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Joint application of local earthquake tomography and Curie depth point analysis give evidence of magma presence below the geothermal field of Central Greece.

Vassilios Karastathis (1), Joanna Papoulia (2), Boris Di Fiore (1), Jannis Makris (3), Anestis Tsambas (2), Alexandros Stampolidis (3), and Gerassimos Papadopoulos (1)

(1) National Observatory of Athens, Institute of Geodynamics, Athens, Greece (Karastathis@gein.noa.gr), (2) Hellenic Centre for Marine Research, Athens, Greece, (3) GeoPro GmbH, Hamburg, Germany

Along the coast of the North Evian Gulf, Central Greece, there are significant geothermal sites, thermal springs as Aedipsos, Yaltra, Lichades, Ilia, Kamena Vourla, Thermopylae etc. but also volcanoes of the Quaternary - Pleistocene age as Lichades and Vromolimni. Since for these local volcanoes and geothermal fields, their deep origin and their relation with the ones of the wider region have not been clarified yet in detail, we attempted a deep structure investigation by conducting a 3D local earthquake tomography study in combination with Curie Depth analysis from aeromagnetic data.

A seismographic network of 23 portable land-stations and 7 OBS was deployed in the area of North Evian Gulf to record the microseismic activity for a 4-month period. Two thousand events were located with ML 0.7 to 4.5. To build the 3D seismic velocity structure for the investigation area, we implemented traveltime inversion with algorithm SIMULPS14 on the 540 best located events. The code performed simultaneous inversion of the model parameters Vp, Vp/Vs and hypocenter locations. In order to select a reliable 1D starting model for the tomography inversion, the seismic arrivals were inverted at first with the algorithm VELEST (minimum 1D velocity model). The values of the damping factor parameter were chosen with the aid of the trade-off curve between the model variance and data variance. Six horizontal slices of the 3D P-wave velocity model and the respective ones of the Poisson ratio are constructed. We also set a reliability limit on the sections based on the comparison between the graphical representations of the diagonal elements of the resolution matrix (RDE) and the recovery ability of "checkerboard" models.

To estimate the Curie Depth Point we followed the centroid procedures so, the filtered residual dataset of the area was subdivided in 5 square subregions, named C1 up to C5, sized 90x90 km2 and overlapped each other by 70%. In each subregion the radially averaged power spectra was computed. The slope of the longest wavelength part for each subregion yield the centroid depth, zo, of the deepest layer of magnetic sources, while the slope of the second longest wavelength spectral segment yield the depth to the top, zt, for the some layer. Using the formula zb=2zo-zt the Curie Depth estimation was derived for each subregion C an assigned at its centre. The estimated depths are between 7 and 8.1 km below sea level.

The results showed the existence of a low seismic velocity volume with high Poisson ratio at greater to 8 km depths. Since the Curie Depth Point analysis estimated the demagnetization of the material due to high temperatures at the top of this volume, we led to consider that this volume is related with the presence of a magma chamber. Below the sites of the quaternary volcanoes of Lichades, Vromolimni and Ag. Ioannis there is a local increase of the seismic velocity over the low velocity anomaly. This was attributed to a crystallized magma volume below the volcanoes. The coincidence of the spatial distribution of surface geothermal sites and volcanoes with the deep low velocity anomaly enhanced our consideration for magma presence at this anomaly.
The seismic slices of 4 km depth showed that the supply of the thermal springs at the surface is related with the main faulted zones of the area.