Application of Regional Gravity and Magnetics to the Regional Geological Framework of Australia

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Summary

The published gravity and magnetic maps of Australia provide a means to extend and refine the generally accepted regional geological framework of the continent. Major crustal units can be recognised by areas of predominantly high or low gravity values. The boundaries of most units are outlined by steep gravity gradients.

Magnetics are used in defining more closely the boundaries of crustal units and features within the units such as igneous rocks, particularly granitic bodies, basic and ultrabasic masses, major faults and other lineaments.

Introduction

Wellman (1976) used the trends of gravity anomalies as outlined on the B.M.R. Bouguer Gravity Map (1973) to divide Australia into certain crustal blocks to which he inferred relative ages in the growth of the Australian continent. Later Wellman (1978) noted that crustal block boundaries inferred from dipole anomalies correspond in position with the crustal blocks boundaries inferred from geology and approximately with the position of block boundaries inferred from changes in the gravity trend pattern.

Other workers including Fraser (1977) divided the Australian gravity map into certain areas referred to as Gravity Provinces — 125 in number — on the basis of uniformity of some property, such as contour trend, gravity level or degree of contour disturbance.

This paper shows that the regional gravity maps as published by the Bureau of Mineral Resources together with the published maps of the total magnetic intensity can be used to assist the outlining of a regional geological framework for the Australian continent that conforms with that generally accepted.

Regional Elements

Figure 1 shows the regional geological elements on the Bouguer Gravity Map of Australia as published in 1979 by the Bureau of Mineral Resources in its Earth Science Atlas. The boundaries of the geological elements have been drawn on the basis of patterns shown by the distribution of the gravity high and low anomalies paying particular attention to steep gradients. The names of the elements follow those used by Palfreyman (1984) for Queensland, the 1975 Geological Map of Queensland published by the Geological Survey of Queensland, and for South Australia the 1982 Tectonic Map of South Australia published by the Geological Survey of South Australia.

The map at Fig. 1 shows that most of the regional geological elements of Australia can be depicted reasonably well having regard for the sale of the map. The effect of the thin crust of the continent around its edges does make the outlining of the geological elements difficult. Some important features are:

(i) the increase in gravity from east to west in the Yilgarn Block, probably reflecting the thinning of the continental crust;

(ii) the good correlation between the areas of high gravity and the Precambrian greenstone belts in the Yilgarn Block;

(iii) the belt of gravity highs that appear to link the southern part of the Musgrave Block in South Australia with the Paterson Province in Western Australia. Rocks in these units are similar and the same age, i.e. Early to Middle Proterozoic;

(iv) the extension of the gravity high zone associated with the Precambrian Mt Isa Block to the north and south beneath the overlying Carpentaria and Eromanga Basins respectively. The southern margin of the Mt Isa Block is truncated by the Cork Fault;

(v) the junction of the Eromanga and Surat Basins with the Galilee, Drummond and Bowen Basins is marked by a north-west trending gravity contour separating a broad area of gravity lows in the south from a broad area of gravity highs in the north. This linear trend is referred to as the 'Longreach-Roma' Line and coincides with the Longreach-Roma Lineament discussed by Evans and Roberts (1980) who suggested that this linear feature marked contrasting structural styles and inhomogeneity in the crust either side of the feature;

(vi) the extension of the gravity high associated with the Precambrian Broken Hill Block to the south-west and south forming a curvilinear western margin to the Darling and Murray Basins;

(vii) the zone of gravity highs in the central portion of the Palaeozoic Lachlan Province referred to in Fig. 1 as the 'Bourke-Bogan Gate Zone'. The south-western boundary of this gravity high zone is marked by a linear feature

of steep gravity gradients and a marked change in magnetics. This feature has been recognised and studied by Suppel *et al.* (1986) of the Geological Survey of New South Wales who consider the suture forms the boundary between geological provinces which have very different geological histories, i.e. Wagga-Omeo sedimentary belt to the west and the Molong Volcanic Arc to the east of the suture. It is interesting to note that the linear break in the magnetics and in the gravity do not coincide in the area of the Gilmore Suture;

(viii) the extension and continuity of the gravity high associated within the Anakie High in Queensland with that of the Nebine Ridge in the Eromanga Basin.

