WAXI - West African Exploration Initiative

IXOA - L'Initiative d'Exploration Ouest Africaine

Centre for EXPLORATION TARGETING

Radiogenic Isotopes as tool to peer into the crustal growth, tectonic evolution and metal fertility of continental masses

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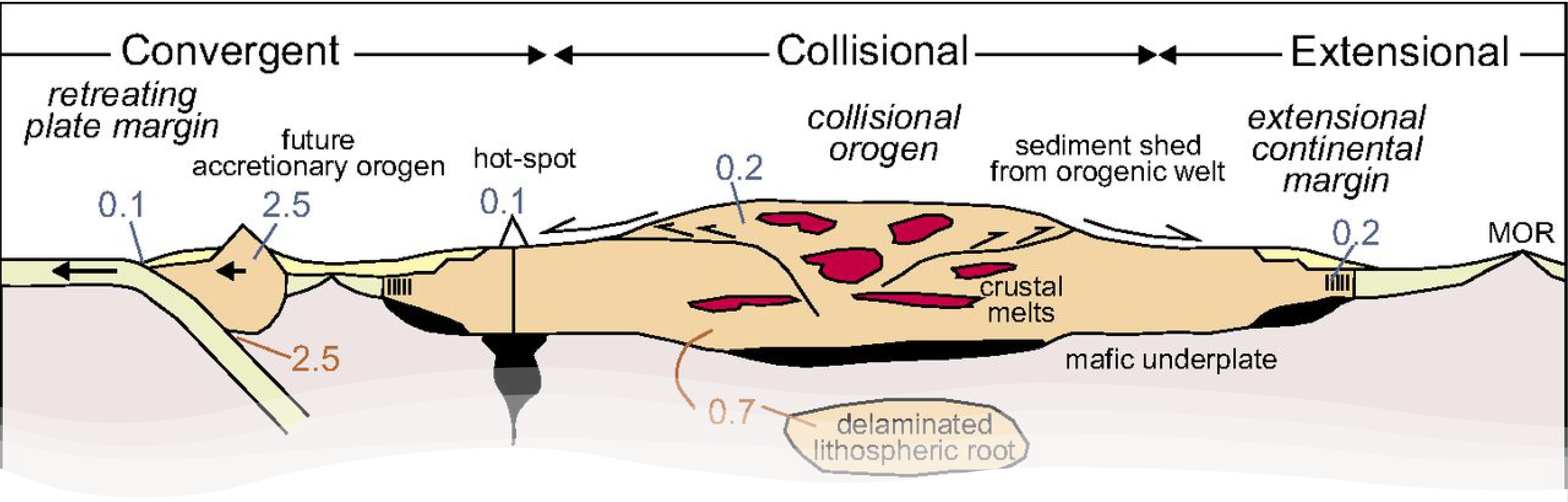
THE UNIVERSITY OF WESTERN AUSTRALIA

IASTG - conference Accra July 2026



Cawood et al., 2013

Where does the continental crust forms?

Mechanism for generating TTGs

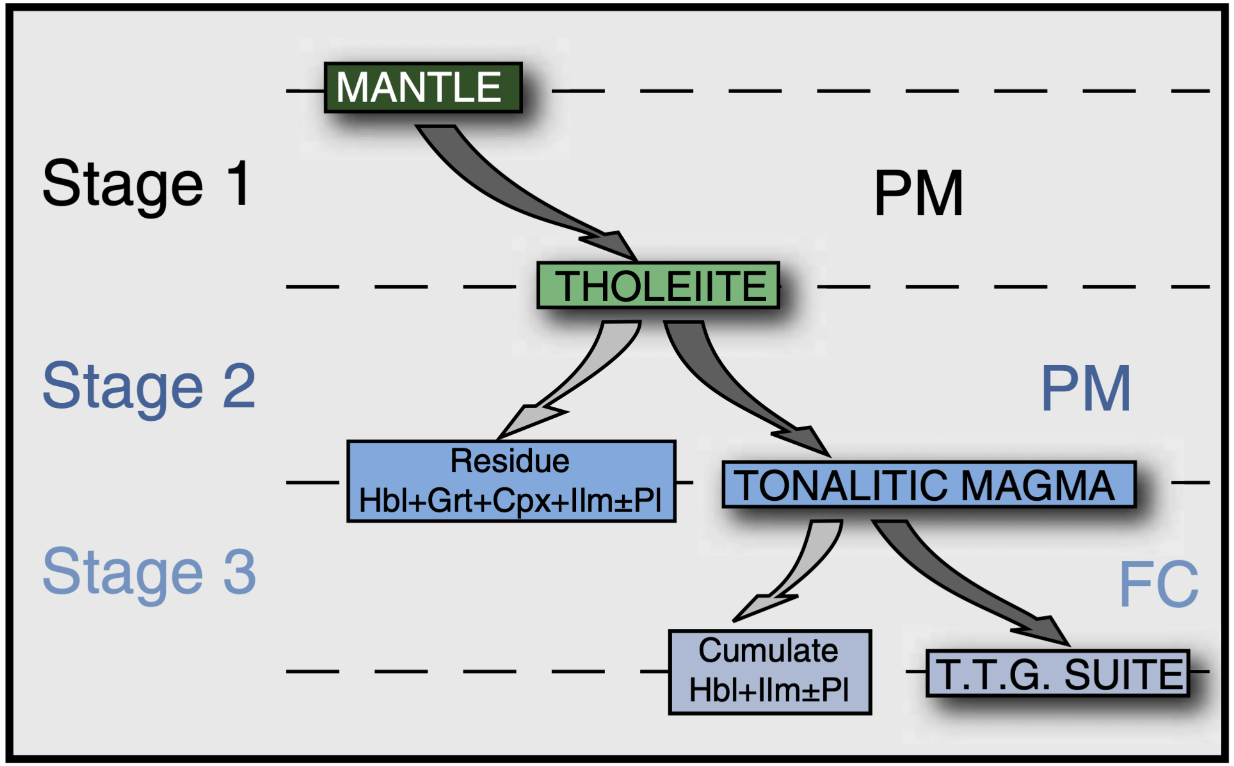
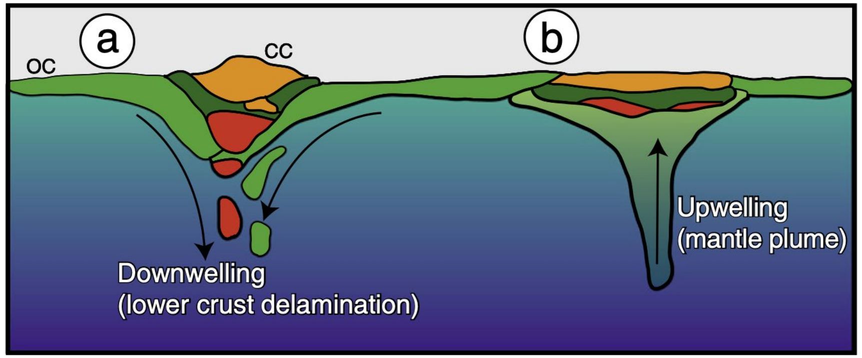
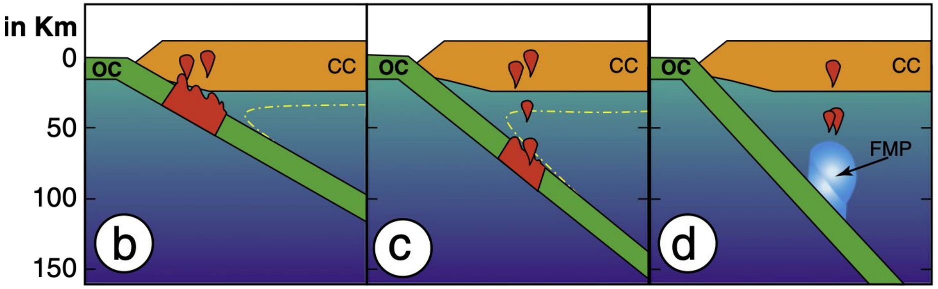


Fig. 8. Schematic diagram summarising the succession of the different mechanisms implied in Archaean TTG genesis (after Martin, 1993). Hbl = hornblende; Grt = garnet; Pl = plagioclase; Cpx = clinopyroxene; Ilm = ilmenite; PM = partial melting; FC = fractional crystallisation.

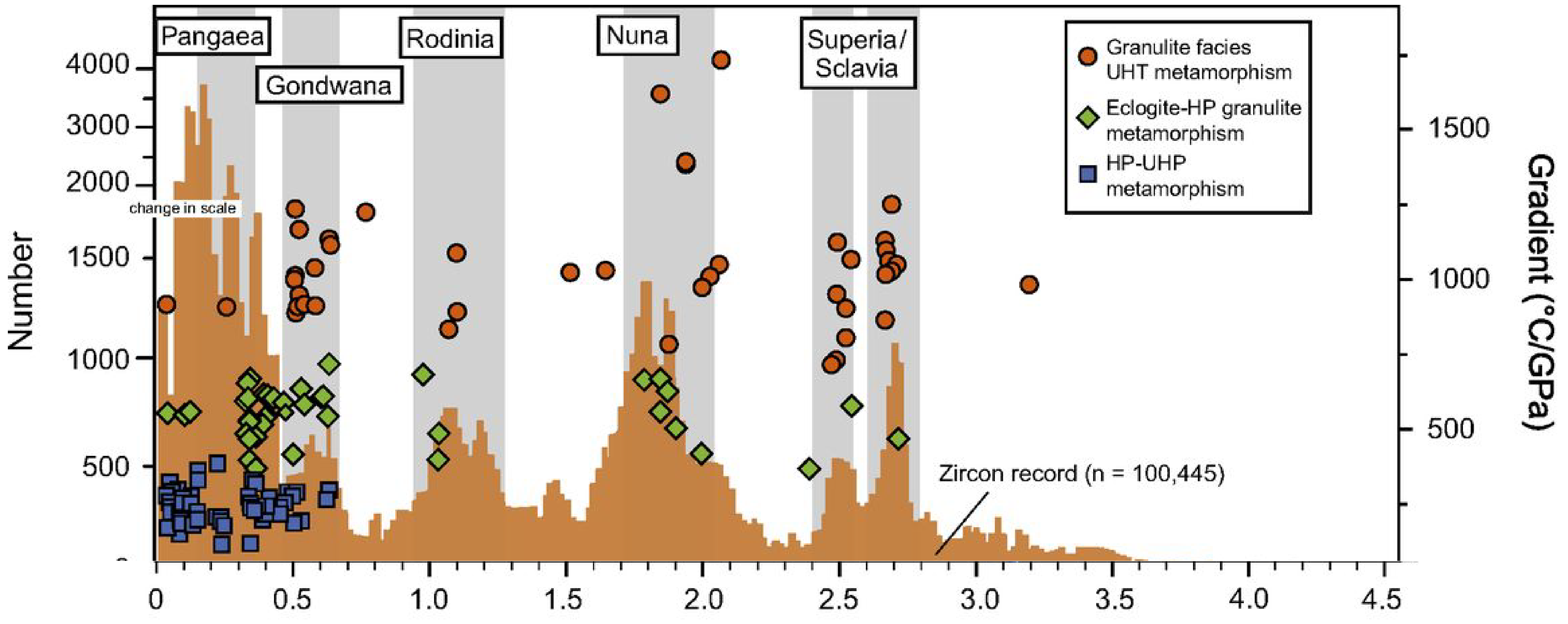
without or with plate tectonics ?





