Australian Government
Geoscience Australia

# AUSTRALIAN CRUSTAL ELEMENTS

## based on the distribution of geophysical domains

Map compilation: versions 1.0 to 2.3, 1995-1996
Re-issued as version 2.4, October 2010

0 200 400 600 kilometres

1:5 000 000

LAMBERT CONFORMAL CONIC
Central Meridian: 134° Standard Parallels: -18°, -36°
Geodetic Datum of Australia 1994

Version 1.0 Interpretation, 1995:
NT, Northwest WA, SA by R.D. Shaw; Northern Qld, NSW, Vic by P. Wellman; SA by P Gunn and R.D. Shaw; WA by A. Whitaker

Revision coordination 1994-96 by R.D. Shaw and W.D. Palfreyman
Versions 2.0-2.3 Revisions, 1996 by R.D. Shaw
Version 2.4 ArcGIS translation, 2010 by J.C. Claoué-Long
Cartography by T. Chiotis and D.P. Connolly

Version 2.4 dataset compiled as an ArcGIS translation of the printed 1996 map and the published description in GA Record 1996/30

Limitations of the current map
The map is only a two-dimensional interpretation of magnetic, gravity and crustal element boundaries. Whereas the boundaries are intended to approximate their mean position in the upper crust, the accuracy of their position is considerably reduced in regions of thick sedimentary cover and sparse data

The map presents a model for the crustal framework of the continent, which requires ongoing testing as further information on crustal structure derived from geology and geophysical datasets, such as heat flow and compressional seismic velocity, become available

It is recommended that this dataset be referred to as:
Shaw, R.D. Wellman, P., Gunn, P., Whitaker, A.J., Tarlowski, C., and Morse, M., 1996, *Australian Crustal Elements based on the distribution of geophysical domains*, (1:5 000 000 scale map; version 2.4, ArcGIS dataset). Geoscience Australia, Canberra

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Published by Geoscience Australia, Department of Resources, Energy and Tourism, Canberra, Australia. Issued under the authority of the Minister for Resources, Energy and Tourism

Copies of this map and digital data can be downloaded from the Geoscience Australia internet site at: http://www.ga.gov.au or by contacting:

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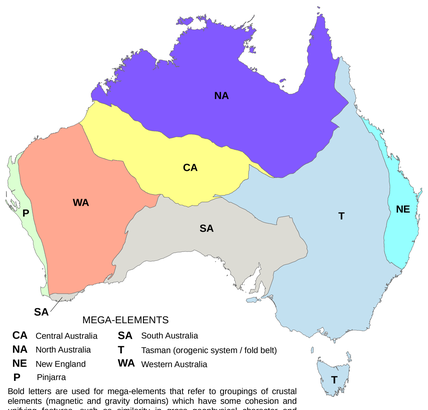
Geocat Number 21195




MEGA-ELEMENTS

| | | | |
|---|---|---|---|
| **CA** | Central Australia | **SA** | South Australia |
| **NA** | North Australia | **T** | Tasman (orogenic system / fold belt) |
| **NE** | New England | **WA** | Western Australia |
| **P** | Pinjarra | | |

Bold letters are used for mega-elements that refer to groupings of crustal elements (magnetic and gravity domains) which have some cohesion and unifying features, such as similarity in gross geophysical character and enclosure within common crustal boundaries

CRUSTAL BOUNDARY TYPE

- *Compositional* — GRAVITY
- *Minor, unclassified* — GRAVITY
- *Structural* — GRAVITY
- *Compositional* — MAGNETIC
- *Minor, undefined* — MAGNETIC
- *Structural* — MAGNETIC

PHA 2, 4 — *Informal letter code reference and relative age(s) of Crustal Element*

! *Capital city*

! *Population centre*

*State boundary*

GUIDE TO THE MAP
- The coloured crustal elements are generalised geophysical domains that are considered to represent individual pieces of upper crust
- The element colour and relative age (sequence of numbers 1–33) gives an indication of when the dominant geophysical character may have been imprinted on the region (see below for further explanation)
- The different types of domain and their geological significance are explained in the legend
- Symbols for the crustal elements are shown on the map sheet and for mega-elements on the inset map
- Capital letters shown on the main map-face provide an informal reference mechanism for individual crustal elements
- Symbols (groups of letters) commonly reflect the name of the corresponding geological province (e.g., MI for Mount Isa). It is anticipated that these symbols will require constant refinement with the incoming of new data and fresh interpretations

