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The Campi Flegrei Deep Drilling Project: understanding the structure and mechanisms of large collapse calderas

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Large calderas are the most dangerous volcanoes on the Earth. They are produced by collapse during explosive super-eruptions, which are capable of triggering global catastrophes comparable to large meteorite impacts.
The mechanisms of unrest and eruption at calderas are at a large extent unknown and, as demonstrated by volcanological research in the last decades, they may be very different from those characterizing more commonly studied stratovolcanoes.
Campi Flegrei caldera (Italy) represents an ideal natural laboratory to fully understand mechanisms of caldera dynamics and to develop techniques for eruption forecast and effective risk mitigation. It is an active volcanic area marked by a quasi-circular caldera depression, formed by huge ignimbritic eruptions. The caldera has recently experienced intense deformation, originating uplift phenomena of more than 3.5 m in 15 years, with maximum rates of 1 m/year in the period 1982-1984, which caused the temporary evacuation of 30,000 people from the centre of Pozzuoli and exposed more than 500,000 to impending eruption risk (several millions in case of an ignimbritic eruption).
This area will be the target of a leading International project, the 'Campi Flegrei Deep Drilling Project', sponsored by ICDP, aimed to study in detail, by a crustal deviated drilling reaching the depth of about 4 km, the deep structure of the caldera. The role of deep drilling at this area is crucial. It could give a fundamental, precise insight into the substructure, the geometry and character of the geothermal systems and their role in the unrest episodes, as well as to explain magma chemistry and the mechanisms of magma-water interaction. One of the main goal will be giving a precise determination of the magma depth, based on the extrapolation of the geothermal gradient in purely conductive conditions, occurring below the maximum aquifer depth. The choice of Campi Flegrei as a target for the deep study of large calderas is justified by the evidence, from previous drillings and recent deformation and seismicity observations, that the structures of main volcanological interest are there considerably shallower with respect to other well studied similar calderas (i.e. Long Valley). For this reason, the inference about its substructure, thermal state, magma chamber and geothermal system will allow a considerable step forward towards the understanding of the most peculiar and potentially catastrophic volcanic areas of the World. The deep well will be further equipped with innovative fiber optics sensors for long term temperature and strain changes monitoring.
Besides the scientific importance of the project for volcanology and for risk mitigation at the large city of Naples, this project will be also a unique opportunity to test and apply new techniques for geothermal exploitation of this and other favourable areas in Italy.