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GOCE observations for Mineral exploration in Africa and across continents

Carla Braitenberg
University of Trieste, Department of Mathematics and Geosciences, Trieste, Italy (berg@units.it, +390405582257)

The gravity anomaly field over the whole Earth obtained by the GOCE satellite is a revolutionary tool to reveal geologic information on a continental scale for the large areas where conventional gravity measurements have yet to be made (e.g. Alvarez et al., 2012). It is, however, necessary to isolate the near-surface geologic signal from the contributions of thickness variations in the crust and lithosphere and the isostatic compensation of surface relief (e.g. Mariani et al., 2013) . Here Africa is studied with particular emphasis on selected geological features which are expected to appear as density inhomogeneities. These include cratons and fold belts in the Precambrian basement, the overlying sedimentary basins and magmatism, as well as the continental margins. Regression analysis between gravity and topography shows coefficients that are consistently positive for the free air gravity anomaly and negative for the Bouguer gravity anomaly (Braitenberg et al., 2013; 2014). The error and scatter on the regression is smallest in oceanic areas, where it is a possible tool for identifying changes in crustal type. The regression analysis allows the large gradient in the Bouguer anomaly signal across continental margins to be removed. After subtracting the predicted effect of known topography from the original Bouguer anomaly field, the residual field shows a continent-wide pattern of anomalies that can be attributed to regional geological structures. A few of these are highlighted, such as those representing Karoo magmatism, the Kibalian foldbelt, the Zimbabwe Craton, the Cameroon and Tibesti volcanic deposits, the Benue Trough and the Luangwa Rift. A reconstruction of the pre-break up position of Africa, South and North America is made for the residual GOCE gravity field obtaining today's gravity field of the plates forming West Gondwana. The reconstruction allows the positive and negative anomalies to be compared across the continental fragments, and so helps identify common geologic units that extend across both the now-separate continents. Tracing the geologic units is important for mineral exploration, which is demonstrated with the analysis of correlations of the gravity signal with selected classes of mineral occurrences, for instance those associated to Greenstone belts.

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