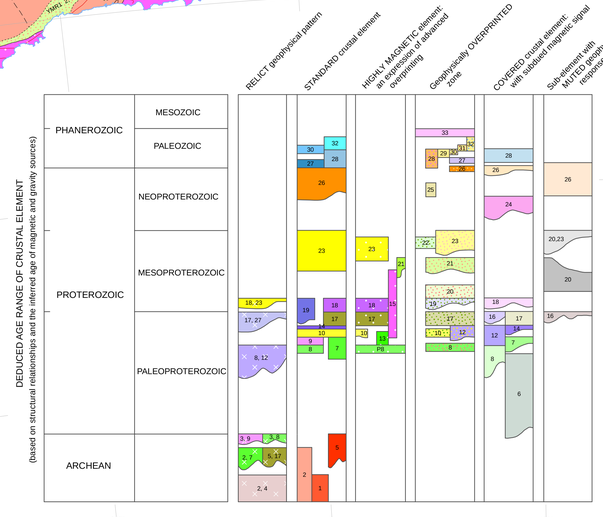
SUGGESTED USES OF THE MAP
The map is designed to be used in conjunction with other types of geological and geophysical maps. It can be used:
- to interpret the distribution of basement geological provinces underneath sedimentary cover;
- to provide an initial model of the framework for the Australian crust;
- to provide regional setting for more detailed geophysical interpretations;
- to provide a framework for many types of geological interpretation, such as solid geology maps, structural syntheses, diagrams of basin development, and reconstructions of plate-tectonic settings and palaeogeographic evolution;
- as a framework for studying crustal processes such as earthquake distribution, geodynamics, crustal heat flow, the formation of metal deposits, and the generation and entrapment of oil

UNDERSTANDING THE DEDUCED TIMEFRAME
In many cases, the possible age-range of the magnetic and gravity sources within the domains can be deduced using gravity and magnetic trend relationships and other overprinting criteria, together with the available geological evidence. Each crustal element is coloured according to its deduced age, which is taken to be the time when the main geophysical features, normally the magnetic patterns, were imposed. In many, but not all, cases this corresponds to the relative age of cratonisation or orogenesis. In several cases, the age for imposition of the magnetic pattern is poorly constrained, especially when the element cannot be related to exposed and well-dated basement provinces. Other complications arise where a region has been subjected to several orogenic events or periods of multiple fault-reactivation. It is for these reasons that the map emphasises the possible age-range of the magnetic and gravity sources within the elements, rather than the age of orogenic events derived from geological and geochronological evidence

Further reading
Shaw, R.D., Wellman, P., Gunn, P., Whitaker, A.J., Tarlowski, C. and Morse, M.P., 1995. Australian crustal elements map. AGSO Research Newsletter 23, pages 1–3

Wellman, P., 1978. Gravity evidence for abrupt changes in mean crustal density at the junction of Australian blocks. BMR Journal of Geology & Geophysics 3, pages 153–162

Shaw, R.D., Wellman, P., Gunn, P., Whitaker, A.J., Tarlowski, C. and Morse, M., 1996. Guide to using the Australian crustal elements Map. Australian Geological Survey Organisation, Record 1996/30, 44 pp




NUMBERS refer to the deduced age range of the primary geophysical signature within each element. More than one age is interpreted in elements with Relict or Overprinted characteristics

RELICT (older) geophysical pattern detectable locally within elements:
Age rank is the minimum deduced age-range of underlying magnetic sources

STANDARD crustal element:
Not modified by any geophysical overprinting;
Shows deduced age-range of the sources that give rise to the magnetic and gravity signals

HIGHLY MAGNETIC element:
Shows relative age-range of magnetic sources associated with metamorphism or magmatism

GEOPHYSICALLY OVERPRINTED zone:
Shows the inferred age-range of the last geological event (structural, metamorphic and/or magnetic) that is linked to the partial disruption of the magnetic pattern

COVERED crustal element:
Shows regions where the magnetic signal is suppressed by sedimentary cover and the minimum age of magnetic sources is poorly constrained

Sub-element with MUTED GEOPHYSICAL RESPONSE:
Shows the inferred age limits of non-magnetic cover-units within larger magnetic elements of a similar relative age

PRINCIPLES OF MAP CONSTRUCTION

The Australian Crustal Elements Map uses magnetic and gravity anomalies to delineate crustal elements, which represent generalised geophysical domains. These are crustal-scale regions where the magnetic and gravity features show unifying characteristics, such as trend, magnitude or frequency content. Many, but not all, exposed geological boundaries correlate in broad terms with the crustal-element boundaries

The crustal-element boundaries are chosen to emphasise the coherence between gravity and magnetic boundaries, and also with geological boundaries. Two main types of element boundary are recognised. One marks a change in trend or pattern indicating a structural domain boundary. The other corresponds to a gross change in field magnitude indicative of a change in upper crustal material. Both types may be present at the same location. Where the magnetic and gravity domain boundaries do not coincide precisely, they are shown separately on the map, together with the interpreted boundary for the crustal elements. The boundaries refer to the trace of the boundary at the basement-cover surface or to a position slightly deeper in the crust. The resulting map provides a working model for the framework of the upper crust

The map illustrates (by means of colour) the deduced age-range of the magnetic and gravity source rocks within each crustal element; that is the time when the dominant geophysical characteristics are thought to have been imposed

The crustal elements are subdivided into types, mainly on the basis of their magnetic response. For understanding tectonic evolution the most important type is that corresponding to a geophysically overprinted zone. In such zones, a gravity or magnetic pattern truncates a clearly older pattern. Some highly magnetic zones can also be related to geophysical overprinting. In many cases, the overprinted zones correspond to zones of geological reworking, caused by processes such as metamorphism, magma intrusion and deformation. Others, however, have a more complex origin

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Re-issued as version 2.4 ArcGIS dataset
Compiled from GA Record 1996/30 and version 2.3 map
(revised, August 1996)
This dataset is subject to continuous amendment