Evidence for Flood fountains adjacent to the cratonic margin of southwestern Australia

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Numerous articles in the creation literature refer to the fountains of the great deep that burst forth in Noah's Flood. However, this paper uses isotopic, petrographic, and geophysical data as evidence for Flood fountains near today's Darling Fault in southwestern Australia in the context of a new proposed model of the early Flood.[1]

Geological setting

Key tectonic elements in southwestern Australia include the Yilgarn Craton, the Albany-Fraser Orogen, the Leeuwin Complex and the Perth Basin (figure 1).

The Archean Yilgarn Craton consists of granitoids, greenstones, and high-grade gneiss belts. It is bounded on its western margin by the Darling Fault. Along the southwestern margin of the Yilgarn Craton, an escarpment (the Darling Range) separates the extensive plateau of the craton from the coastal plain. The scarp's location closely parallels that of the Darling Fault, which separates the Precambrian rocks to the east from the Phanerozoic sediments of the Perth Basin to the west.

The Mesoproterozoic Albany-Fraser Orogen is located along the southern and southeastern margin of the Yilgarn Craton. It consists of high-grade gneisses and granitoid intrusions.[2]

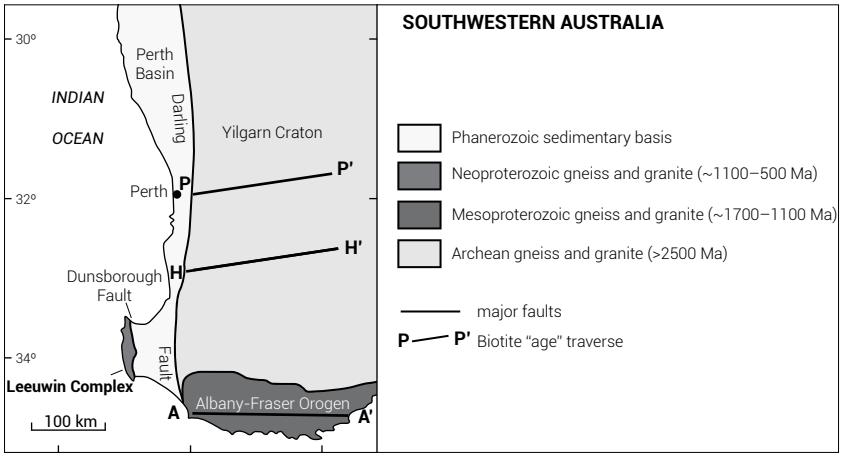

Figure 1. Map showing key tectonic elements of southwestern Australia (after Janssen *et al.*[11]) and approximate location of biotite 'age' traverses of Libby and De Laeter,[5] shown in figure 2

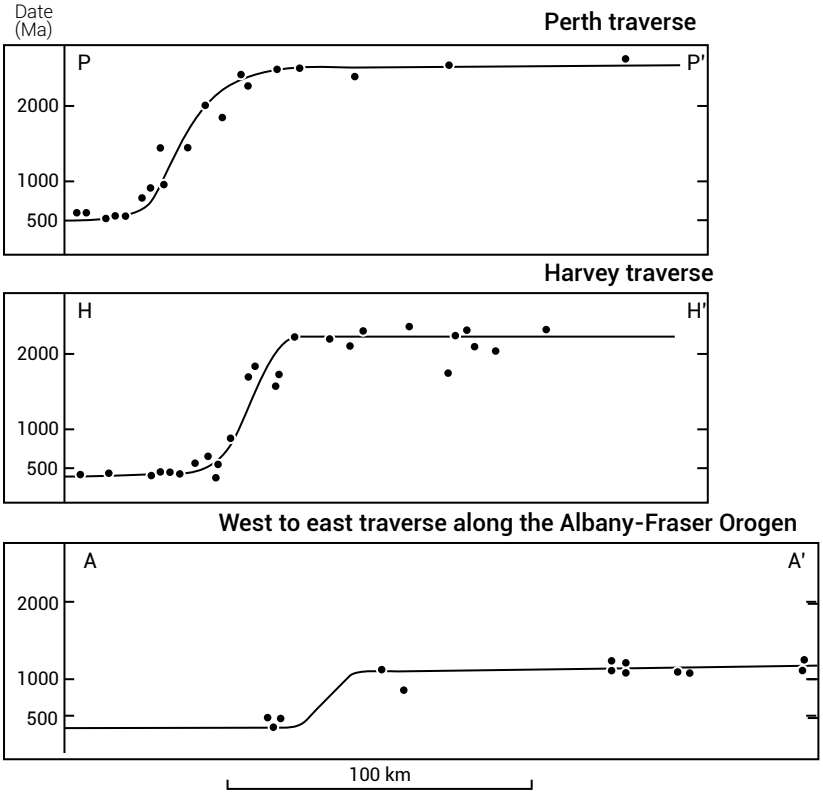

Figure 2. Biotite Rb-Sr radiometric 'age' versus distance sections extending eastward from the Darling Fault (after Libby and De Laeter[5])

