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This Rift is on Fire: Volcano-Tectonic Evolution of the Christiana-Santorini-Kolumbo volcanic field, Aegean Sea

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Many of the most hazardous volcanoes lie in rift systems, where tectonics often seems to exert control on magma emplacement. However, our current knowledge of the interplay between volcanism and tectonics is immature due to the lack of observations on geological time scales. Located in the southern Aegean Sea, the Christiana-Santorini-Kolumbo (CSK) volcanic field lies in a prominent continental rift zone caused by back-arc extension along the Hellenic Arc. Covered by numerous geophysical surveys, this area offers the unique possibility to reconstruct a volcanic rift in time and space. Previous studies have revealed that the CSK volcanic field developed during four distinct volcanic phases, which initiated in the Pliocene and only recently matured to form the vast Santorini edifice. Here, we combine P-wave velocity tomography models and high-resolution reflection seismic data to reveal the internal architecture and the spatio-temporal evolution of the rift basins as well as their relation to the evolution of the CSK volcanoes. Our joint analysis reveals a distinct NE-SW-directed horst-structure separating the volcanic rift into a volcanically active northwestern zone and a volcanically inactive southeastern zone. Using a refined seismo-stratigraphic framework of the internal architecture of the rift basins, we identify four distinct phases of the rift system that correspond to the volcanic phases of the CSK field. These phases reflect the gradual development of a Pliocene-Pleistocene NE-SW oriented fault system overprinting an older Miocene-Pliocene ESE-WNW oriented fault system. The latest volcanic phase, during which volcanism focussed on Santorini and became highly explosive, corresponds to a distinct shift in the tectonic behavior of the rift system after which enhanced subsidence at the Santorini-Anafi and Amorgos faults occurred that was rapidly filled up by thick volcano-sedimentary deposits. We conclude that the volcanism of the CSK field is fundamentally controlled by NE-SW-directed rifting, which lies parallel to the Pliny and Strabo trends of the southeastern Hellenic Arc. This volcanic system is bounded to the southeast by the Akrotiri-Anhydros horst, which seems to be a deep-rooted structural boundary for the volcanic plumbing system. The shift from ESE-WNW directed faulting to NE-SW directed faulting is an indication that the dominant direction of slab-rollback driving the extension of the CSK rift shifted from the southwestern to the southeastern Hellenic Arc with Santorini lying at the hinge of these trends.