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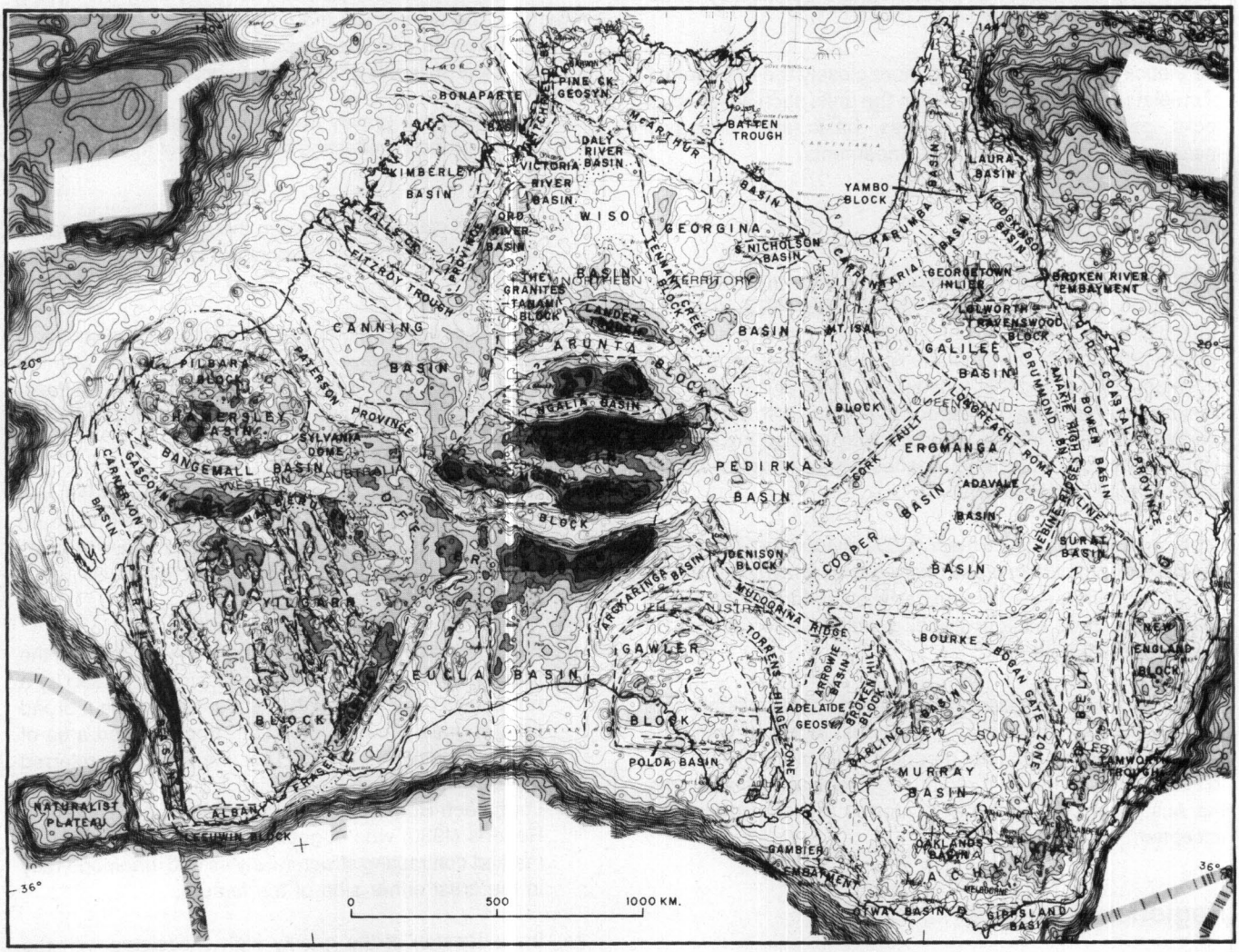

FIGURE 1
Regional Geological Framework shown on the B.M.R. 1979 Bouguer Gravity Map of Mainland Australia.