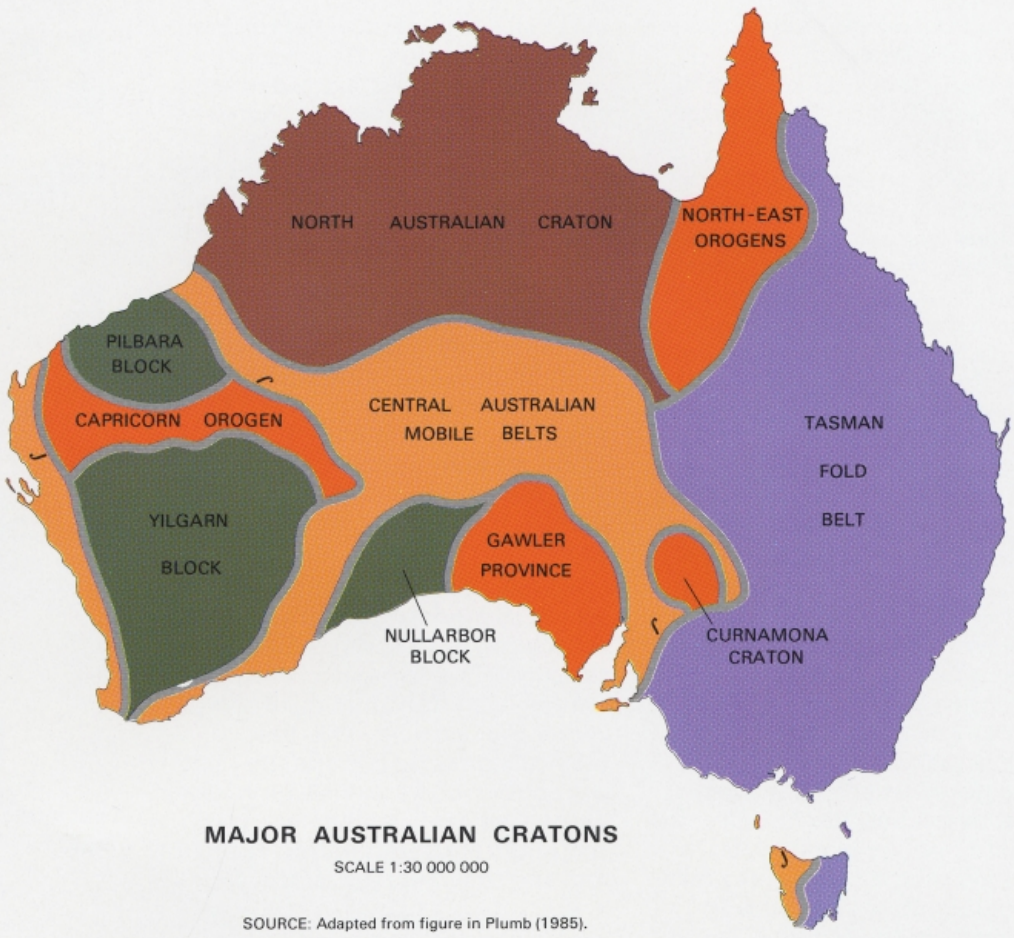
The building blocks of a continent

Cratons, the primary building blocks of a continent, are major structural units of the earth's crust. They generally consist of igneous and metamorphic rocks that have evolved through a cratonisation cycle of sedimentation, deformation, metamorphism and volcanism, gradually stabilising over millions of years. Those which make up the Australian continent are shown on the map 'Major Australian Cratons'.

As the cratons have stabilised, weathering and erosion have led to the accumulation of layers of relatively undeformed sedimentary rocks in broad downwarps over the surface of the craton. These craton covers, called basins on geological maps, are the secondary units of the continental crust. As the covers are derived from pre-existing rock they are merely rearrangements of the continental crust rather than additions to it.

Although Australia is everywhere underlain by the major cratons much of the surface is now covered by craton covers, often leaving isolated blocks of exposed cratons as inliers of older rock surrounded by much newer cratonic cover rocks. The exposed cratons and craton covers that make up the surface of the continent are shown on the map 'Major Structural Elements'; the companion cross-section illustrates the relationship between them in south-eastern Australia.



