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3D geophysical insights into the Ciomadu volcano

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RATIONALE
Located at the south easternmost end of the Neogene to Quaternary volcanic chain of East Carpathians, the Ciomadu volcano (last erupted approx 30 ka ago) seems to represent the latest volcanic manifestation within the Carpatho-Pannonian region.
Based on the interpretation of some large-scale electromagnetic and seismological surveys, the hypothesis of the in depth (8 -15 km) existence of a magma reservoir raises the volcanic hazard in the region. The close neighbourhood of the Vrancea active geodynamic zone, where intermediate-depth seismicity occurs within full intra-continental environment makes the study of the Ciomadu volcano of higher interest.
METHOD
During the time numerous geological investigations have been conducted in the area, but except for the previously mentioned large-scale electromagnetic and seismological approaches geophysical tools have been less employed.
Relatively recent, within the frame of the INSTEC project, funded through a CNCS-UEFISCDI (Romanian Science Foundation) grant, the area has been subject to an integrated gravity and geomagnetic survey accompanied by outcrops sampling and lab determinations on rock physics. Field data have been highly processed and models of their sources have been constructed through 3D inversion techniques.
RESULTS
Overall, the potential fields have revealed a large gravity low covering the whole volcano area associating a residual geomagnetic anomaly with local effects mainly bordering the gravity anomaly.
3D inversion of the gravity data provided an intriguing image on the mass distribution within the volcanic structure, with underground densities much bellow the figures provided by the lab determinations on rock samples collected at the surface.
The geometry of the revealed gravity source clearly suggests an andesitic/dacitic intrusion acceding to the surface along a deep fault that seems to belong to the alpine overthrust system of East Carpathians.
Attempts to interpret the low value densities in the numerical model through the presence of a liquid phase in the underground failed due to the relatively shallow position of the gravity source (approx 2 km beneath the Sf. Ana lake) which should imply significant thermal manifestations at the surface (e.g. geysers), not known in the area.
Consequently, the unusual lowering of density in the inner part of the magmatic body might be due to the fissuring and late circulation of hot hydrothermal solutions. Located within geothermal fields volcanic rocks (like andesites and dacites that dominate the Ciomadu structure) interact with thermal water and intensity of alteration depends on the water temperature. The development of smectite-filled micro-cracks may decrease density from 2.6 to 2.1 g/cm3, and the total transformation may provide a significant density change, especially in the inner (hotter) part of the assumed intrusive body, in full agreement with figures provided by numerical modelling: from 2.5-2.6 g/cm3 (fresh andesites) down to 1.1-1.0 g/cm3 (clays).
The assumption is strongly supported by the geothermal setting of the area. Temperature determinations in some wells laterally located have indicated high value geothermal gradients (up to 250-400 °C/km).

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