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Reconstructing the spatial and temporal evolution of caldera formation on Nisyros, Greece

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We present the preliminary results from a combination of field and lab-based investigations, which form part of a study to reconstruct and gain a fundamental understanding of the caldera-formation of Nisyros volcano, Greece. Nisyros Island is an 8km wide Quaternary strato-volcano located at the eastern-most end of the South Aegean active volcanic arc. It hosts a well-developed 3.8km wide caldera at its centre, and is itself considered to be nested within the larger submarine caldera responsible for the 161Ka Kos Plateau Tuff eruption. The island's caldera is presently affected by intense hydrothermal activity and at least 13 phreatic eruptions have occurred in historical times, most recently in 1888. Nisyros showed signs of unrest in 1995-1998 with a volcano-seismic crisis accompanied by intense ground deformation and increased fumerolic activity.

Two major explosive caldera-forming events appear to be recorded on Nisyros associated with the deposition of the rhyolitic Lower Pumice and Upper Pumice units. These are separated by the voluminous and extensive Nikia Lava Flow. While numerous studies have focused on reconstructing the eruptive sequences of these two explosive events, none have looked in detail at their association with caldera-formation. Consequently there is still considerable ambiguity surrounding the evolution of the present-day caldera, and what, if any, contribution the Nikia Lava Flow may have had.

This study uses a combination of detailed field studies with geochemical and petrological investigations to try to solve these outstanding issues. A particular emphasis is on detailed qualitative and quantitative lithic component studies, supported by juvenile clast geochemistry, within the stratigraphic framework of the Lower and Upper Pumice pyroclastic deposits, to establish spatial and temporal variations in magma chamber-vent processes associated with their eruptions. This, together with the use of isopach and isopleth data from successive fallout deposits, is used to determine eruption volumes and help constrain vent locations. In addition, petrological and geochemical analyses of juvenile samples reveal the chemical differences between the Lower and Upper Pumice units and the Nikia Lava Flow and help constrain magma chamber conditions and differentiation processes. The outcomes of this study are expected to not only shed light on the dynamic processes leading to caldera formation on Nisyros, but also significantly advance our understanding of collapse calderas and the spatio-temporal relationship of their causative processes.