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Syn-eruptive circulation of carbonate-rich fluids and significance on paleoeruption dating

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In the volcanic regions, deformation is caused by shear failure, tensile failure or fluid pressurization processes that produce the ruptures at the tip of magma body. During crustal strain cycles related with volcanism, CO_2-bearing spring waters under high pressure in subsurface reservoirs are mobilized, so that carbonates are precipitated in the fractures that act as conduits for hot waters. Investigation of fracture systems and carbonate veins is thus important for evaluating recent mechanism of crustal deformation and tectonic origin in areas under regional stress. In the current study has been funded by the Scientific and Technological Research Council of Turkey with the project no. 115Y497, we provide direct field evidence of various stress directions and investigate carbonate-filled fracture systems in the Central Anatolian Volcanic Province using U-Th geochronology and isotope geochemistry to evaluate the episodes and sources of multi-eruption centers.
In the region, successive fracture development has been controlled by three main volcanic eruption centers (Acıgöl caldera Hasandag and Erciyes stratovolcanos) within an area of 40 km radius. A number of previous studies reported paleoeruption events with different techniques on extrusive materials (at least 35 volcanic events in the region for the last 700 ka). However, paleoeruption dating on extrusive materials has been a major challenge because of the difficulty in distinguishing the field relationships of volcanic products in spatial and temporal patterns. For example, in volcanic successions, heating of old rocks in contact with relatively younger one could reset ages, rendering the identification of stratigraphic sequences of extrusive materials difficult. Commonly, there are also unrecorded and unpreserved volcanoclastic layers due to depositional and erosional processes.
We focused on two different travertine deposition sites in the region; Ihlara and Avanos. Trace element, and stable (C and O) and radiogenic (Sr) isotope compositions of carbonate veins indicate different fluid migration pathways for different fracture systems. This situation is attributed to the crustal deformation controlled by different sources in the region. The U-Th age data for carbonate veins of Ihlara site indicate that the crustal deformation intensified during 7 episodic periods in the last 150 ka. Although studies in the Avanos site are still in progress, the periods of carbonate precipitation inferred from U-Th age distributions in this study are comparable with the previous dating results of surrounding volcanic eruption events. As a result, investigation of fracture systems and carbonate veins in volcanically active regions are useful to determine the time and source of paleoeruption events.