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GOCE data evidence underplating beneath the Paraná basin

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Abstract:

The Paraná basin in the stable South American Platform accumulated a thick sediment layer during the Paleozoic, with more than 3500 m thickness. In Early Cretaceous the same area experienced a flood basalt volcanism which produced a LIP-(Large Igneous Province, Bryan & Ernst, 2008). We present here a new approach that integrates the newest gravity data of the satellite mission GOCE (Gravity Ocean Circulation Explorer) and the seismologic and geophysical drilling information to determine the Paraná basin lithospheric structure. The latest seismological investigations in South America (Assumpção et al., 2012) reveal a deep (> 40 km) Moho under the Paraná basin. These observations do not agree with the gravity data that evidence a relative gravity high trending NE-SW in the central portion of the basin and over the greatest thickness of the sediment layers. Further constraint for the gravity modeling are the geophysical data obtained from a drilling survey in search for hydrocarbons (Melfi et al., 1987). Isostatic modeling show us, that this relative gravity high cannot be explained by the volcanic deposits because they are less in volume with respect to the light pre-volcanic alluvional layer. The gravity high certainly cannot be explained by crustal thinning, as the seismological data suggest normal to thick crust. In our work we calculate the effect of underplating related to magmatic effusion. This magmatism is supposed to be more than 10 time the volume of superficial flood volcanism (Bryan & Ernst, 2008). We calculate the missing mass using isostatic modeling: we first reduce the Bouguer field by the gravity effect of crustal thickness using the seismological Moho, and the effect of sediment. We test 2 different density contrasts

between crust and mantle: -0.5 and -0.3 Mg/m^3, the first takes into account a light, and the second a heavy crustal density. After that we use the spectral methodology for gravity inversion, and obtain a crustal body that explains our missing mass. To test the different possible patterns, we adopted several models, changing the reference depth, and the density contrast. Finally we simplify the unknown body with a cut off cone, and we estimate the volume of intruded basaltic material. We see that the geometry is in agreement with petrologic considerations. We conclude that the deep Moho under Paraná basin can be explained for example by a thick layer of gabbro with a contrast density of 0.2 Mg/m^3 with respect to a normal crust, located at 40 km, with a volume of about 1.66×10^6 km^3 (Assumpção et al., 2012) when the total volume of the superficial LIP is 0.46×10^6 km^3.

References

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