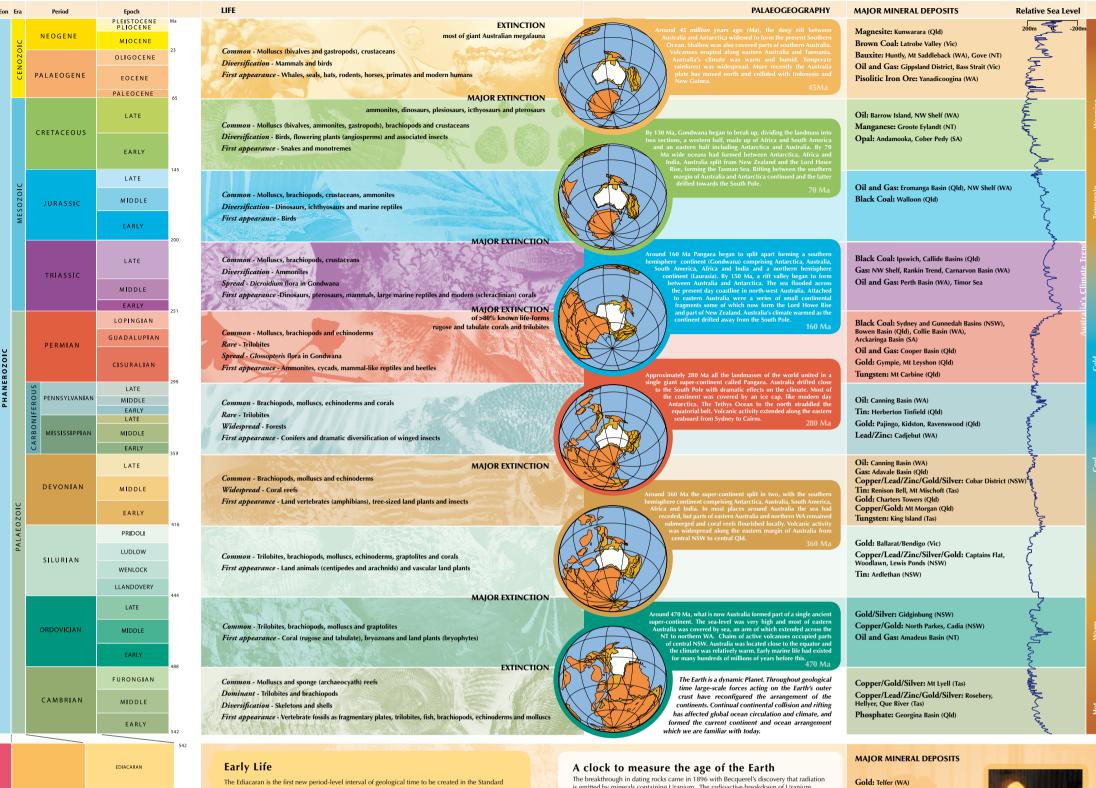
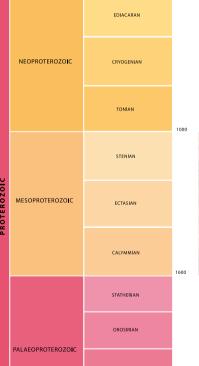
# AUSTRALIA





SIDERIAN

NEOARCHAEAN

PALAEOARCHAEAN



## First Life - living rocks, living fossils

Dickinsonia costata (length 1.5cm) and Tribrachidium heraldicum (holotype) (diameter 2.5cm) © Jim Gehling, South Australian Museum

Stromatolites first appeared in the fossil record between 2.7 billion years and 3.465 billion years ago. Stromatolites are laminated mound-like sedimentary structures which form over time as single-celled filamentous cyanobacteria bind layers of sediment grains together. Fossil stromatolites from the Pilbara in Western Australia are some of the earliest evidence of cellular life on Earth. Stromatolites were the Earth's first reef-building organisms and still exist today in places such as Hamelin Pool - Shark Bay,

Global Chronostratigraphic Scale for well over 100 years. It takes its name from the Ediacara Hills in the northern Flinders Ranges in South Australia. The Ediacaran Period covers an interval of about

88 million years from the end of the Marinoan glaciation 630 million years ago to the beginning of the Cambrian Period 542 million years ago. The Ediacaran Period is famous for its association with the Ediacara biota, marking the first appearance of large, architecturally complex organisms in Earth history. The marked and rapid increase in abundance, size and diversity of life-forms during the

Australian Ediacaran shows that it was a period of major evolutionary change



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The breakthrough in dating rocks came in 1896 with Becquerel's discovery that radiation is emitted by minerals containing Uranium. The radioactive breakdown of Uranium produces a stable end-product, namely Lead. The constant rate of Lead accumulation from Uranium decay is a Lead-accumulation clock with which the ages of rocks and minerals can be measured.

