Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.35931

Evolution of the mantle melting regimes and plumbing system in the Mount Melbourne Volcanic Field, Antarctica

IRENE ROCCHI[1], PIER PAOLO GIACOMONI[1], ALESSIO DI ROBERTO[2], MATTEO MASOTTA[1,3] AND SERGIO ROCCHI[1,3]

[1]University of Pisa
[2]Istituto Nazionale di Geofisica e Vulcanologia
[3]Center for Instrument Sharing of The University of Pisa (CISUP)

The Mount Melbourne stratovolcano and its peripheral vents form the Mount Melbourne Volcanic Field (MMVF), one of the largest and longest-lived volcanic systems in northern Victoria Land, Antarctica, with the oldest products dated at 4.1 Ma. The temporal variability of magma compositions provides an opportunity to investigate the evolution of mantle melting conditions and crustal magma transfer. To explore this variability, we acquired LA-ICP-MS trace-element data on a suite of glass shards from proximal pyroclastic deposits across several Cenozoic volcanic centres of the MMVF, revealing the existence of systematic compositional patterns. In mafic glasses, trace-element signatures primarily reflect mantle-source characteristics, whereas intermediate compositions record processes within the crustal plumbing system.

The La/Nb ratios of mafic glass shards define two partially diverging trends, suggesting a temporal evolution in the characteristics of an enriched mantle source. Moreover, the oldest eruptions display notably high Nb, Zr, Rb, and Sr contents, consistent with decreasing degrees of partial melting from older to younger products. Variations in REE fractionation further support this interpretation: the most enriched signatures occur in the oldest outcrop, indicating low degree of partial melting and deeper melt segregation, whereas younger volcanic centres record progressively higher melt fractions at shallower conditions.

Within this framework, the oldest samples document an early magmatic stage predating the construction of the Mount Melbourne central edifice, pointing to an evolution of the MMVF plumbing system from fissure eruptions to scattered vents and ultimately to a central volcano. As magmatism evolved toward higher melt productivity and conditions favouring the generation of increasingly evolved magmas, volcanic activity shifted toward the development of a central edifice. Overall, the trace-element patterns indicate that the MMVF evolved through a combination of mantle-source enrichment and temporal changes in melting conditions, reflecting not only variations in source composition and melt productivity but also the progressive maturation of the MMVF plumbing system.