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Analyses on Origin of positive gravity anomalies of sedimentary basins of the Ross Sea

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We have adopted gridded products describing surface elevation, ice-thickness and the sea [U+FB02]oor and subglacial bed elevation south of 60[U+25E6] S from Bedmap2 and north of 60[U+25E6] S from JGP95E to calculate Bouguer and isostatic gravity anomaly of the Ross Sea region based on the DTU10 free-air gravity anomaly.Taking a view of the free-air, Bouguer and isostatic gravity anomalies, it is unusual that high values overlay the Victoria Land Basin, Central Trough, Northern Basin and Northern Central Trough while basement highs are associated with low value.

A number of studies have attributed the high gravity anomalies across the depocenters to high-density volcanics deep within the basins or magmatic intrusions within the region of the thinned crust or upper mantle (e. g., Edwards et al., 1987). According to the conclusion from Karner et al. (2005), the anticorrelation of gravity anomalies with sediment basement can be reproduced if the flexural strength of the lithosphere during the late Cretaceous rifting is significantly lower than the flexural strength of the lithosphere at the Oligocene and Neogene time of sedimentation.

We note that the isostatic gravity anomalies are higher than the free-air gravity anomalies adjacent to the Transantarctic Mountains, and vice versa away from the Transantarctic Mountains. We may ignore the constraints offered by the tranditional isostasy in the local gravity studies of the Ross Sea basins, especially advancing the concept of high density material in the lower crust or upper mantle. In particular, the modeled gravity does not laterally integrate to zero, due to the existence of unbalanced forces induced by mantle.

Along the outer shelf uplift zone surrouding Antarctica, the positive gravity belt has higher values in free-air gravity anomalies than those in isostatic gravity anomalies. Meanwhile, the positive gravity belt of isostatic gravity anomalies almost disappears in the background anomalies of [U+F02D]20 mGal to [U+F02D]10 mGal facing the Pacific ocean between 105°E and 70°W. Moreover, the lithosphere of Ross Sea and offshore Wilkes Land near the Pacific-Antarctic Ridge are intensively broken by transform faults, its strength becomes weak, and this favors a local equilibrium adjustment with the Airy isostatic model. Within the Ross Sea sector area, including its outer ocean, isostatic gravity anomalies are smoothly lowest in the entire region. These transform faults may cut through lithosphere to induce the mantle thermal turbulence, which further reduces the lithospheric strength and brings about an over-compensation phenomenon.

If both the Ross Sea and the outer shelf uplift zone, the Transantartic Mountains or the Antarctic Ice Sheet are treated as one system, we may get rid of this dilemma. As the outer shelf uplift zone had been broken and the Transantartic Mountaisn or the Antarctic Ice Sheet had been developing, the local crust would gradually subside and its underlying anthenosphere would flow outwards. Along weak belts or faults at the depocenters or edges of basins of the Ross Sea, compressed magma were likely to upwell, stretching the crust and uplifting the Moho with high gravity anomalies in basins.