MAJOR AUSTRALIAN CRATONS

SCALE 1:30 000 000

SOURCE: Adapted from figure in Plumb (1985).

Australia's cratons and craton covers

Cratons and craton covers formed during two major structural regimes: an older one which existed during the Archaean and Proterozoic, and a younger one spanning the Palaeozoic, Mesozoic and Cainozoic. Five major cratons and their covers belong to the older regime—the Pilbara and Yilgarn Blocks, the North Australian Craton, the North-East Orogens and the Central Australian Mobile Belts. The Tasman Fold Belt (which forms most of eastern Australia) developed during the younger regime.

The sequence of craton formation is generally one of eastward evolution from Archaean in the west to Cainozoic in the east. The oldest craton stabilised about 2300 m.y. ago at the end of the Archaean and is represented by the exposed Pilbara and Yilgarn Blocks in Western Australia. This craton may extend to the north and east below younger cratons and parts of it are probably represented by the oldest rocks in the Pine Creek Inlier (N.T.) and the Gawler Block (S.A.)—see 'Major Structural Elements' map.

At the time that craton covers, such as the Hamersley and Nabberu Basins, were being formed on the stabilising Yilgarn and Pilbara Blocks the North Australian Craton began to develop in adjacent unstable regions. This craton eventually stabilised during Early Proterozoic times, about 1750 m.y. ago. Today, areas of this craton remain exposed as The Granites–Tanami, Tennant Creek and Arnhem Inliers, the Nicholson Block and the Halls Creek Province. The Kimberley Basin and parts of the Nabberu Basin are the initial older cover of the craton while the McArthur, Birrindudu and South Nicholson Basins represent younger cratonic covers. The Gawler Province and the Curnamona Craton stabilised at the same time as the North Australian Craton.

The North-East Orogens stabilised about 1200 m.y. ago in Middle Proterozoic times and are exposed today as the Mount Isa, Georgetown, Yambo and Coen Inliers. They are similar to the North Australian Craton and can be regarded as part of it. The craton cover that followed this stabilisation is preserved as the Victoria River and Bangemall Basins.

The Central Australian Mobile Belts are sandwiched between and draped around the older cratonic blocks in zones that remain relatively unstable. The Albany–Fraser Province and the Arunta and Musgrave Blocks represent the oldest parts; rocks of the Northampton Block are much younger, while the Leeuwin, Rocky Cape and Tyenna Blocks and the Mount Babbage–Mount Painter Inliers are younger still. The major craton covers are the Georgina, Amadeus and Officer Basins. Stabilisation of the mobile belts around 900 m.y. ago marked the end of cratonic development in the older regime; then followed nearly 300 m.y. of continental stability.

The exposed Palaeozoic to Mesozoic cratons of the younger regime shown on the 'Major Structural Elements' map are part of the Tasman Fold Belt. The oldest cratonic elements of this belt are the Dundas Trough and Kanmantoo Fold Belt. As these elements stabilised eastward, sedimentary trends continued, forming the Lachlan and Hodgkinson Fold Belts. Again, as these belts stabilised sedimentation had begun for the youngest Australian region—the New England Fold Belt.

Just as the cratonic elements of the Tasman Fold Belt developed successively so did its cover, much of which overlaps onto the Proterozoic and Archaean cratons. Some of these relationships are shown by the cross-section on page 11.

Major physiographic regions

Unlike other continents Australia has been mostly stable for the past 200 million years. Throughout this long interval the forces of erosion have slowly levelled large areas of the continent to low lying plains, making Australia relatively flat.

