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Heterogeneous upper mantle melting in Mayotte evidenced by noble gas isotopes in the Fani Maoré lavas

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Recycling of oceanic lithosphere generates chemical heterogeneities in the Earth's mantle, whose expression depends on tracer behavior and melting conditions. Lithophile and atmophile isotopes may record contrasting signatures due to their differential behavior during subduction and mantle processes. We investigate the mantle source of the Fani Maoré lavas (Mayotte, Comoros archipelago), erupted during the largest documented submarine volcanic eruption, using the first comprehensive noble gas isotope dataset (He-Ne-Ar-Xe) obtained for the Comoros, combined with published lithophile isotope constraints. Noble gases were measured by stepwise crushing of pristine lava fragments. The glassy rims of the Fani Maoré lavas are exceptionally gas-rich ("popping-rocks"), enabling high-precision constraints on mantle source characteristics. Lithophile isotopes require the involvement of an ancient recycled component, characterized by a high time-integrated U/Pb ratio, consistent with long-term radiogenic ingrowth and commonly interpreted as a HIMU-type mantle signature. In contrast, noble gases in the Comoros are largely MORB-mantle like (DMM), with minor recycled atmospheric contributions and no evidence for a primordial deep-mantle plume input. This apparent decoupling may result from low-degree partial melting, which preferentially samples recycled fertile heterogeneities in the upper mantle. This generates HIMU-like lithophile signatures, while these components are likely largely degassed and contribute little to the noble gas budget. Consequently, noble gases remain dominated by the surrounding upper mantle peridotite matrix. Fani Maoré magmas could therefore primarily record upper mantle melting and atmospheric recycling rather than a deep plume source. These results provide a rare glimpse of tracer-specific behavior in a very young intraplate volcanic system and highlight how low-degree partial melting can modulate the expression of mantle heterogeneities in intraplate magmatism. They emphasize the value of combining lithophile-siderophile and atmophile tracers to distinguish the contribution of mantle components to magmatism.