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Using gravity for monitoring an active geodynamic area: Vrancea intermediate-depth seismic zone

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Rationale
Located in the bending area of East Carpathians, Romania, the so called Vrancea zone is a place where intermediate-depth seismicity unusually occurs within full intra-continental environment. Despite many years of research efforts, mainly based on seismological approach, genesis of the Vrancea intermediate earthquakes still represents a challenge.
Background
In an attempt to advance the knowledge in the related field, the Solid Earth Dynamics Department in the Institute of Geodynamics of the Romanian Academy has built up a special gravity monitoring network covering the epicentre area, where high accuracy gravity observations have been repeatedly conducted. Time series lasting for more than ten years have revealed a systematic gravity decrease over the active intermediate-depth seismic zone. More intriguing is that the epicentre area is subject to relative subsidence of topography, overlapped on the general upraising trend of East Carpathians catena following denudation and erosion.
Non-tidal gravity change and seismicity
A clear gravity lowering could be also distinctly associated with the Mw 5.5 earthquake on October 2013. The elliptically shaped anomaly covering the epicentre area exhibited amplitude of 15 - 20 microgals.
Case study
Quite recently, on October 28, 2018, another significant seismic event (Mw 5.8 at H=150 km) offered an adequate confirmation of the gravity behaviour related to the 2013 earthquake. High accuracy gravity determinations conducted on the dedicated network prior and after the seismic event have pointed out a relevant space-time gravity decrease over the epicentre area. After removing the tide effect, a similarly shaped gravity low (as in the case of the 2013 earthquake) has been outlined with the maximum amplitude of about 20-25 microgals.
A roughly made 2D estimate along a line crossing the apex of the anomaly locates the top of the mass deficit at the depth of the bottom of the crust in the area. Also, the asymmetry of the observed effect suggests a slight NW tilt of the source, close to the vertical position.
For a more accurate estimate on the location, geometry and physical parameters of the gravity source, a 3D gravity structural inversion has been performed under constraint of the results of the seismic tomography previously performed in the area based on combined seismological and gravity data interpretation.
Interpretation
The assumed density decrease was interpreted in terms of lithosphere vertical stretching under the gravity pull generated by phase-transform processes in the lower part of the crust /lithosphere penetrating the upper mantle.
Finally, based on the inversion results, some speculations are made in the paper on the amount of extension needed for justifying the observed anomaly, and the governing geodynamic circumstances.

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