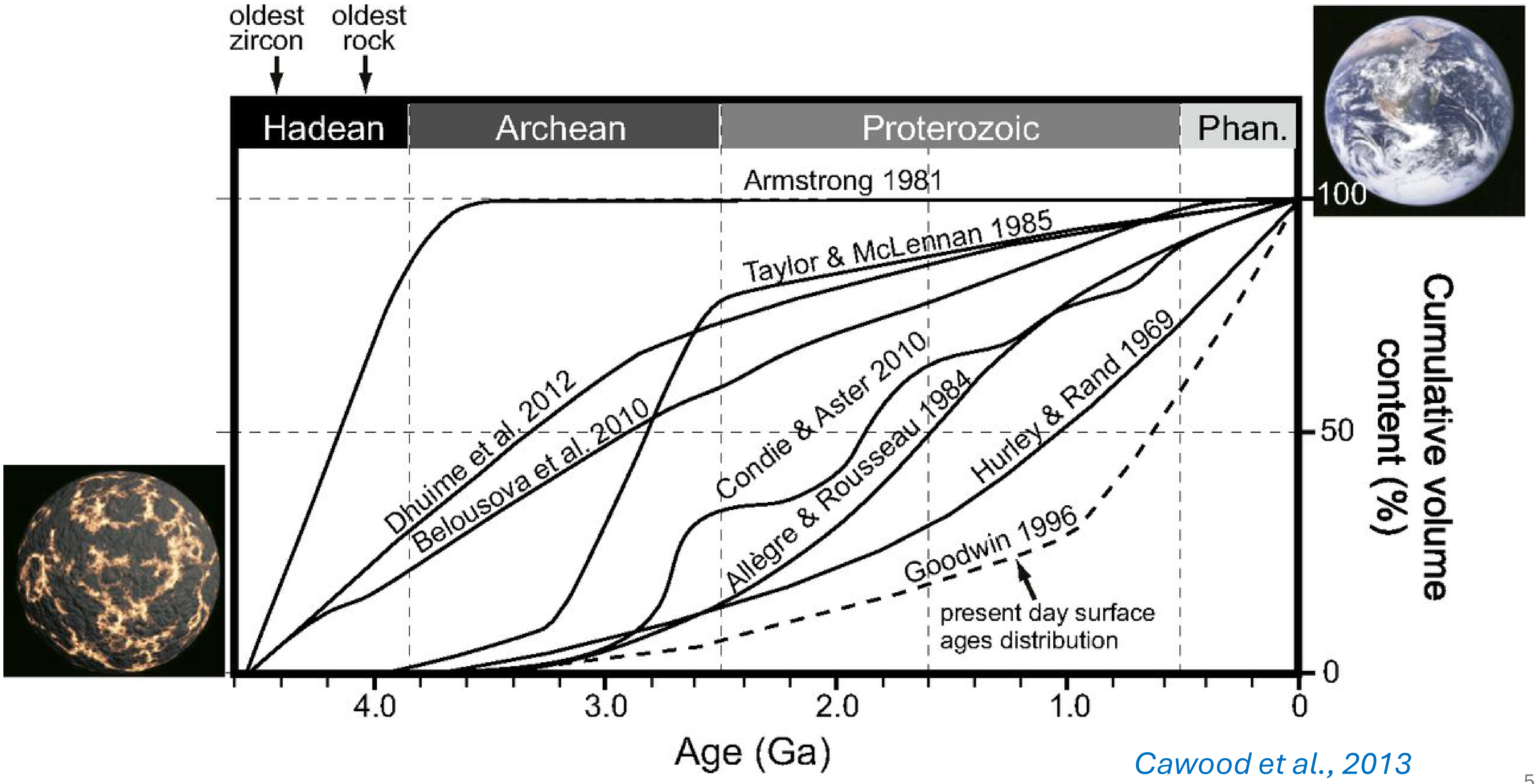
Moyen and Martin., 2012

Emergence of the felsic crust ?

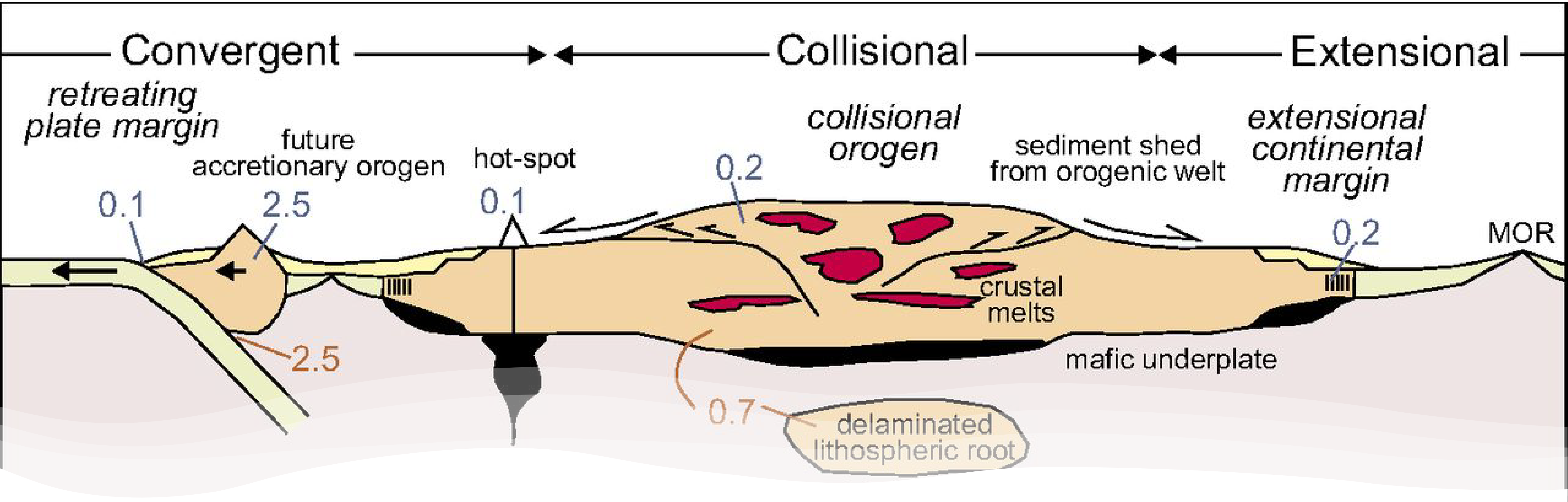


Histogram of over 100,000 detrital zircon analyses showing several peaks in their U-Pb crystallization ages over the course of Earth history (Voice et al., 2011 and modified after Cawood et al., 2013)

Emergence of the felsic crust ?



