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Moho depth evaluation using GOCE gradient data and Least Square Collocation over Iran

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Investigating the crustal architecture, specifically the discontinuity interface between the upper mantle and lower crust of the Earth, so-called Moho, can be done in three prevailing techniques, namely lithology, seismicity, and gravity. In contrast to using the information from analyzing the characteristics of rocks and seismic waves, which are sparsed and expensive, inverting gravity data of satellite missions such as GOCE and GRACE is a suitable alternative for such purposes.

The present paper attempts to map the Moho surface using the gravity data as we considered a simplified Earth model based on three shells including the core, mantle and crust with a potential T on a given sphere outside this body. In this notation, by subtracting the topographic effects, compensating for density anomalies in the crust, and other known constants from the observation that are given on and outside the mean Earth radius, one is left with the potential of a single layer on the mean Moho sphere by taking into consideration the Helmert condensation approach. In planar approximation, this is to say that the topography is formally referred to an xy plane and also the condensation surface which is a plane, situated at a depth D below the previous one. Therefore, relating the topographic load of a mass column with height h over the same elementary area element at depth d, the measure of how deep the crust is sinking into the mantle material as a consequence of the load, we can interpret the Moho variations with respect to some mean crustal thickness.

To do this inversion, we applied the Least Square Collocation (LSC) approach which uses the functional relationships between the quantities, the auto-covariance and cross-covariance matrices based on a covariance function between observations and the unknowns. Practically, after constructing the required residual data, an empirical covariance is estimated, then fitted to analytical one to define the required covariance models.

Finally, the Moho variations has been estimated in an active tectonic zone created by the continental collision of the Arabian plate from South-West and Turan shield from North-East with respect to a mean Moho depth equal to 45 km. Results of this study are comparable and much the same with other studies so that different rheological zones of Iranian plateau can be seen in this estimated map of Moho. For instance, a maximum depth is estimated for Sanandaj-Sirjan zones in

South-East and minimum depth for Caspian Sea in North.