The Neoproterozoic Leeuwin Complex is situated in the far southwest of Western Australia. It is bounded to the east by the Dunsborough Fault and to the west by the Indian Ocean. The Leeuwin Complex is a small segment of sialic crust and essentially consists of granulite metamorphic facies felsic gneisses.[3] The Leeuwin Complex is considered part of the Pinjarra Orogen, which is the name proposed for Precambrian rocks west of the Darling Fault.[4]

The Darling Fault is a major geological boundary between the Yilgarn Craton in the east and the Perth Basin in the west. It can be recognised at the surface and by geophysical methods for some 1,000 km. Up to 15 km of Phanerozoic sedimentary rocks occur in the Perth Basin.[4]

Isotopic and petrographic data

Rb-Sr radiometric 'ages' of biotite can be reset at temperatures well below magmatic conditions and are well suited for studying the post-emplacement history of crystalline basement rocks.[5] Biotite is particularly useful because of its wide distribution and well-known closure temperature.[5] The Rb-Sr system is very sensitive to hydrothermal fluid alteration, as this enables the diffusion of Rb and Sr, and the preferential loss of Rb from biotite.[6] Thermal resetting of radiometric ages is described in greater detail in the literature.[7,8]

Libby and De Laeter showed that biotite dates vary systematically along a traverse east from Perth (the Perth traverse; figure 2).[9] The traverse was divided into three sections, each with a distinctive set of Rb-Sr biotite dates:

1. The western section (closest to the Darling Fault) was shown to have the youngest biotite dates.
2. The middle, transition zone, tending to become older toward the east.
3. The eastern section has the oldest 'ages' and which are very similar to biotite dates over much of the rest of the Yilgarn Craton.

A second traverse about 100 km to the south of Perth (the Harvey traverse, figure 2) established that the trend of younging Rb-Sr biotite dates westward towards the Darling Fault was regional, reproducible, and systematic. This second traverse also defined the trend of the break between biotite on the east, which had typical Yilgarn Craton ages, and biotite to the west, which had younger 'ages'. The regional trend was found not to be parallel to previously described tectonic lineaments, such as the Darling Fault.[10]

