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Total Field and Residual Bouguer Gravity in South Australia

Gisela Estermann

Research School of Earth Sciences,
The Australian National University,
0200 Canberra, Australia
Email: gisela.estermann@anu.edu.au

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Table of Contents

Extended Abstract

Total-field Bouguer Gravity images (for South Australia and for eastern Australia in Figure 2 in Murray et al., 1989) can be used for interpretation of geological structures. The Bouguer anomaly gravity image reflects rock density distribution below the Earth's surface and is the combined influence at a given point at the Earth's surface of all subsurface density features down to the core. South Australia is covered extensively with sand dunes, soil and regolith, which obscure the geology. The gravity meter can see through this layer to identify density changes. Within a local area of interest it is primarily the distribution of different rock types that gives the highs and lows in the image, which allows for interpretation of architecture of the rock systems. On larger scales the Bouguer anomaly is also associated with undulations of density discontinuities at and below the base of the crust and temperature controlled density variations in the mantle.

The Bouguer anomaly is defined as the remaining value of gravitational attraction after correcting for the free-air correction (which compensates for height above sea level assuming there is only air between the measurement station and sea level) and the Bouguer correction. This correction is used in order to remove the gravitational attraction of a layer of rock between the station and sea level.

The residual Bouguer gravity image is the result of a wavelength cut-off at 250km (Murray et al., 1989). The term 'residual gravity' refers to gravity anomalies arising from crustal masses as opposed to 'regional or total-field gravity' anomalies arising from larger and usually deeper features. A short wavelength residual Bouguer gravity image emphasizes therefore anomalies and anomaly patterns related to continental crustal structure in comparison with total-field gravity image. Short wavelength anomalies are mainly caused by density differences within the crust and give an indication of source shape. The dominant characteristic of the short wavelength residual gravity image (Figure 1 in Murray et al., 1989) is the linear shape of anomalies, which must reflect crustal structure. Groups of anomalies with similar trends define major crustal blocks. It is felt that the residual Bouguer gravity image provides more information relevant to crustal structure and development than the total-field gravity (see Figure 2 and 1 in Murray et al. (1989) for total-field and residual Bouguer gravity of eastern Australia).

Parallel total-field Bouguer anomalies can be found at the Flinders and Mount Lofty Ranges, which are roughly aligned with the topography. The axis of the central and northern Flinders Ranges corresponds with the generally positive Bouguer anomaly of amplitude ca. 20mgals.

In the region of the 'Adelaide Fold Belt' the gravity ridges are indicative of rifting and emplacement of dense igneous rocks into the crust. The shape of residual Bouguer gravity anomalies differs from the total Bouguer gravity anomalies. The northern triple junction shown in Figure 91 in Preiss (1987b) is less pronounced in the residual Bouguer anomaly image (Figure 1 in Murray et al., 1989), mainly due to the diminution of the east-west ridge. The meridional gravity ridge around 30°S curving into the east is also somewhat weaker but could still represent rifting in the basement plus emplacement of denser rock into the crust (Murray et al., 1989). The large gravity ridge to the east of the Flinders Ranges appears to be caused dominantly by exposed or near surface dense Proterozoic basement in the Kanmantoo Fold Belt.

Tucker et al. (1979) present several alternative explanations for each of the three arms, and it appears that they could represent basement highs, or possible high density basement at depth below Adelaide Rift strata.

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