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# TECTONIC EVOLUTION OF THE WESTERN AUSTRALIAN SHIELD

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India and Western Australia were formerly contiguous parts of Gondwanaland. Both regions contain similar kinds of Precambrian rocks and this abstract presents an outline of the tectonic evolution of the cratons and orogenic belts of Western Australia. The outcrop of Precambrian rocks called the Western Australian Shield (Fig. 1) consists of two cratons >2.5 Ga, four orogenic belts active between 2.0 and 0.65 Ga, and less deformed sedimentary rocks ranging from 1.6 - 0.75 Ga.

The oldest components of the Yilgarn Craton (Fig. 1) are remnants of early gneiss terranes that occur along its western margin. The largest and best known is the Narryer Gneiss Complex which consists of two groups of quartzo-feldspathic gneiss: Meeberrie gneiss derived from 3.65 Ga monzogranite and Dugel gneiss derived from 3.4 Ga syenogranite. They contain inclusions of a 3.73 Ga gabbro-anorthosite complex and are tectonically interleaved with a former cover of siliceous metasedimentary rocks about 3.35 Ga old. The gneiss complex was deformed and metamorphosed in granulite facies about 3.3 Ga. It is in steep tectonic contact with granite-greenstone terrane that makes up most of the Yilgarn Craton. These terranes were juxtaposed, intruded by large volumes of granite sheets and intensely deformed about 2.7 Ga ago.

The Yilgarn granite-greenstone terrane consists of 3.0 - 2.9 Ga ultramafic and mafic volcanic rocks that formed as extensive submarine lava plains and local volcanic centres of mafic and felsic volcanic rocks. The volcanics were deformed in a horizontal tectonic regime, intruded by extensive sheets of granite 2.7 Ga ago and then deformed into large scale upright fold interference structures. Most of the granite-greenstone terrane is in greenschist or low amphibolite facies but deeper levels are exposed in the southwest where the rocks are in granulite facies. This tilting and erosion of the craton occurred before the widespread intrusion of high-level plutons ranging from tonalite to granite about 2.6 Ga ago. These plutons are associated with major transcurrent shear zones and faults and the massive mobilization of gold which was concentrated in these structures.

The Pilbara Craton (Fig. 1) also consists of granite-greenstone terrane but most formed 3.6 - 3.0 Ga ago and is deformed and metamorphosed in greenschist facies. It is overlain with marked unconformity by 2.8 Ga Fortescue basaltic volcanics and intruded by tin-bearing granites 2.7 - 2.6 Ga ago. The Fortescue volcanics are conformably overlain by the 2.4 Ga iron formations of the Hamersley Basin.

The collision of the Pilbara and Yilgarn Cratons about 2.0 - 1.8 Ga ago led to the intervening Capricorn Orogen (Fig. 1). Collision began in the east where a thick slab of granitic basement was obducted onto the margin of the Pilbara Craton and adjacent rocks of the Hamersley Basin were folded and transported northward on thrusts. Uplift and erosion led to the infilling of a foreland basin subsequently deformed and metamorphosed in greenschist facies. At the southern margin of the orogen a sheet of imbricated mafic and ultramafic schists was obducted onto the Yilgarn Craton and over-ridden by thrust sheets of metasedimentary rocks and

