Use of Twin Grace Satellite Gravity Data and Geoid signals in the characterization of major underlying aquifer regimes and tectonic structure of the middle Indus Basin, Pakistan

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Geoid signals provide important information about the subsurface density structure of the earth and can be effectively utilized for identification of mass anomalies at depth with respect to the characterization of buried features i.e., aquifers, minerals, oil and gas reservoirs, and tectonic boundaries. Due to long wavelength characteristics, geoid can be more useful in studying the regional and global anomalous structures. Longer wavelength geoids corresponds to the lower mantle signals and shorter wavelength depicts the heterogeneities in the lithosphere. Moreover, underlying aquifers of various characteristics tend to exist due to the tectonic hierarchy, active fault plains, and nature of terrain consisting of alluvial flood plains and potwar strata.

This study encompasses the impact of geoid model, gravity, topographic and satellite data that was used on the detection of specific plate tectonic boundaries responsible of generating the earthquakes and vast plains along fault line containing unconfined and confined groundwater aquifers of variable yielding capabilities. To circumvent the hypothesis a precise gravimetric geoid model was determined for the Pakistan and surrounding areas using EGM2008 gravity model. In addition to this, twin GRACE satellite gravity data has been utilized in the detection of major tectonic boundaries and aquifers characterization mainly in Pakistan and adjoining areas. The monthly gravity solutions of GRACE satellite data have been compared for the year 2005 to establish the relationship of time variable gravity field with tectonic, geological and water bearing structures. With the conclusive findings from the study, it has been observed that the horizontal gradient of the geoid, density variation in buried masses, aquifer’s geometry and their characterization, and tectonic structure can be related to each other. A significant correlation can be seen between the lateral geoid gradient and distribution of vast flood plains on the middle Indus Basin. Density of the buried masses attribute to the locations of suitable aquifers in the areas of maximum geoidal slope.