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The 2011-2012 Santorini unrest: Swarms of micro-seismicity, crustal deformation and magma pulses

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In 2011-2012 swarms of micro-seismicity were observed in Santorini caldera for the first probably time since its last eruption 60 years ago. This seismicity was along a major extensional lineament (Kammeni Line), in which all post-Minoan eruptions were confined and was characterized by extensional focal mechanisms. GPS observations provided evidence of a somewhat radial deformation, which was assigned to a spherical magma source $\sim$4km deep in the north part of the caldera, about 2km away from the Kammeni Line. Because such a source cannot explain extensional seismicity observed along the Kammeni Line, we investigated alternative intrusion models.
On the basis of seismicity and deformation rates, the unrest period was divided into five intervals each 3-6 months long. Then, using a new inversion method/software we modeled each interval separately for one or two sources. No solution was found possible for the fifth interval, while for the other four there was evidence of a shallow, relative small source at the north part of the caldera; this source tends to overshadow other deeper sources. During intervals of seismicity, the deeper source is identified inside or beneath the Kammeni Line and has the potential to produce the deviatoric stresses and explain the observed seismicity swarms. During the fourth interval, this source was found much smaller and at some distance from the Kammeni Line, in a position not permitting to trigger seismicity. The northern source seems to be systematically arrested by the upper most layers of sediments, as is also derived by marine geophysical surveys.
The variability in space and time of intrusions in 2011-2012 is consistent with the hypothesis of composite pulses of magma from deeper sources.