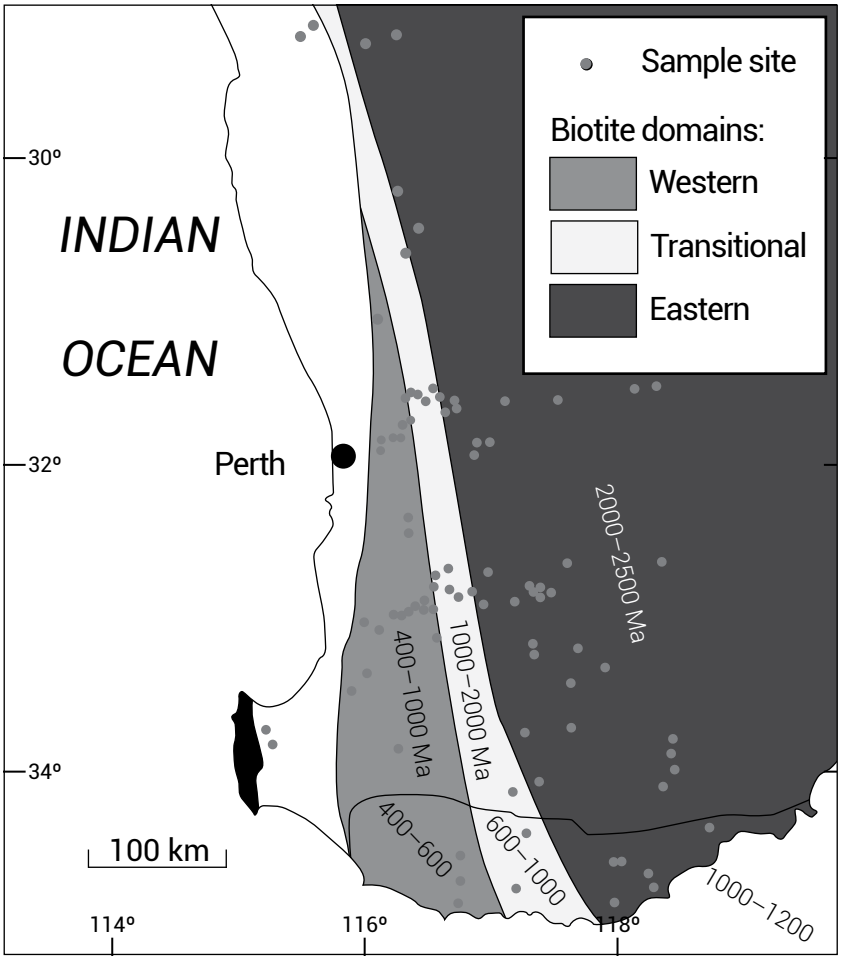

Figure 3. Map showing three biotite 'age' domains in southwestern Australia (after Janssen *et al.*[11])

To resolve the question of whether the regional trend extended further south, sampling was extended southward across the Albany-Fraser Orogen to the south coast and eastward beyond Albany. Rb-Sr biotite dates obtained along the Perth and Harvey traverses, and along the Albany-Fraser Orogen, were projected into cross-sections shown on figure 2.[5] Janssen *et al.*[11] produced an updated map of the three biotite 'age' domains—the western, transitional, and eastern biotite domains (figure 3).

Lu *et al.*[6] employed $^{40}Ar/^{39}Ar$ incremental heating experiments on muscovite and biotite grains from sample sites broadly comparable to those sampled by Libby and De Laeter's Perth traverse for Rb-Sr biotite analysis. Similar trends were obtained by $^{40}Ar/^{39}Ar$ biotite 'age' dating—oldest dates for the more interior Yilgarn Craton, with 'ages' decreasing abruptly to a narrow transitional zone, before decreasing further along the western margin of the craton.

In light of $^{40}Ar/^{39}Ar$ data in the western margin of both the Yilgarn Craton and the Albany-Fraser Orogen, young biotite 'ages' have been interpreted to result principally from hydrothermal fluid alteration.[12] Younger biotite $^{40}Ar/^{39}Ar$ 'ages' from the western margin of the craton are consistent with a late Neoproterozoic

tectonic event between Greater India and Australia (figure 4).[6,13] Moreover, paleomagnetic studies indicate that 'Greater India' was in a position adjacent to Western Australia in the late Neoproterozoic (figure 4).[13,14]

Petrographic observations indicate that most biotite grains in the transitional zone and western margin are severely chloritized and contain abundant titanite inclusions. These may have been caused by fluid-induced recrystallisation during an episodic hydrothermal and/or tectonic event.[6] Petrographic and chemical studies indicate that the biotite from each domain differs markedly in composition and origin, that is magmatic to the east versus hydrothermal to the west.[12]

The general northerly trend of late Proterozoic mafic dykes close to the Darling Fault[4] is consistent with an east–west extensional regime necessary for the development of the Leeuwin Complex.[2] These subvertical dykes are known as the Boyagin dyke swarm and increase in abundance towards the Darling Fault (figure 5). The Rb-Sr radiometric 'age' of 590–560 Ma together with the pattern and spatial distribution of these dykes in the southwestern part of the Yilgarn Craton suggests that the Boyagin dyke swarm is related to late Proterozoic orogenic activity.[4]