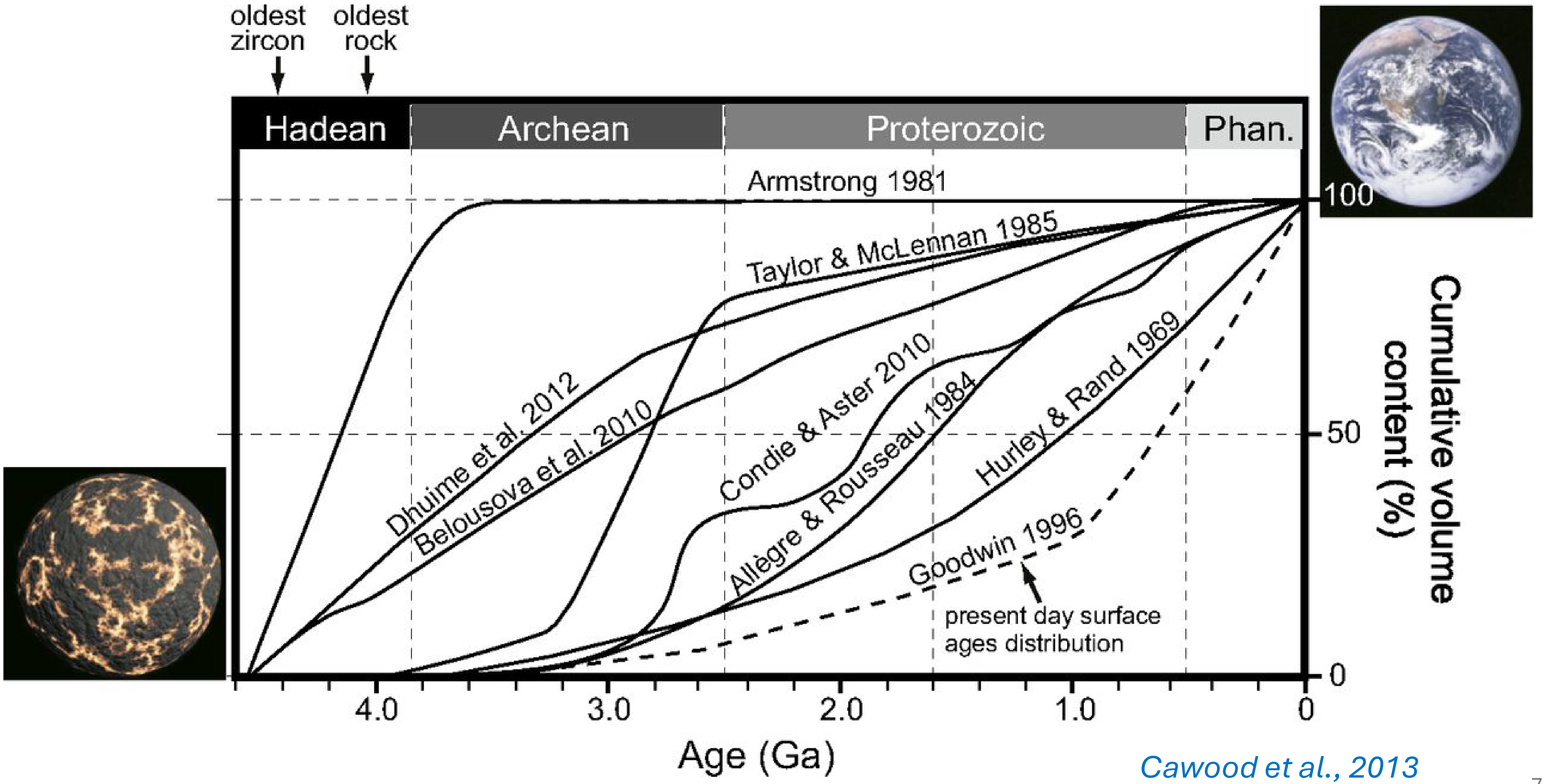
Cawood et al., 2013



Cawood et al., 2013

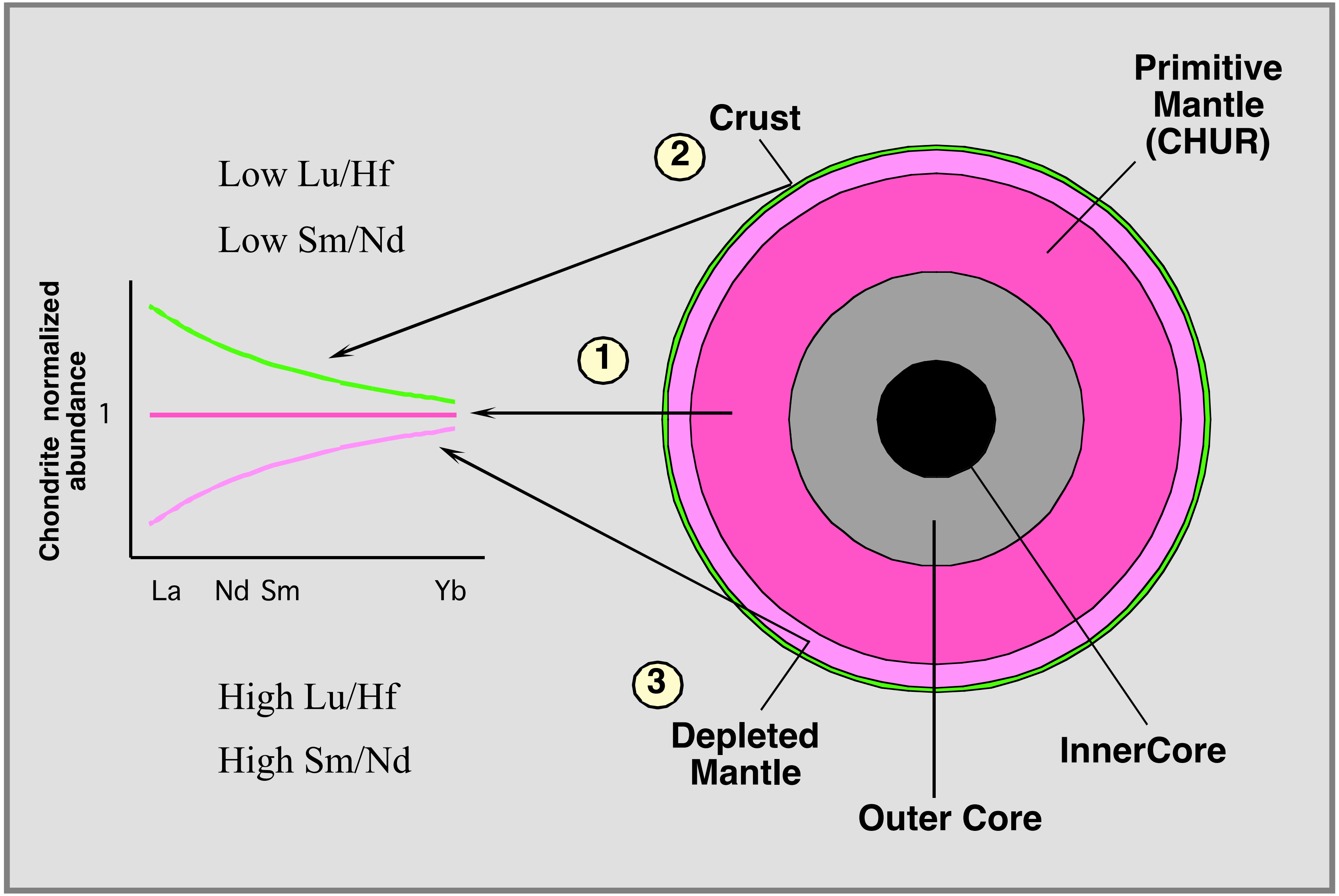
Where does the continental crust disapears?

Emergence of the felsic crust ?



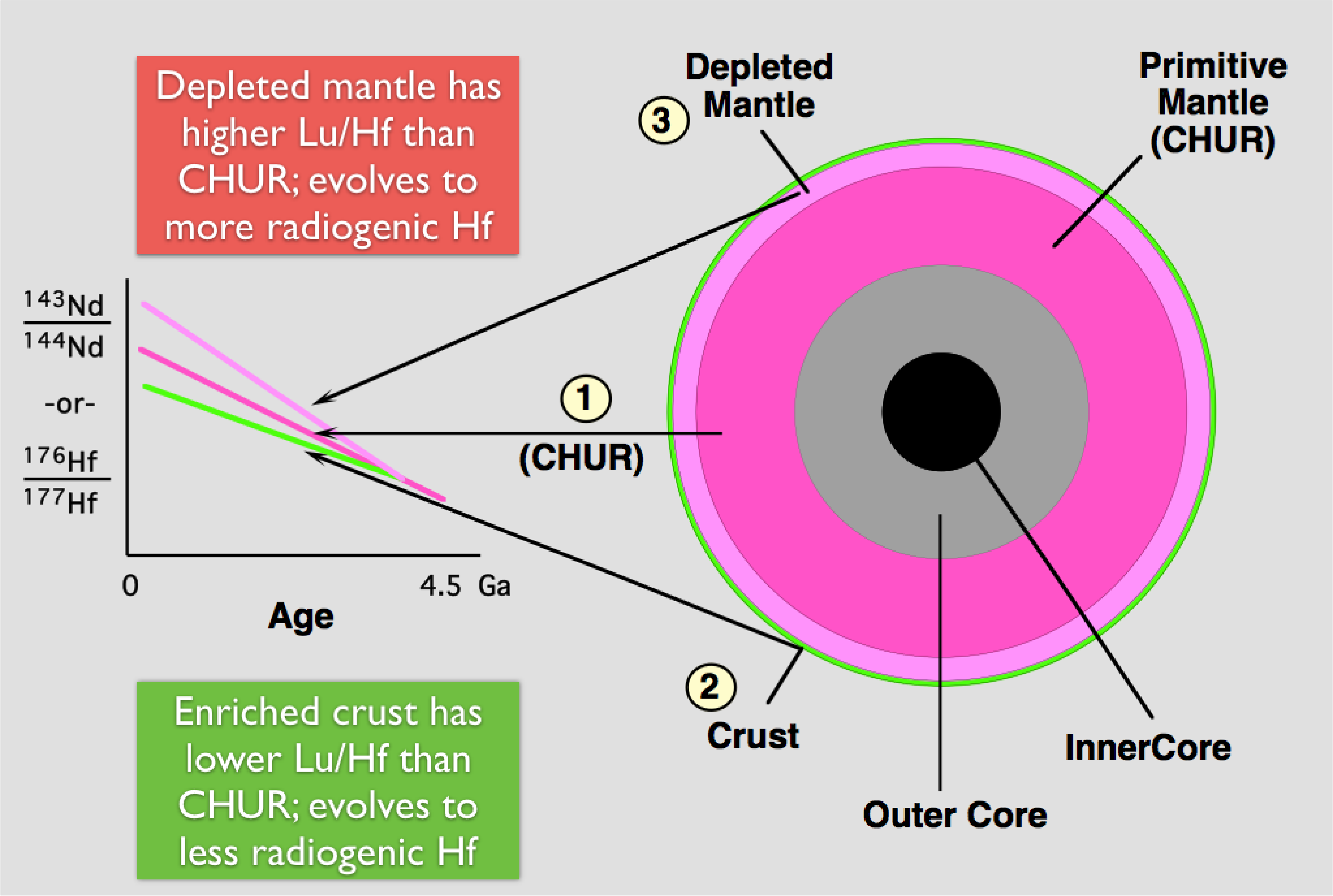
Cawood et al., 2013

Peering further into the crustal growth using radiogenic isotopes Lu/Hf and Nd/Sm systematic