Two isotopes of Uranium with slightly different masses – <sup>235</sup>U and <sup>236</sup>U – decay radioactively to produce two isotopes of Lead: <sup>236</sup>Pb and <sup>236</sup>Pb. Their rate of decay is extremely slow: it takes about 700 million years for half of the <sup>235</sup>U to decay into <sup>237</sup>Pb, and the decay of <sup>238</sup>U is even slower. This decay period is known as the 'half-life' and is known to very high precision, which permits measurement of the ages of geological events that occurred between a few million to billions of years ago.

Other elements are radioactive and they all have different rates of decay and dating. For example, Rubidium decays to form Strontium, and Potassium decay causes accumulation of Argor gas locked in certain minerals. The Lead-accumulation clock is the most widely used because tiny, but measurable, amounts of Uranium and Lead are found in most rocks Zircon is a mineral which locks traces of Uranium within its crystals and it is found in many types of rocks. The Lead that accumulates from decay of

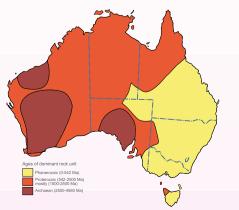
the Uranium is trapped within the crystals and scientists measure the amount of lead inside zircon crystals to measure the time since the crystal formed.

The science of dating rocks is called 'geochronology'. 'Mineral chronometers' like zircon reveal the ages of magmatic events, metamorphism (when rocks are altered by extreme heat) and the deposition of sedimentary rocks many millions of years ago.

# How old is the Earth?

4,000 million years old. Rare sand grains found in some sandstones in Western Australia are even older, at 4,250 million years. The Earth's formation predates these, but preserved remnants of the original crust have not yet been found.

Fortunately, fragments of the earliest rocks in the Solar System have periodically fallen to Earth as meteorites. With the Earth, the Sun and the other planets, meteorites are a product of the event which created the Solar System and stared the Lead-accumulation clock. Several meteorites preserving remnants of the original matter have been dated at 4,560 million years old. This is the formation age of our Solar System and of the Earth.

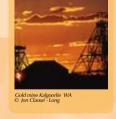


Australia has grown from west to east. The Pilbara (north) and Yilgarn (south) Blocks, in WA and the Gawler Block in SA, are Archaean. Proterozoic basement extends eastwards from these and this is bounded by Phanerozoic rocks, which form most of the eastern states. Much of the older basement in the western half of the continent is covered by younger Phanerozoic sediments and recent regolith, which are not shown.

on Ore: Savage River (Tas)

Diamond: Argyle (WA)





Gold/Uranium/Copper/Rare Earth Elements: Olympic Dam (SA)

By this time crustal growth had progressed far enough to support the formation of large sedimentary basins, which host Lead/Zinc: McArthur River (NT), Mt Isa & Century (Qld), Broken Hill (NSW)

Gold: Tanami region(NT) Gold/Tin/Base Metals (Lead/Zinc/Copper): Pine Creek region (NT)

Uranium/Gold/Platinum/Palladium: Pine Creek (NT) Uranium/Rare Earth Elements: Mary Kathleen (Qld) Gold/Copper/Bismuth: Tennant Creek (NT)

Iron: Hammersley (WA), existing formations underwent hydrothermal upgrading

### MAJOR MINERAL DEPOSITS (2500-3000 Ma)

Platinum horizons: Munni Munni (WA)

Gold deposits: 2900 and 3400 Ma. Pilbara (WA)

Gold: Yilgarn Block (WA) Banded Iron Formations: Hammersley Ranges, Shay Gap, numerous small formations in the Pilbara and Yilgarn (WA) Tin/tantalum/lithium: Greenbushes, SW Yilgarn; Wodgina, Pilbara (WA) Nickel sulphide: Kambalda, Yilgarn Block (WA) Nickel/Copper: Ruth Well (WA) Copper: Mons cupri/Whims Creek (WA)

### OLDEST KNOWN MINERAL DEPOSITS (older than 3000 MA)

Barite-rich Lead/Zinc: Big Stubby, 3470Ma; Panorama, 3240 Ma, Molybdenum/Copper: Spinifex Ridge, Gobbos, 3324 Ma, Pilbara (WA)

(the age of many of these deposits are uncertain; the oldest age considered possible has been used)

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