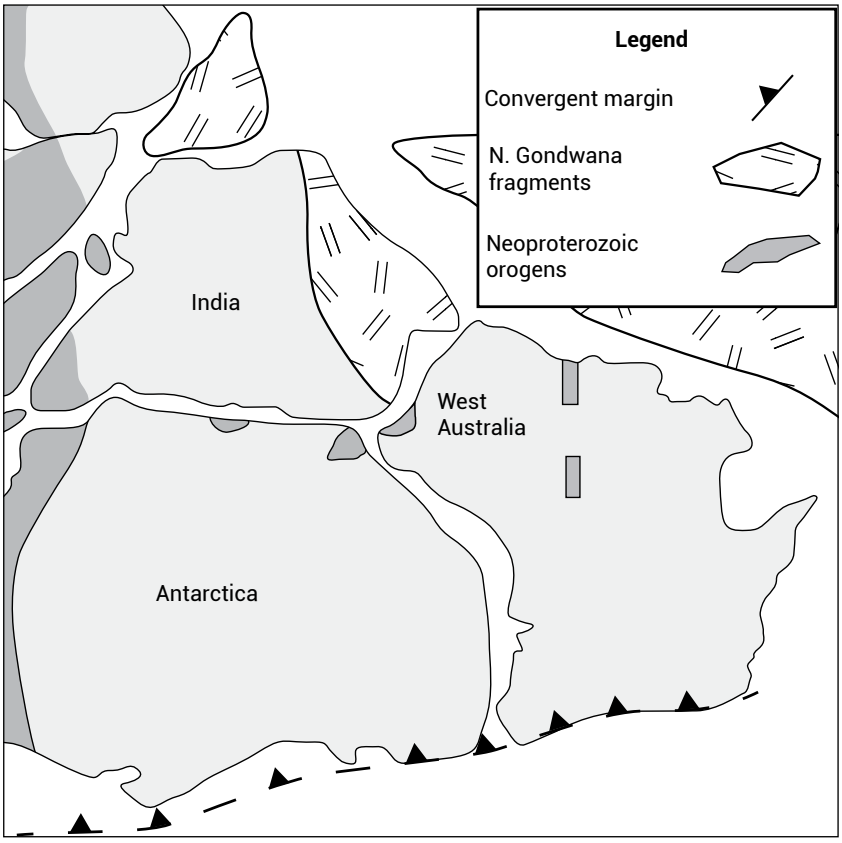

Figure 4. An inferred configuration of part of Gondwana around the time of the late Precambrian (Neoproterozoic) to Cambrian transition (after Kroner and Stern[13])

Geophysical data

Magnetotellurics is a passive geophysical method which uses natural time variations of the earth's magnetic and electric fields to measure the electrical conductivity of the subsurface. Depth information is obtained by measuring the time variations over a range of frequencies. High frequencies penetrate the earth to shallow depths only, while low frequencies penetrate deeper. Information is obtained from a few hundred metres depth to hundreds of kilometres depth.[15] Magnetotelluric data indicate a conductivity anomaly associated with the Darling Fault Zone, and this anomaly has been imaged as penetrating into the upper mantle.[16] Conductors have been imaged on other lithospheric fault zones around the world, being explained by fluids in the enhanced permeability of the damage zone.[16] Other examples of this are found in places such as China, Japan, India, and Turkey.[17]

By the late Neoproterozoic, the tectonic style along the western margin of the Yilgarn Craton appears to have become that of an extensional, rift environment, with granitoid emplacement and then granulite facies metamorphism affecting the Leeuwin Complex.[3] A geophysical (seismic and magnetics) traverse across the Darling Fault Zone supports a late Proterozoic rifting model, with evidence of extension affecting the upper 8–10 km of crust along the western margin of the Yilgarn Craton.[18] Leeuwin Complex granites have been interpreted to have resulted from intracontinental high temperature melting in a rift environment,[19] consistent with development of rifting associated with the breakup of Rodinia.[3]

A young earth Bible model

I have previously suggested that the erosion of land due to the enormous (prolonged and global) rain of the Noahic Flood can be correlated with Neoproterozoic sedimentary sequences, and that strontium isotope trends indicate Neoproterozoic continental erosion.[20] A corollary is that Archean to Mesoproterozoic rocks may be correlated with the first few days of Creation Week.[1]

"He set the earth on its foundations" (Psalm 104:5a ESV).

Mantle roots of Archean cratons may be considered as the foundations of the earth's crust during Creation Week (possibly on Day 1).[21] The Archean Yilgarn Craton was cratonized around 2,600 Ma (radiometric 'age') by the emplacement of extensive granitoids into pre-existing greenstone and high-grade gneissic belts.[3,22] This is considered to correspond to the Kenoran Event of North America's Superior Province.[23]

"And God said, 'Let the waters under the heavens be gathered together into one place, and let the dry land appear.' And it was so" (Genesis 1:9 ESV).

The 1,200–1,100 Ma peak in isotopic and geochemical signatures, identified in Western Australia's Albany-Fraser Orogen, North America's Grenville Province, and global data sets, signifies that the Grenvillian Orogeny represents a unique episode in Earth history.[24] The Grenvillian Orogeny has been correlated with crustal thickening and consequent emergence of land on Day 3 of Creation Week.[1,25]

"In the six hundredth year of Noah's life, in the second month, on the seventeenth day of the month, on that day all the fountains of the great deep burst forth, and the windows of the heavens were opened" (Genesis 7:11 ESV).

"… by His knowledge the deeps broke open" (Proverbs 3:20a ESV).