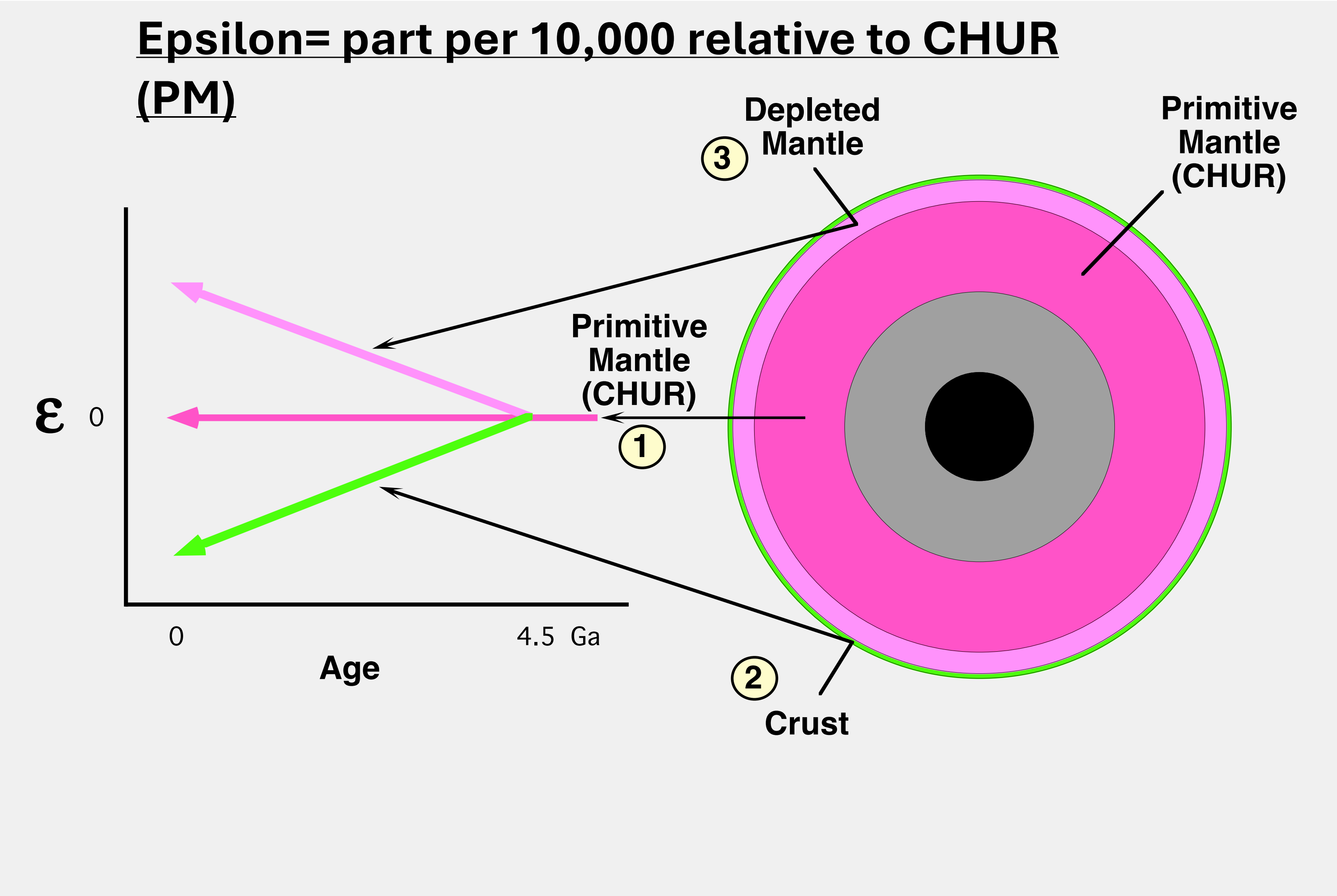
credit: C. Fisher

Peering further into the crustal growth using radiogenic isotopes Lu/Hf and Nd/Sm systematic

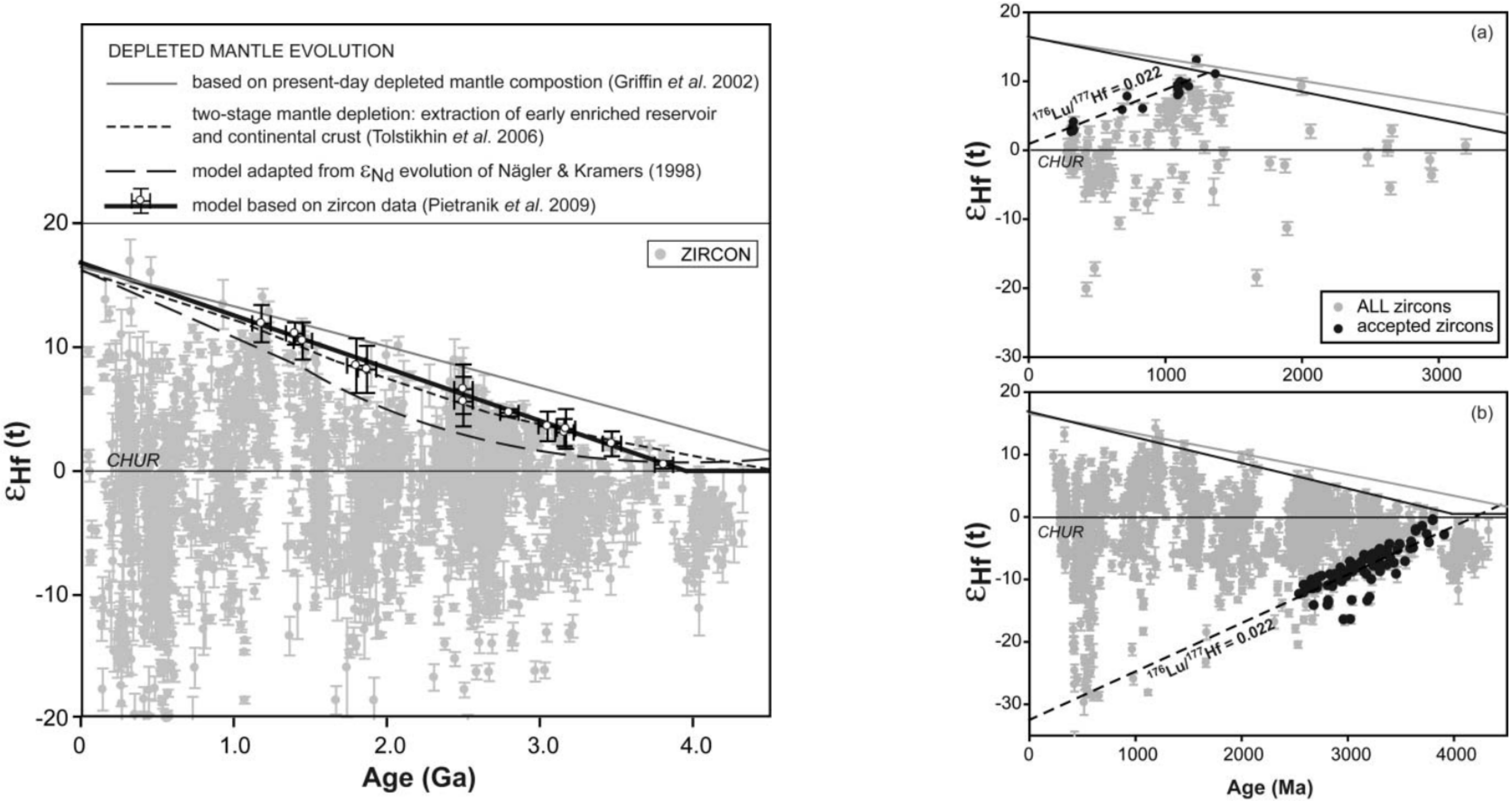


credit: C. Fisher

Peering further into the crustal growth using radiogenic isotopes Lu/Hf and Nd/Sm systematic

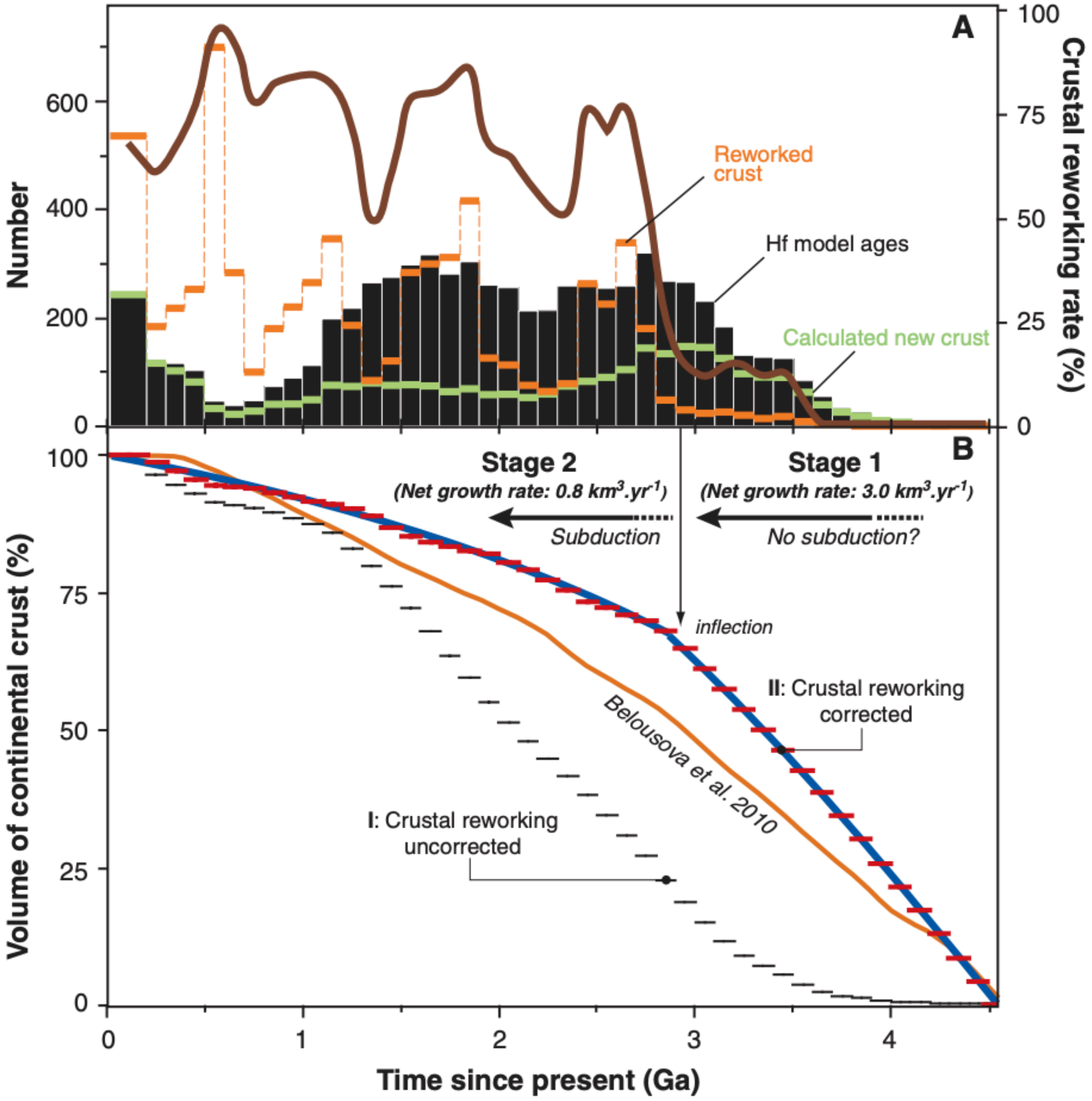


credit: C. Fisher



Hawkesworth et al., 2010

Emergence and preservation of the felsic crust ?



