GOCE data demonstrate magmatic underplating beneath the Paraná basin

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The Paraná is an intracratonic basin located on the stable South American platform. The shallow stratigraphy of the basin is composed of 3500 m of Paleozoic rocks, 1500 m of Serra Geral Formation and 300 m of Late Cretaceous sediments. The recent seismological studies have shown that the crust-mantle interface below the basin is deep between 40-46 km, depending on the specific model. Thick crust and thick sediments generally generate a strongly negative Bouguer anomaly that is not found in the Paraná basin. Instead of the expected Bouguer minimum, a relative anomaly high along the maximum sediment accumulation is found. During the Early Cretaceous, the same basin was affected by a large amount of basalt deposits of (Serra Geral Formation) that belong to a Large Igneous Province (LIP). The volcanic deposits in the basin are however too thin to explain the relative gravity high. The goal of this work is to explain the apparent discrepancy between crustal thickness and the Bouguer anomaly by modeling the crustal densities of and below the Paraná basin. Our approach integrates the new gravity observations of the GOCE satellite, and the constrains provided by the geophysical and seismological information to define geometry and densities. We reduce the gravity value for these known structures. The final residuals we obtain are interpreted as deviations from the assumption of a contrast density contrast located either in the crust or mantle according to the involved wavelengths of the residual gravity signal. Assuming a fixed density contrast, we estimate the thickness of the underplated body by inverting the gravity residual. The clear positive Bouguer residual anomaly suggests the presence of hidden mass. This hidden mass is located in the mid to lower crust, with a thickness over 10 km, and is probably made of gabbro. This mass is a magmatic material left behind by the ascending basalts, and contributes to isostatic balance. The study of underplating under the LIP is very useful to understand the relationship between the alteration of the thermal gradient of the crust and the hydrocarbon maturation of sediments.