Waikato, Hamilton, New Zealand, alanh@waikato.ac.nz
[6]University of California, Irvine, USA, gdossant@uci.edu
[7]CSIRO, Perth, Australia, Noreen.Evans@csiro.au
[8]Australian National University, Canberra, Australia, Keith.Fifield@anu.edu.au

Combined $^{238}U/^{230}Th$ disequilibrium and (U-Th)/He dating of zircon [1] is a novel approach for dating young (<350 ka) volcanic eruptions. This method with great potential for the Quaternary geochronology has been successfully applied in various settings [e.g. 2,3], however its accuracy and limitations has not been rigorously tested and validated by independent methods. New Zealand's record of late Quaternary tephras provides an excellent natural laboratory for conducting such inter-calibration experiments.

In this study we apply the combined $^{238}U/^{230}Th$ disequilibrium and (U-Th)/He zircon dating to the deposits of the coeval Rotoiti and Earthquake Flat eruptions in the Taupo Volcanic Zone to investigate consistency of the method. In addition, wood sampled below and above the Rotoiti tephra is dated by high-precision radiocarbon method to provide independent constraints on the accuracy of the zircon eruption ages.

Results and Conclusion

The two independent methods revealed concordant ages, which are also in accord with the stratigraphic position of the samples. Based on these results we assign new ages of ~45 ka to the Rotoiti and Earthquake Flat eruptions. This is by ~16 kyr younger than the currently accepted age, which has implications for paleoclimatic reconstructions and volcanic hazards assessment in the Taupo Volcanic Zone. This study proves the combined $^{238}U/^{230}Th$ disequilibrium and (U-Th)/He dating of zircon reliable at late Quaternary time scale and also demonstrates demonstrates reliability of the radiocarbon dating method at higher end of its sensititvity at ~50 ka.

[1] Schmitt *et al.* (2006) *J. Volcanol. Geoth. Res.* **158** (3-4), 281-295. [2] Schmitt *et al.* (2010) *Earth Planet. Sci. Lett.* **295** (1-2), 91-103. [3] Schmitt *et al.* (2011) *Contrib. Mineral. Petrol.* **162** (6), 1215-1231.

The Pantelleria shallow plumbing system: extreme differentiation processes and dynamics in an intraplate volcanic field

MASSIMO D'ANTONIO [1,2*], ROBERTO MORETTI[3,2], LUCIA CIVETTA[1,2], AND GIOVANNI ORSI[2]

[1]Università di Napoli "Federico II", Napoli, Italy, masdanto@unina.it (* presenting author)
[2]Istituto Nazionale di Geofisica e Vulcanologia, Sezione Osservatorio Vesuviano, Napoli, Italy
[3]Seconda Università di Napoli, Napoli, Italy

The island of Pantelleria, the type locality for pantelleritic rocks, is an active volcanic field located in the Sicily Channel Rift Zone, an intraplate setting affected by transtensional tectonics related to the complex geodynamics of the Western Mediterranean area. The island, dominated by a nested, resurgent caldera, has been affected by regional tectonism and volcano-tectonism that controlled both evolution of the magmatic system and distribution of eruption vents. The eruptions were fed through time by magmas of variable composition, typically bi-modal, both mafic and silicic. The island is divided into two sectors by a NE-SW fault system, which likely represents a crustal discontinuity along the axial ridge of the rift. The north-western sector, affected only by NW-SE crustal structures, includes most of the exposed transitional to alkaline basaltic rocks. The south-eastern sector includes silicic peralkaline rocks, variable from comenditic trachyte to rhyolite (pantellerite). Eruption of differentiated magmas and occurrence of the nested caldera, suggest that crustal magma chambers were established in this sector, probably at the intersection of the main tectonic lineaments. On the other hand, eruption of abundant mafic magmas in the north-western sector of the island suggests a deeper plumbing system linked to the mantle source region. The geochemistry of volcanics representative of the younger-than-15 ka activity has been investigated with the aim of better understand the magmatic processes governing the behaviour of the Pantelleria shallow plumbing system. The investigated volcanic rocks, products of both explosive and effusive activity, range in composition from comenditic trachyte to pantellerite, matching the typical range of evolved peralkaline composition of Pantelleria. Alkali-feldspar-rich enclaves are common in these rocks, testifying to diffuse mingling phenomena. Electron microprobe and micro-Raman analyses of interstitial glass of enclaves has revealed unusual compositions even more evolved than the host rocks. These data, integrated with recent experimental petrology results on peralkaline silicic magmas, allowed us to put forward hypotheses on the extreme differentiation processes and dynamics occurred within the Pantelleria shallow plumbing system in the past 15 ka.