

crust have reconfigured the arrangement of the continents. Continual continental collision and rifting has affected global ocean circulation and climate, and formed the current continent and ocean arrangement which we are familiar with today.

Copper/Lead/Zinc/Gold/Silver: Rosebery, Hellyer, Que River (Tas)

Phosphate: Georgina Basin (Qld)

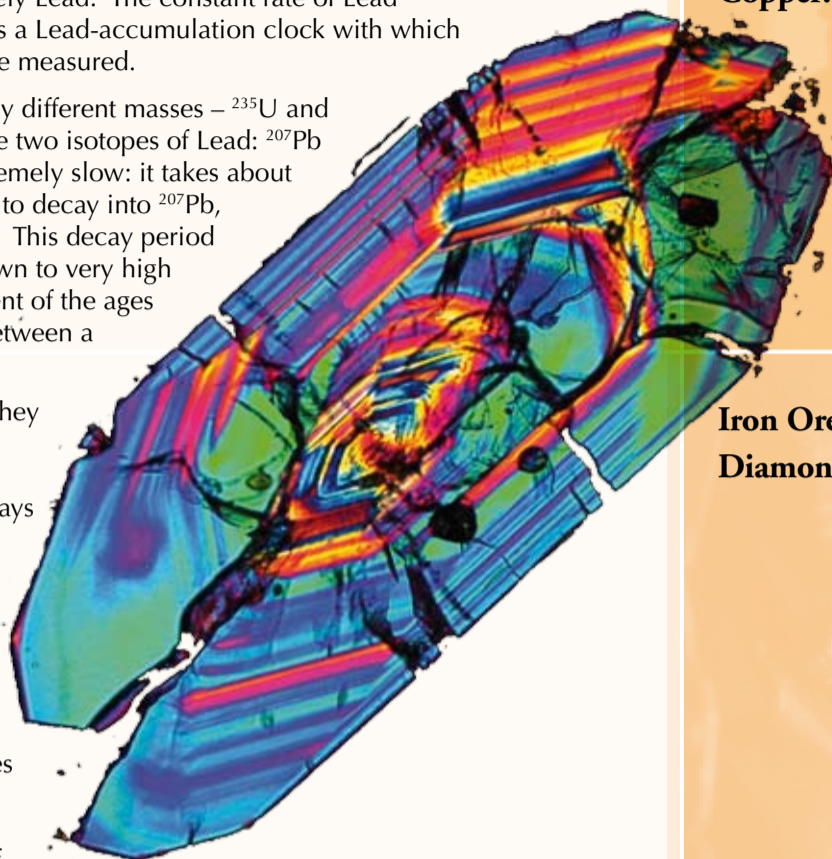
Hot

A clock to measure the age of the Earth

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 – ^{235}U and ^{238}U – decay radioactively to produce two isotopes of Lead: ^{207}Pb and ^{206}Pb . Their rate of decay is extremely slow: it takes about 700 million years for half of the ^{235}U to decay into ^{207}Pb , and the decay of ^{238}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 accumulation useful in geological dating. For example, Rubidium decays to form Strontium, and Potassium decay causes accumulation of Argon 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.

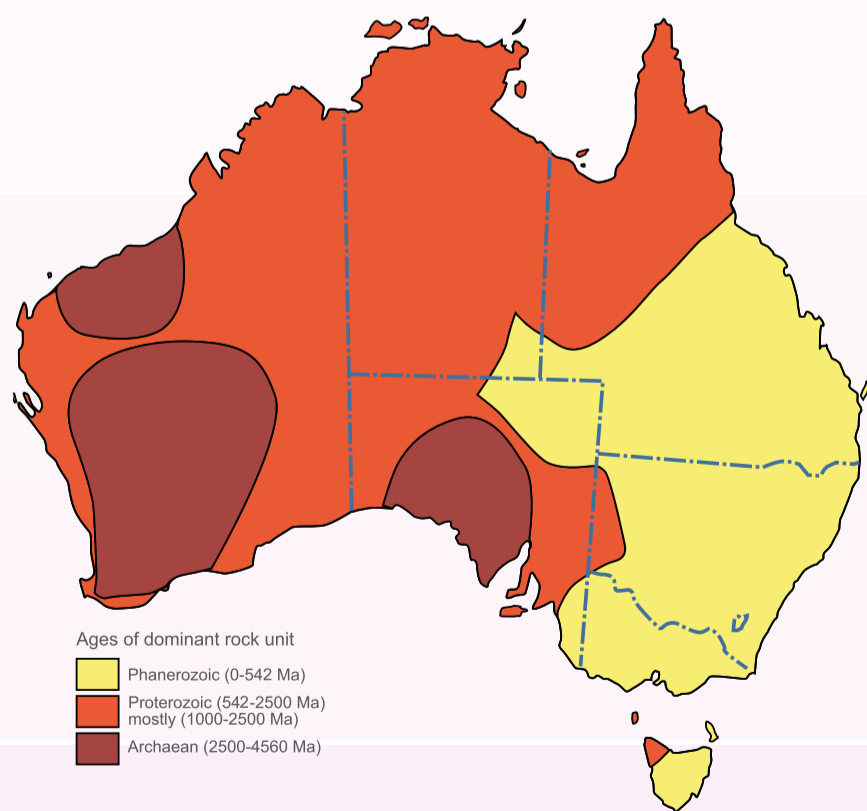


The science of dating rocks is called 'geochronology'. 'Mineral chronometers' like zircon reveal the ages of magmatic events, metamorphism (when rocks are altered by extreme heat) and the deposition of sedimentary rocks many millions of years ago.

How old is the Earth?

Using the Lead-accumulation clock, it has been discovered that some rocks in Alaska are 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 started 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.



Evolution of Australia

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.

MAJOR MINERAL DEPOSITS

Gold: Telfer (WA)

Copper: Nifty, Maroochydore (WA)



Gold pour WA © Jon Claoué - Long

Iron Ore: Savage River (Tas)

Diamond: Argyle (WA)



Gold mine Kalgoorlie WA © Jon Claoué - Long

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)

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)

Platinum horizons: Munnii Munnii (WA)

OLDEST KNOWN MINERAL DEPOSITS (older than 3000 MA)

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

Barite-rich Lead/Zinc: Big Stubby, 3470Ma; Panorama, 3240 Ma, Pilbara (WA)

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)