Dhuime et al., 2012

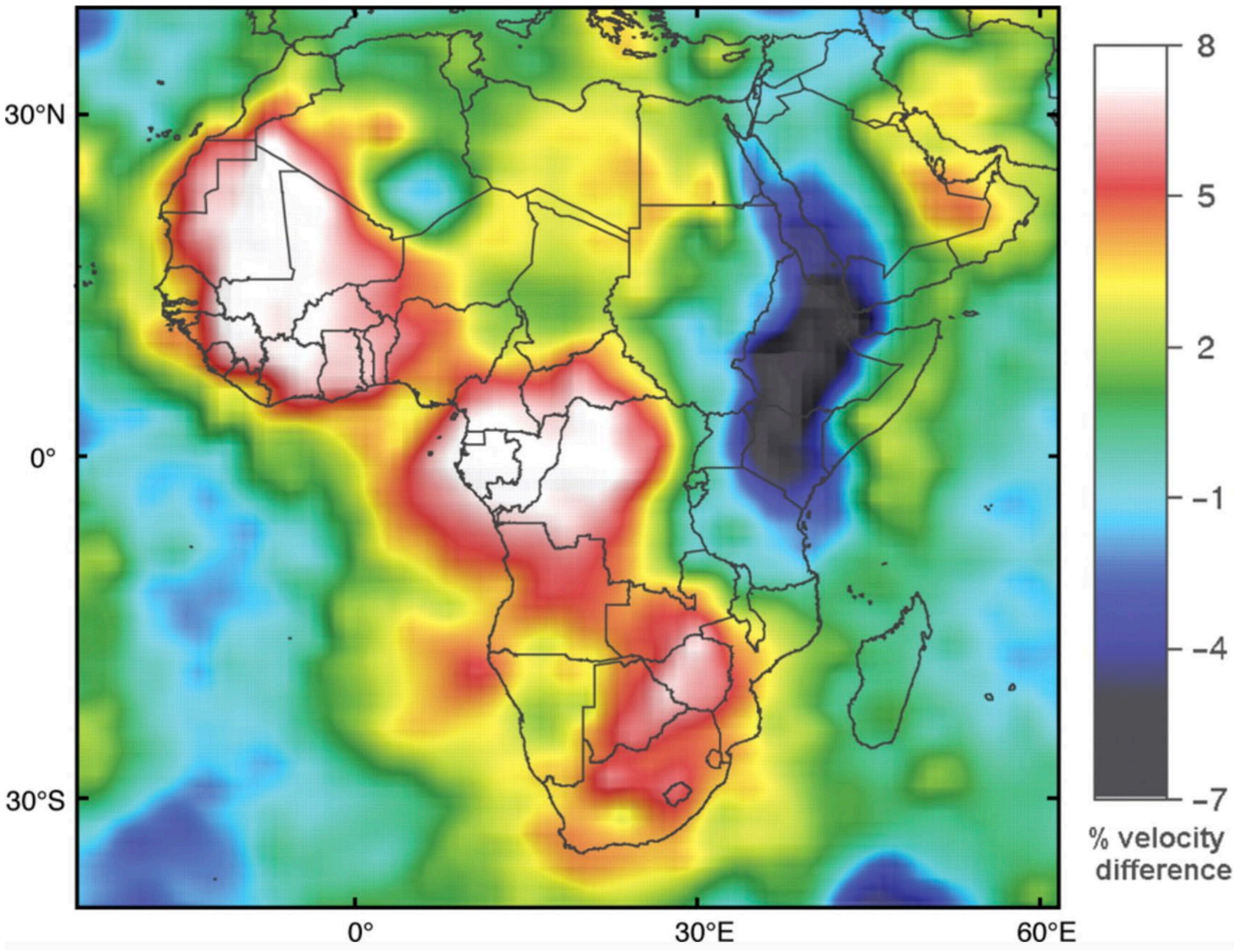
Why does the ancient crust best preserved?

Role of the continental lithospheric mantle?

Credit Griffin

Africa 100-175 km Vs tomography

- Red/white = large Vs
- blue = small Vs



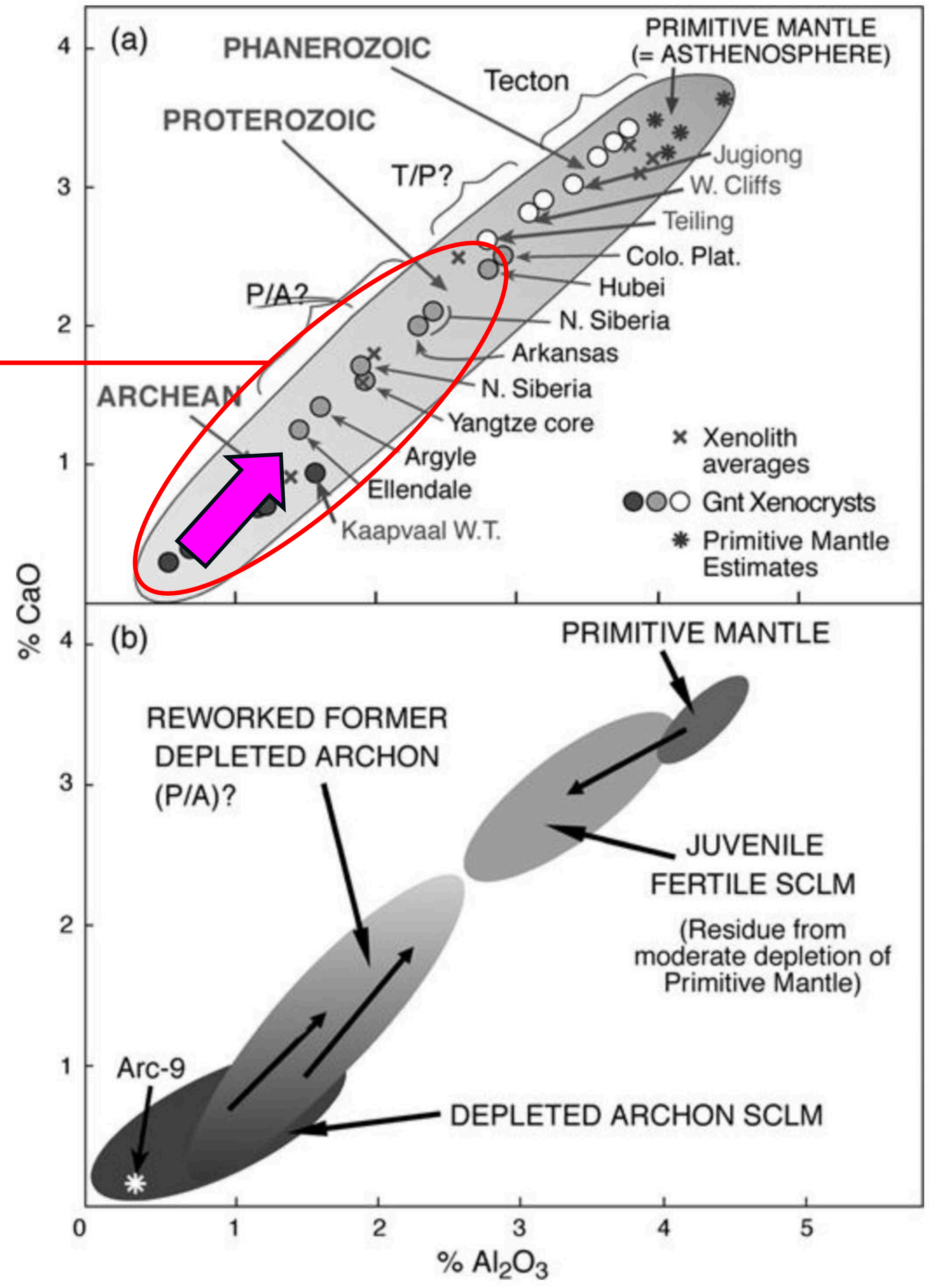
Source data Deen et al. 2006, published in Griffin et al., 2009

Contributions from mantle xenoliths

Archean CLM!

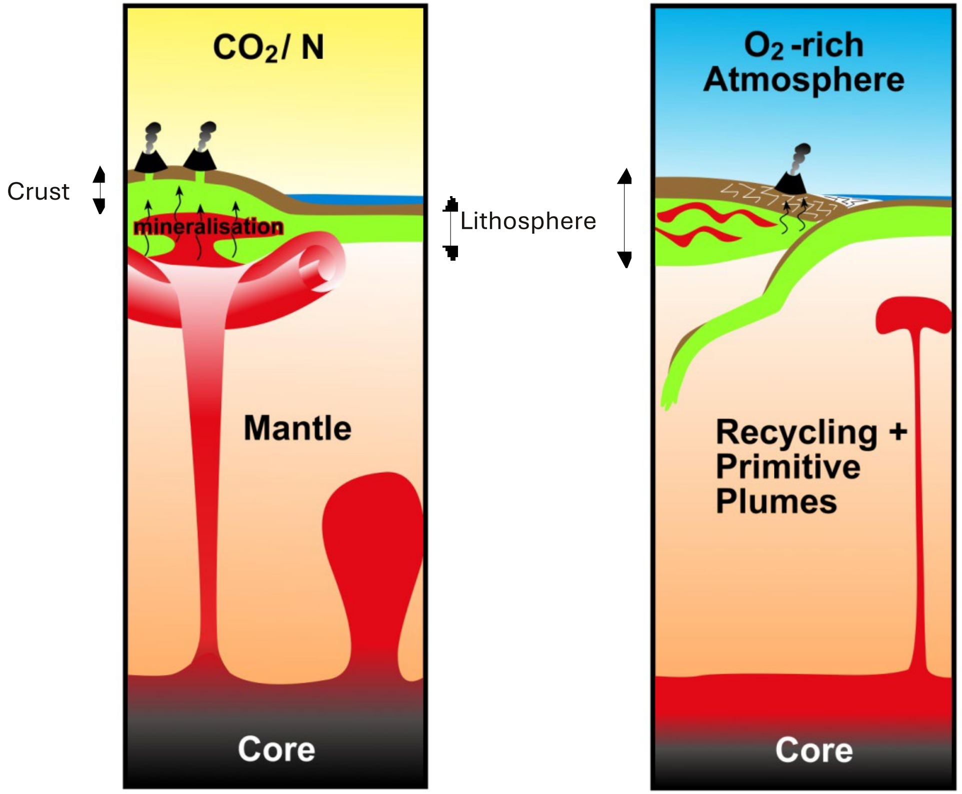
PLUME RESIDUE

- dominated by **Mg-rich** (fosterite) Olivine
- Unique to melting of high T Archean plumes
- Distinctive **High Velocity**



