Vent migration and caldera collapse during the Minoan eruption of Santorini

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The late 17th century BC Minoan eruption of Santorini discharged 30-60 km3 of rhyodacitic magma, and minor andesitic magma, and collapse deepened and widened a partially flooded 21 ka caldera already present in the northern half of the volcanic field. The resulting present-day caldera has distinct northern and southern basins, separated by a NE-SW line of tectonic weakness (Kameni Line, KL). Juvenile and accidental component populations from the deposits exhibit systematic variations between the four eruptive phases, allowing reconstruction of vent migration during eruption. The plinian phase (phase 1) discharged rhyodacite and a suite of compositionally distinctive Ba-rich andesites from a subaerial vent situated on the KL. The vent then migrated northwards into the ancient caldera, causing eruption of syn-plinian base surges (phase 2) then cohesive, low-temperature pyroclastic flows (phase 3). The andesitic magma ceased to be erupted as the vent migrated away from the KL. However, the phase 3 tuffs contain abundant black, glassy andesitic lithics that are chemically very similar to the juvenile Ba-rich andesite, and which are pieces of a partly subaqueous lava complex present in the 21 ka caldera prior to the Minoan eruption. Blocks of lava compositionally identical to Minoan rhyodacite were also discharged in abundance during phase 3. The lithic assemblage is uniform throughout phase 3, suggesting a single vent situated within the 21 ka caldera, consistent with Pfeiffers (2001) ballistic data. Phase 4 discharged hot pyroclastic flows that poured into the sea forming three ignimbrite fans (NW, E and S). The first flows (phase 4a) were erupted from one or more vents in the north and laid down lithic-block-rich ignimbrites and lag breccias containing abundant clasts of Tertiary basement. These constitute much of the NW ignimbrite fan, and contain gas escape pipes suggesting that some of the lithic debris was wet when incorporated into the flows. Subsequent flows (phase 4b) were much poorer in block-sized lithics and laid down the hot, fine-grained, tan-coloured ignimbrite typical of phase 4. Package 4b, which accounts for most of the onland ignimbrite, contains only trace amounts of basement clasts, makes up the S and E ignimbrite fans, and overlies package 4a in the NW. The greater thickness of the S and E fans compared to the NW fan suggests that, unlike phase 4a, the phase 4b flows were erupted from the area of the present-day southern basin. Moreover, their hot, dry nature shows that that the erupting vents were subaerial, being sited south of the flooded 21 ka caldera. In summary, the principal eruptive vents migrated from the KL first northwards into the ancient flooded caldera (future northern basin), then southwards onto dry land (future southern basin). Caldera collapse in the north may have begun as early as phase 3, but the southern half of the caldera was still subaerial when the eruption ceased.