



The study highlights a fundamental shift in the nature of crust formation 3.75 billion years ago, which facilitated the formation of Earth's unique, stable continental crust. Credit: CC0 Public Domain

An international study led by Monash University geologists provides a new insight into how Earth's first continents formed.

The study involving researchers from Melbourne University, University of St. Andrews (Scotland), and the Geological Survey of Western Australia is published in *Nature Communications*.

Although the Earth formed over 4.5 billion years ago, the oldest preserved parts of our planet's continental [crust](#) date back to 4.0—3.6 billion years ago.

"Why it took over half a billion years for these ancient, stable pieces of crust to start forming remains a key unknown in our understanding of the origin of Earth's continents," said lead study author, Dr. Jack Mulder, a Research Fellow with the Monash University School of Earth, Atmosphere and Environment.

To address this question, Dr. Mulder and the research team studied 4.2- to 3.2-billion-year-old microscopic grains of the mineral [zircon](#) from the Yilgarn Craton of Western Australia.

Crust can form through two fundamentally different processes: remelting of pre-existing crust or through fresh melting of Earth's underlying mantle.

The hafnium isotopic composition of zircon grains can track these

processes.

"The new data we collected shows a dramatic shift in the hafnium isotopic composition of Yilgarn Craton zircons 3.75 billion years ago," Dr. Mulder said.

"Older zircons formed in magmas that were derived solely through re-melting of older crust," he said.

"From 3.75 billion years ago onwards, zircon-bearing magmas began to be sourced, at least in part, from Earth's mantle.

"Importantly, the isotope shift recorded in the zircon time-capsules, coincides precisely with the time when the oldest preserved crust in today's Yilgarn Craton formed."

Dr. Mulder and the study co-authors attribute this coincidence to a simple, causal relationship: When magma is extracted from Earth's mantle, the deep residue underpinning the crust is dry, rigid, and most importantly buoyant— analogous to squeezing water from a sponge.

"These buoyant keels of melt-depleted residual mantle may have served as 'life-rafts' that protected the new, overlaying earliest continents from diving back into the deep Earth," Dr. Mulder said.

"These results highlight a fundamental shift in the nature of crust formation 3.75 billion years ago, which facilitated the formation of Earth's unique, stable continental crust."

Dr. Mulder said these ancient crustal nuclei around which today's continents grew, had a profound influence on the climate, atmosphere, and ocean chemistry of the early Earth, paving the way for establishment of life.

**More information:** Jacob A. Mulder et al, Crustal rejuvenation stabilized Earth's first cratons, *Nature Communications* (2021). [DOI: 10.1038/s41467-021-23805-6](https://doi.org/10.1038/s41467-021-23805-6)

Provided by Monash University

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