Griffin et al., 2009

CLM – Archean Genesis



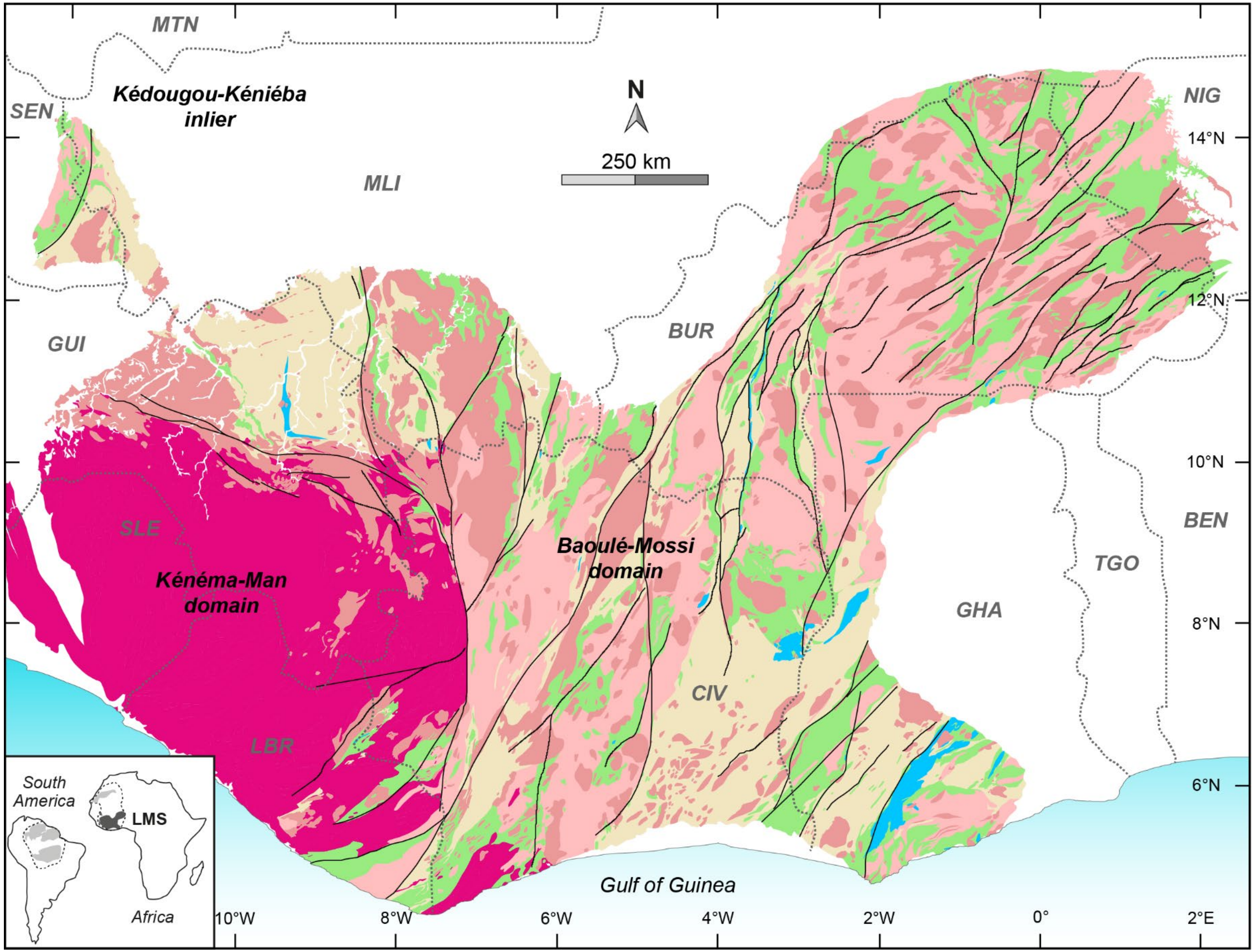
Hadean
- no stable CLM
- no preservation of the crust

Archean (3.6-3.0 Ga)?
- *mantle overturns formation of stable* CLM
- subduction?

Today
- subduction
- steady-state recycling
- no more formation of CLM stable

Credit Griffin and O'Reilly

What about the south West African Craton (sWAC) ?



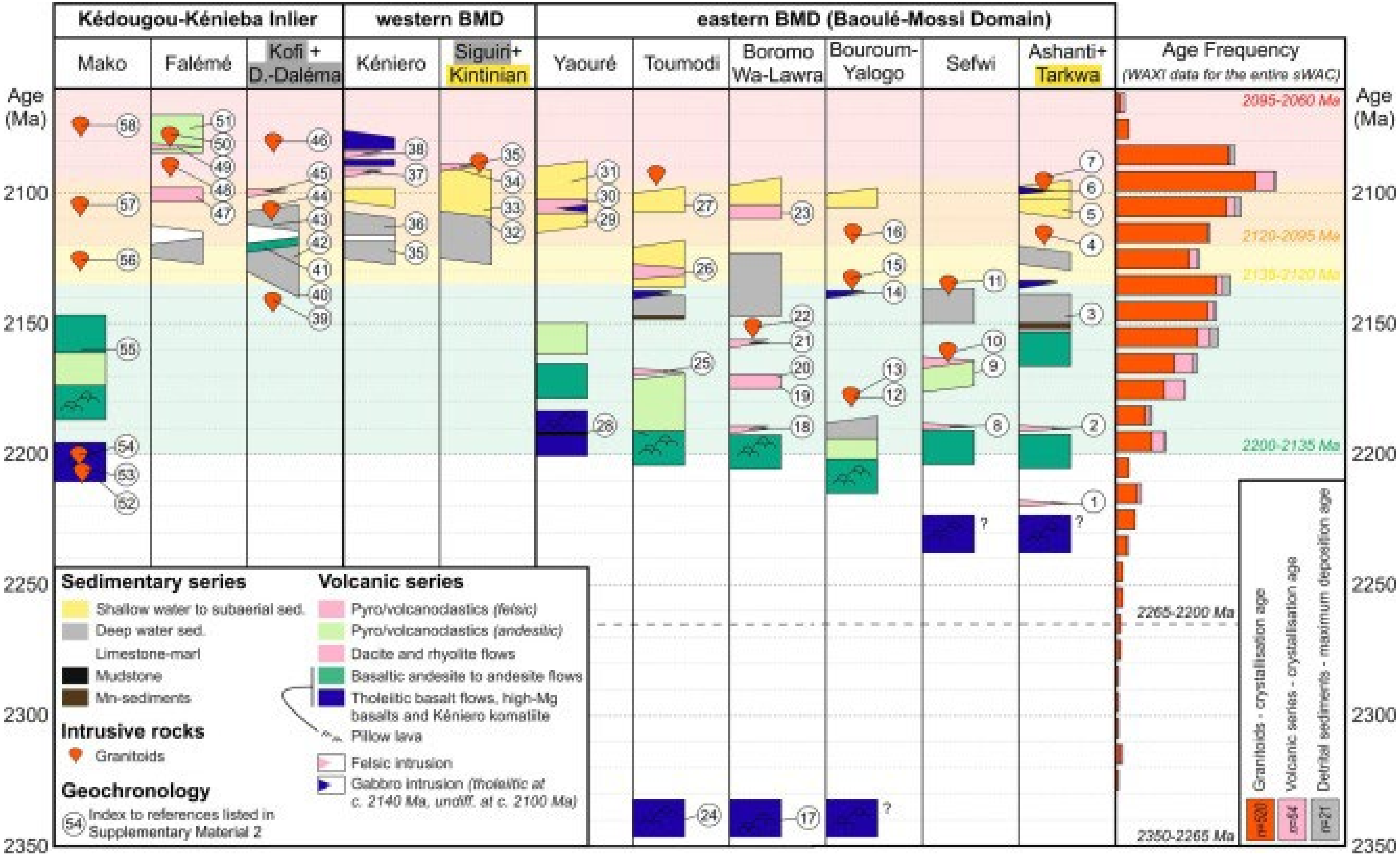
Paleoproterozoic

- High-K and peraluminous granites
- Shallow water to subaerial sediments («Tarkwa»)
- Deep water sedimentary series («upper Birimian»)
- Volcanic and volcano-sedimentary series («lower Birimian»)
- Tonalite-Trondhjemite-Granodiorite-Diorite plutonic suites