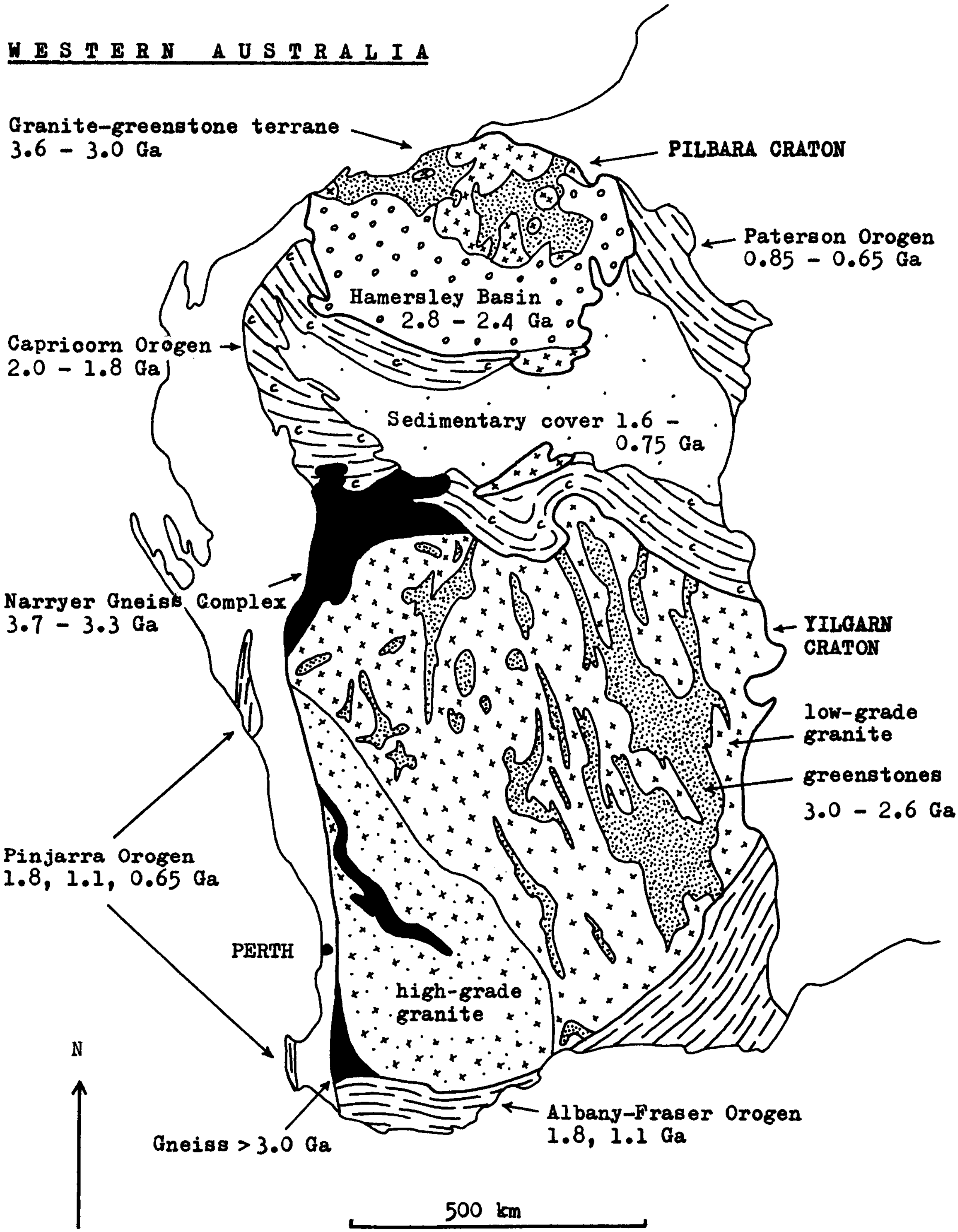
WESTERN AUSTRALIA
Granite-greenstone terrane
3.6 - 3.0 Ga
PILBARA CRATON
Paterson Orogen
0.85 - 0.65 Ga
Hamersley Basin
2.8 - 2.4 Ga
Capricorn Orogen
2.0 - 1.8 Ga
Sedimentary cover 1.6 - 0.75 Ga
Narryer Gneiss Complex
3.7 - 3.3 Ga
YILGARN
CRATON
low-grade
granite
greenstones
3.0 - 2.6 Ga
Pinjarra Orogen
1.8, 1.1, 0.65 Ga
PERTH
high-grade
granite
N
Gneiss > 3.0 Ga
Albany-Fraser Orogen
1.8, 1.1 Ga
500 km

Fig. 1

gneissose granites. The inferred suture between the cratons is marked by a wide belt of granite plutons associated with a variety of mineral deposits.

Orogenic belts also developed along the southern and western margins of the Yilgarn Craton 2.0 - 1.8 Ga ago. In the south the Albany-Fraser Orogen (Fig. 1) incorporates both Archaean and early Proterozoic rocks and was substantially reworked about 1.1 Ga ago. It consists of a northern belt of low grade metasedimentary rocks thrust northward onto the craton. To the south are tectonic slices of intensely deformed lower crustal rocks (metagabbros and quartzo-feldspathic gneisses in granulite facies), and then a belt of Proterozoic ortho- and paragneisses in amphibolite facies intruded by sheets of 1.1 Ga granite. The southern margin of the orogen may lie in Antarctica.

Most of the Pinjarra Orogen to the west of the Yilgarn Craton (Fig. 1) is buried beneath about 10 km of sedimentary rocks which filled a rift valley 430 - 130 Ma ago that preceded the separation of the Indian subcontinent from Australia. In addition to tectonic and plutonic avtivity about 1.8 and 1.1 Ga the southern part of this orogen was reactivated about 650 Ma when a new plutonic complex of anorthosite and granite was deformed and metamorphosed in granulite facies and the adjacent craton was cut by faults, shear zones and pegmatites.

A fourth orogen (Paterson Orogen, Fig. 1) developed 850 - 650 Ma ago along the eastern margin of the Pilbara Craton. Thrust sheets of late Precambrian sedimentary rocks and older basement gneiss were transported southwestward, and the orogen may reflect the collision of the Western Shield with central and northern Australia.