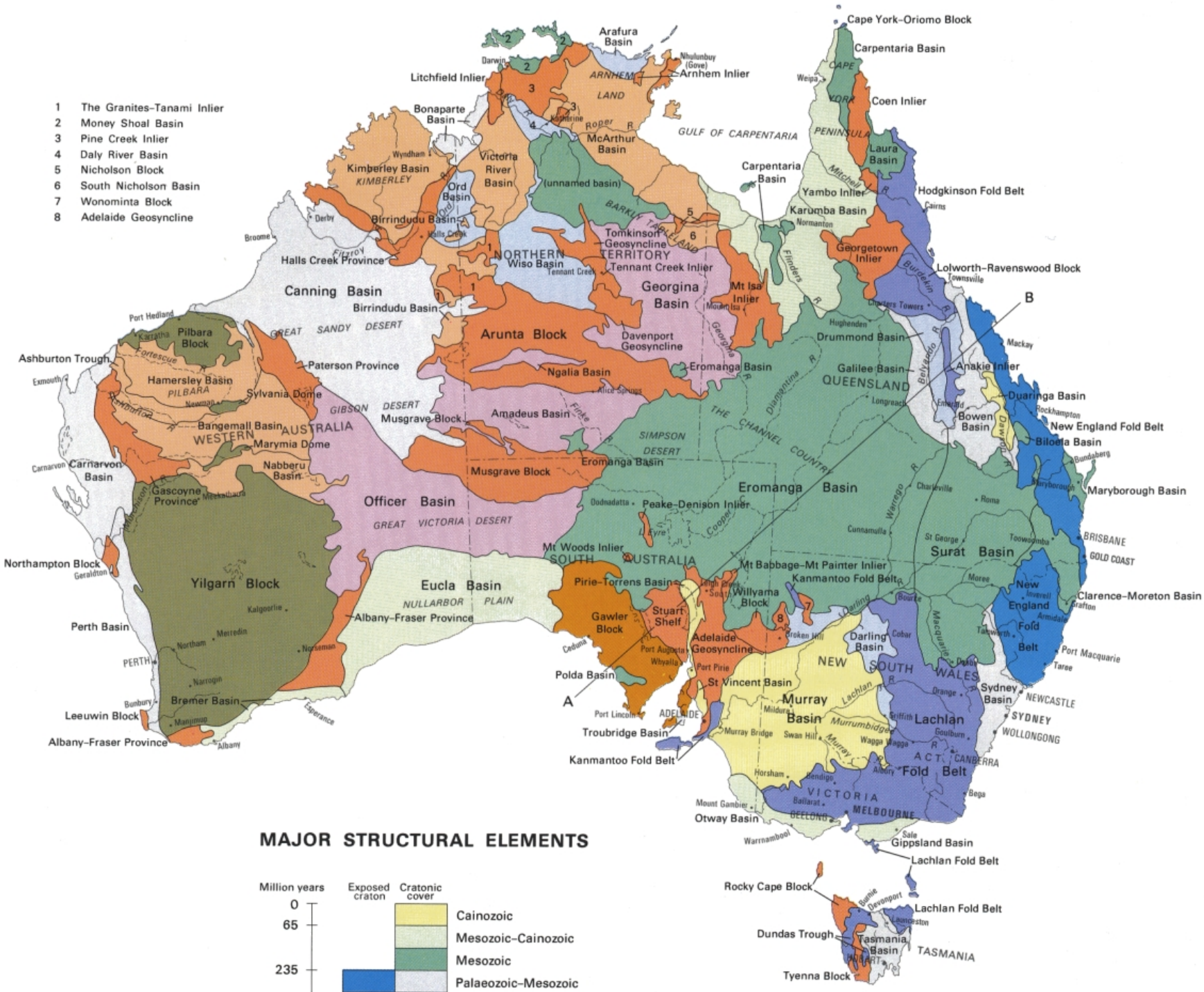
This computer-generated image shows the effects of an artificial 'sun' shining on a digital elevation model at such an angle that it enhances the generally low relief, thus showing up major topographic and tectonic features. Three distinct physiographic features—the ***Western Plateau,*** *the* ***Interior Lowlands*** *and the* ***Eastern Uplands***—*become evident.*

The Western Plateau coincides with the main Archaean and Proterozoic structural elements. The landscape is now dominated by sand plains and low tablelands.

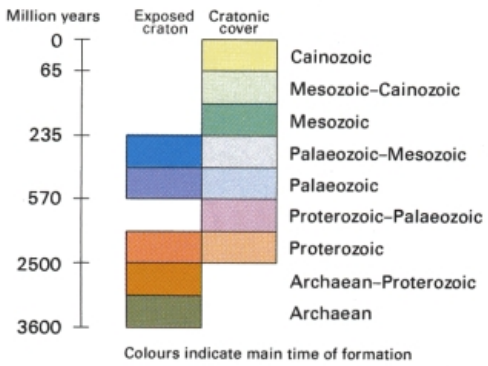
The Interior Lowlands are the flat, low lying and generally deeply weathered Mesozoic and Cainozoic sediments of central eastern Australia. This landscape features vast floodplains and landforms of low relief along the western and eastern margins.