Archean continental crust

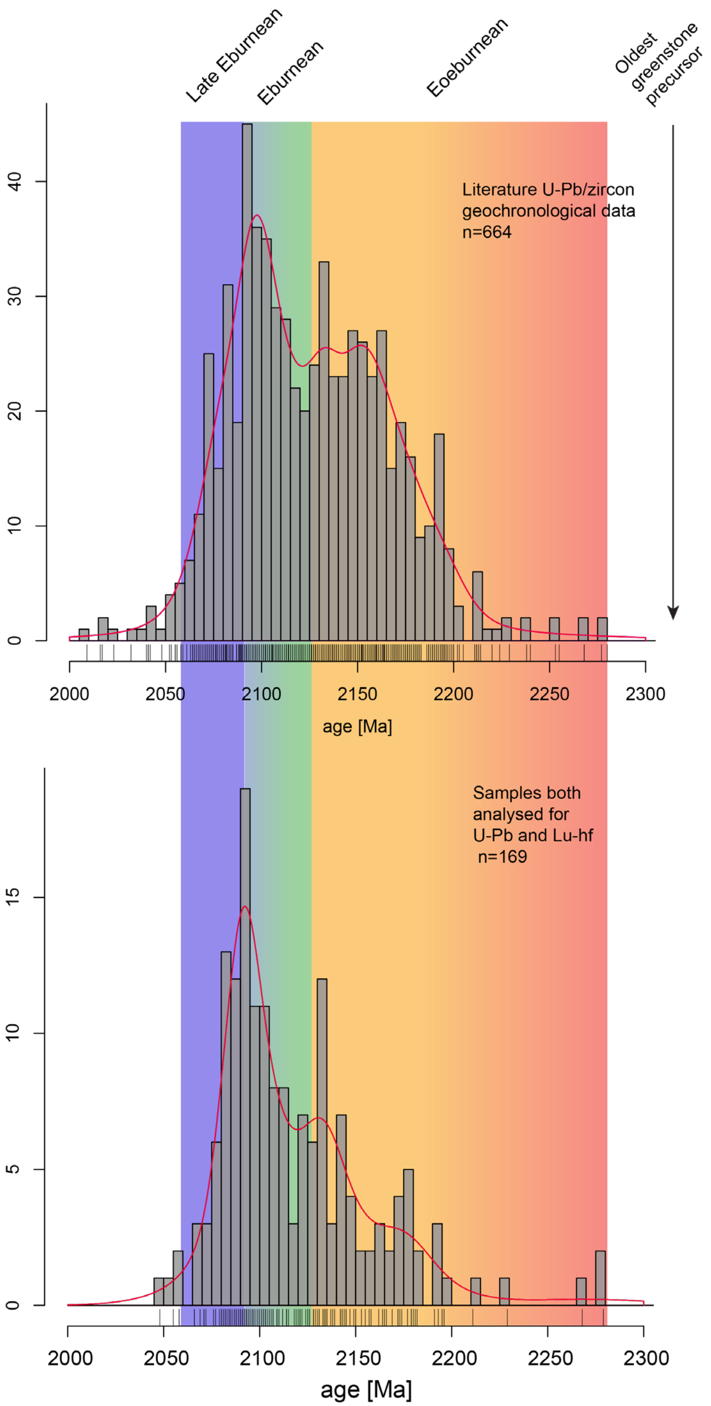
Masurel et al., 2022

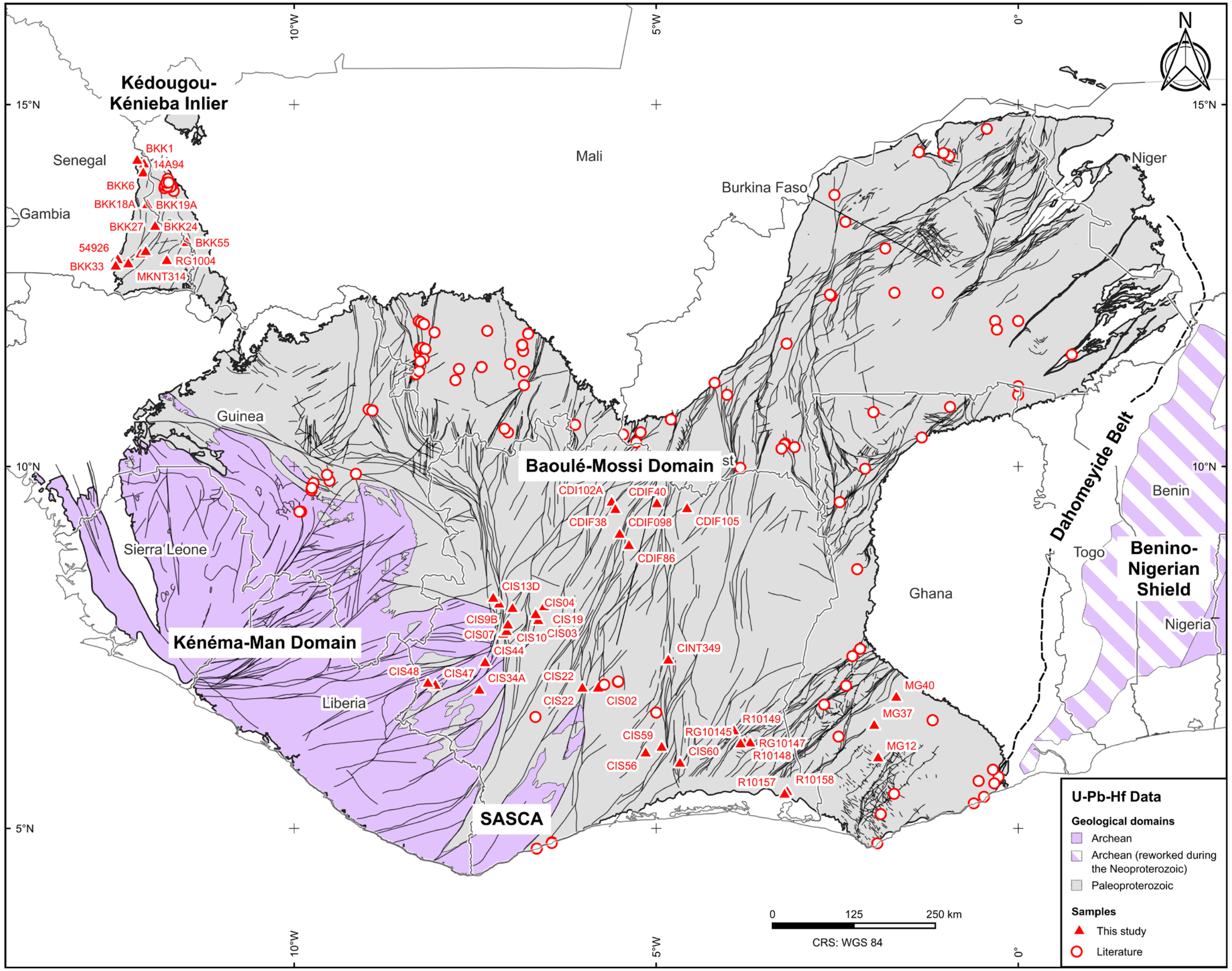
Greenstone stratigraphic record in the sWAC



Perret et al., 2025

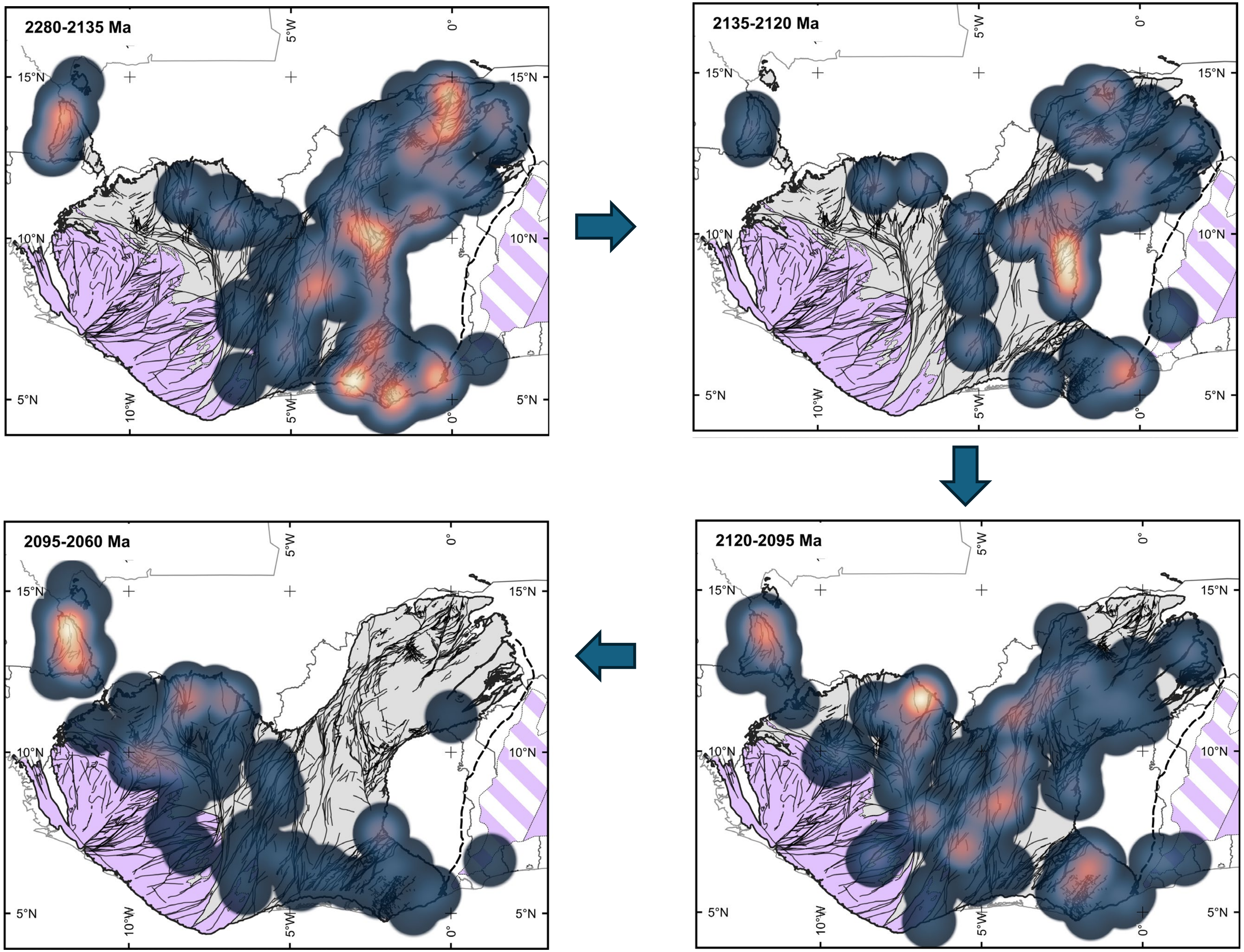
U-Pb felsic igneous record in the sWAC





Thébaud et al., 2026

Diachronous felsic igneous activity over the sWAC



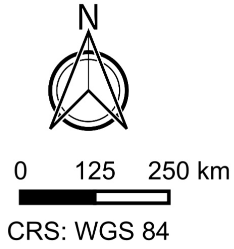
Spatial Distribution of Magmatic Record

Geological domains

- Archean
- Archean (reworked during the Neoproterozoic)
- Paleoproterozoic

Heat map of magmatic activity (search radius = 100 km)