The Bible clearly states that on a specific day there was simultaneous worldwide fracturing of the earth's crust as the fountains burst forth. The phrases "fountains of the great deep burst forth" and "deeps broke open" imply rifting and fracturing of the earth's crust. The text implies that water flowed from within the earth through the fountains, and rain fell. Much of the water for the Noahic Flood may have come from various depths within the earth, with the mantle being the major water source.[21]

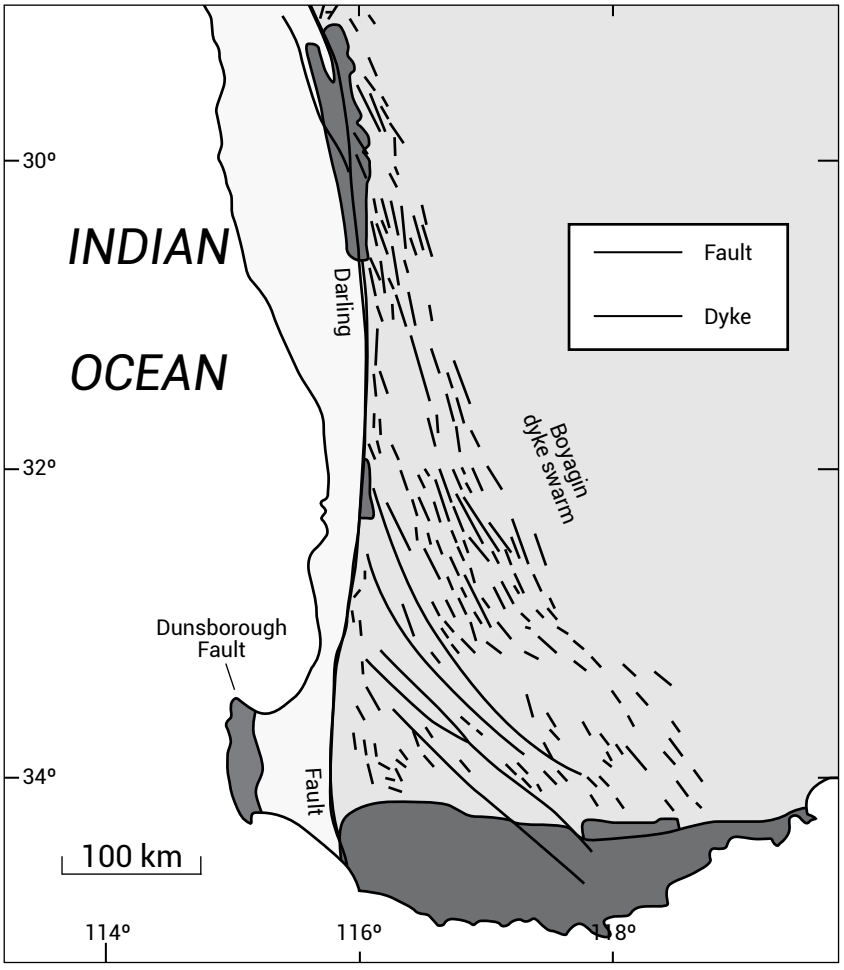

Figure 5. Late Proterozoic Boyagin dyke swarm and major faults cutting the Yilgarn Craton and Albany-Fraser Orogen (after Janssen *et al.*[11])

The term 'Pan-African' is used to describe much of the global tectonic (including rifting), magmatic, and metamorphic activity of Neoproterozoic to earliest Paleozoic geology. The Pan-African event is interpreted as a tectono-thermal event at around the radiometric 'date' of about 500 Ma ago, during which a number of orogenic belts formed, surrounding older cratons.[13] The Pan-African event is associated in secular literature with Neoproterozoic rifting of the Rodinian supercontinent.[3] This event is inferred to have initiated with the breaking open of the fountains of the great deep.[1]

The granulite facies metamorphism of the Leeuwin Complex is considered characteristic of the low-pressure metamorphism in Pan-African terranes.[3] $^{40}Ar/^{39}Ar$ 'ages' from the Yilgarn Craton's transitional domain may have been reset due to hydrothermal alteration related to Pan-African tectonism, as recorded in the Leeuwin Complex.[12] In light of $^{40}Ar/^{39}Ar$ data in the western margin of both the Yilgarn Craton and the Albany-Fraser Orogen, young biotite 'ages' have been interpreted to result principally from hydrothermal fluid alteration.[12]

In my early Flood model,[1] the vicinity of the Darling Fault is considered to be a region where continental crust fragmented and the fountains of the great deep broke open.

Rb-Sr and Ar-Ar isotope systems, petrography, and magnetotelluric data all point to a regionally extensive and major hydrothermal event around the Darling Fault. Paleomagnetic data, mafic dykes close to the Darling Fault, a seismic traverse across the Darling Fault Zone, and intracontinental high-temperature melting suggest a model of late Proterozoic rifting. This may have been associated with the breakup of Rodinia or some version of a supercontinent. In this study of southwestern Australia, all these pieces of evidence taken together are consistent with the Bible's account of the Flood event initiating as "the fountains of the great deep burst forth".

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