The younger Eastern Uplands are more complex, with elevated remnants of the Tasman Fold Belt exposed at various levels. These uplands slope gradually westward to the Interior Lowlands and more sharply eastward to narrow coastal plains.

1 The Granites–Tanami Inlier
2 Money Shoal Basin
3 Pine Creek Inlier
4 Daly River Basin
5 Nicholson Block
6 South Nicholson Basin
7 Wonominta Block
8 Adelaide Geosyncline



MAJOR STRUCTURAL ELEMENTS



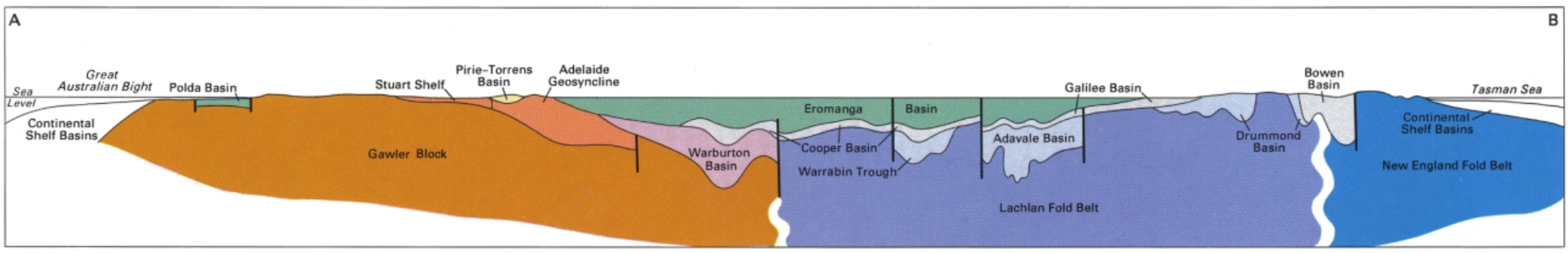
Colours indicate main time of formation

SCALE 1:20 000 000

SOURCE: Adapted from map 'Major Structural Elements' (1979) in *BMR Earth Science Atlas of Australia.*

Generally the locations of Australia's mineral and fuel resources are closely related to particular structural elements. Many metallic mineral deposits such as those of copper, iron and gold occur in complexes of deformed igneous and metamorphic cratonic rock. On the other hand, fossil fuels (oil, natural gas and coal) have formed in the sedimentary basins of the craton covers.

The distribution of known mineral deposits and their host geological structures are shown on the accompanying two 1:5 million scale maps 'Minerals other than Fuels' and 'Fuels'.



Relationships between cratons and cratonic cover in south-eastern Australia
Adapted from Bureau of Mineral Resources (1979c).

The terms used to describe the cratons on the 'Major Structural Elements' map give an indication of their origins.

Blocks are stable areas of cratonic rock bounded by faults. Where portions of cratons are exposed at the surface and surrounded by younger rocks they are referred to as **inliers.** Blocks and inliers are the oldest exposed areas of rock, formed during the Archaean and Proterozoic and found predominantly in western and central Australia. **Province** is the term used when the origin of the craton has been obscured by metamorphism and deformation.

Basins are large depressions which have formed on the surface of craton covers, usually as a result of broad downwarping prolonged by extensive periods of sedimentation.

Geosyncline, trough, fold belt and **dome** describe the most conspicuous attribute of the region so named. Geosynclines and troughs are generally deep, long trenches containing particular kinds of sediments and volcanics. Fold belts are regions where layers of rock have been severely folded as a result of surrounding crustal pressure and movement. Apart from the Adelaide Fold Belt, which is a zone of folded cratonic cover rocks, all of the fold belts shown on the 'Major Structural Elements' map are exposed parts of the Tasman Fold Belt, the most easterly craton. Domes may form as a consequence of folding, the term specifically applying to underlying dome-shaped rock masses.

Orogens are geosynclines which have undergone metamorphism, deformation and a mountain-building phase, eventually stabilising to form cratons.

Mobile belts may contain any of the features so far described. The term implies that the region has been more unstable than most other areas. Central Australia, for example, was unstable for millions of years.