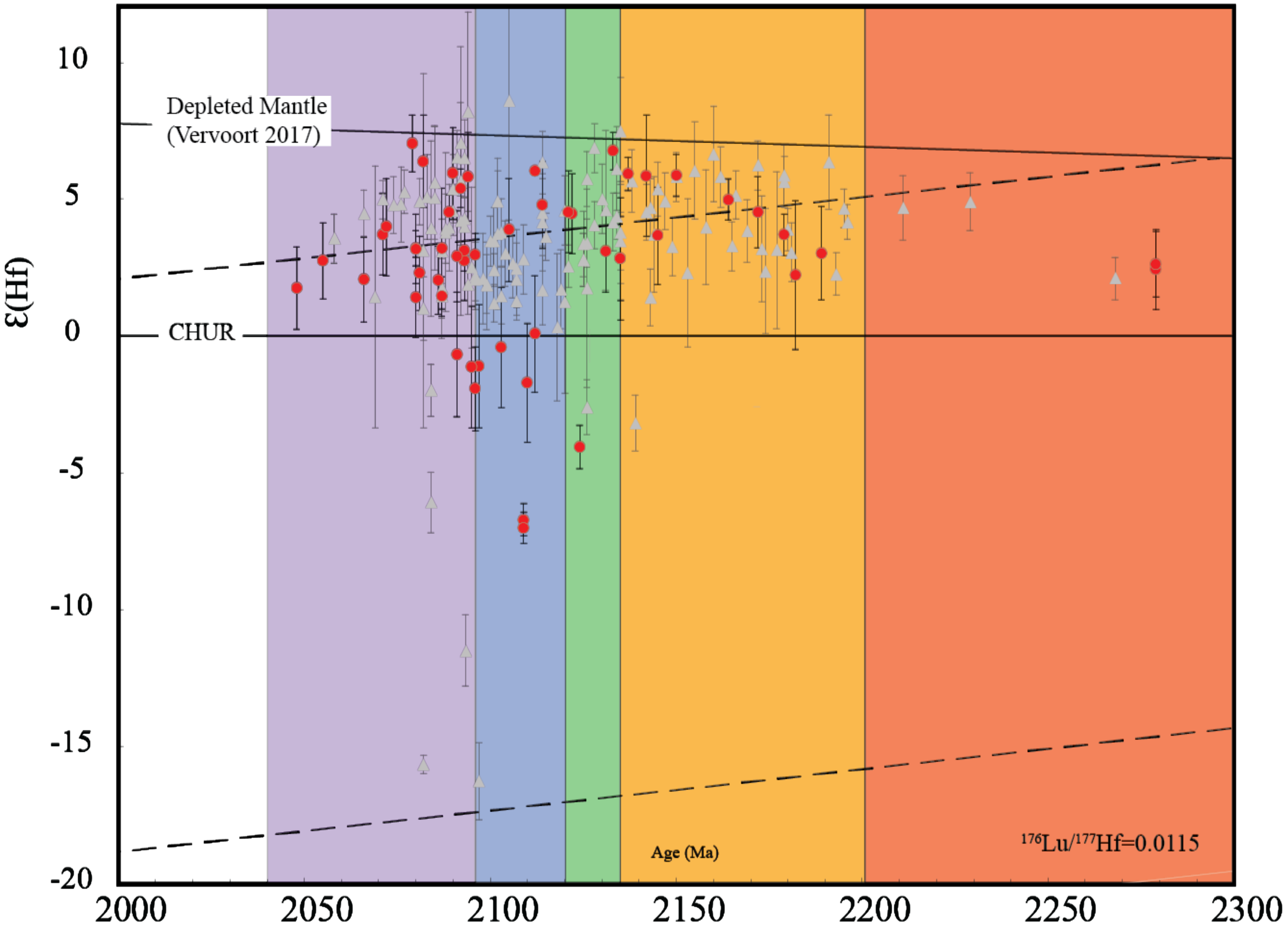
- Strong activity
- Little activity



Migration westward at about 3.5 cm/yr (Parra-Avila et al., 2017)

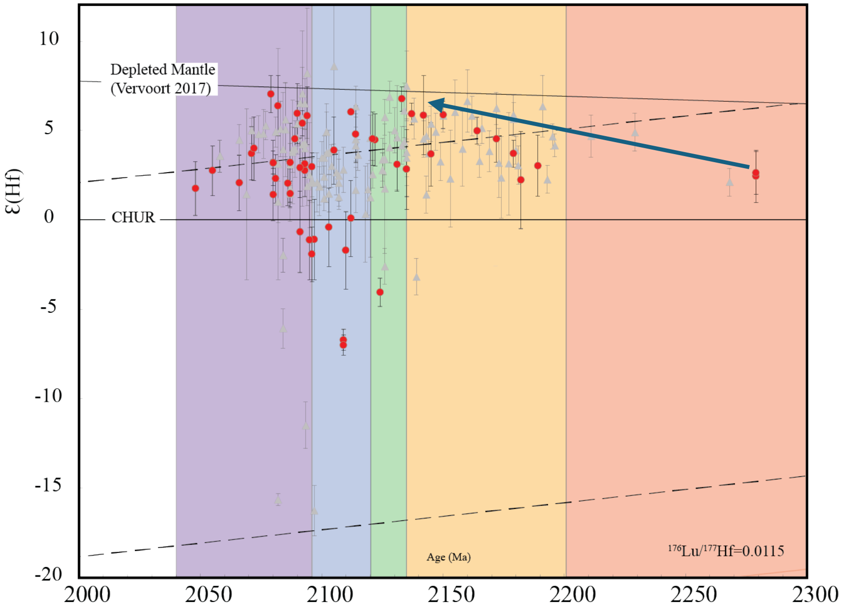
Thébaud et al., 2026

Lu-Hf isotopic temporal record



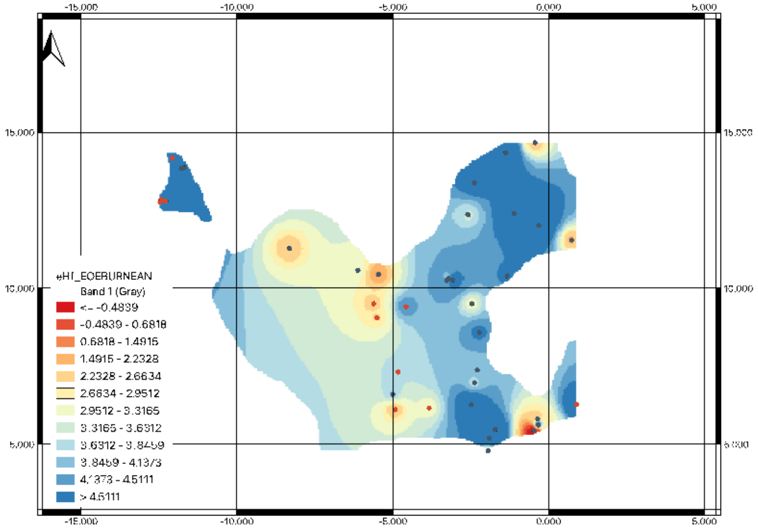
Thébaud et al., 2026

sWAC crustal growth and evolution during the Rhyacian



2030 to 2150 Ma
Early juvenile associated with reworking of early (2350Ma) mafic crust but also some reworking of pre-existing Archean crust.

Eoeburnean magmatism



Thébaud et al., 2026

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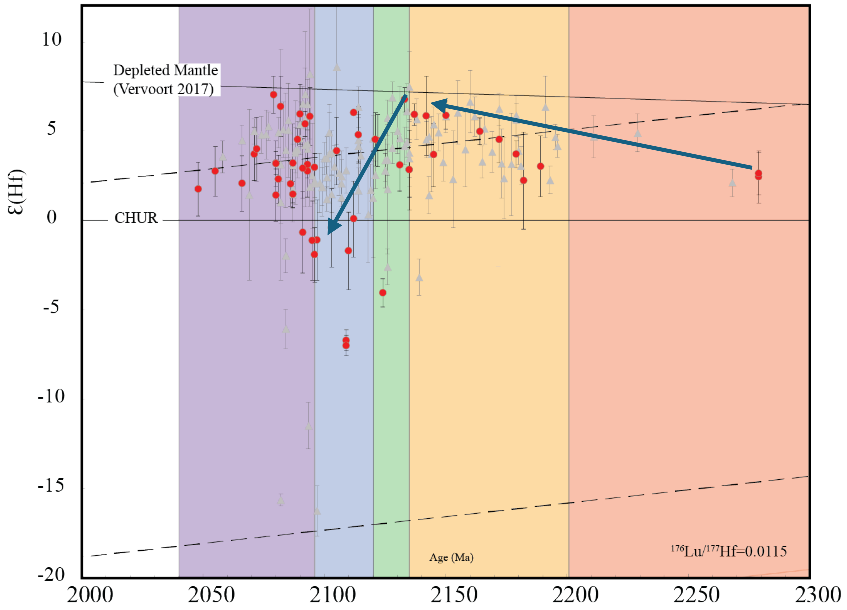


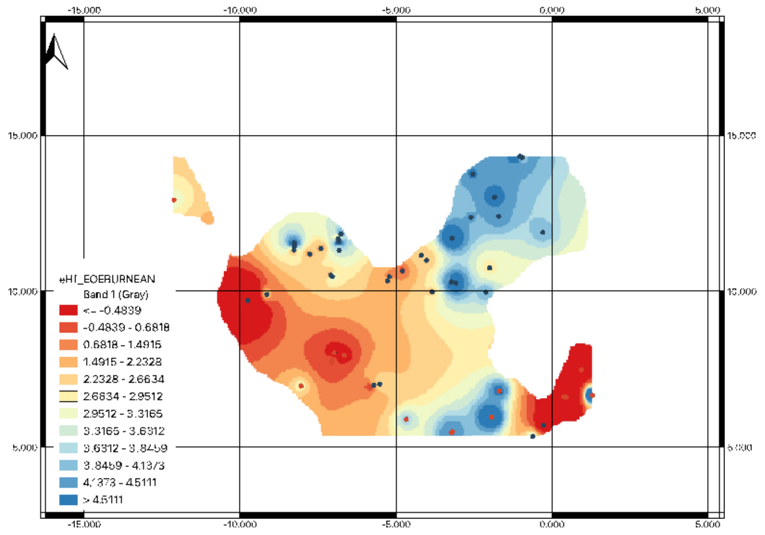
2150 to 2135 Ma

Reworking of newly formed Eoeburnean continental crust and pre-existing Achean crust (Kenema Man Domain and BurGhana domains) in a convergent setting (Eoeburnean Orogeny).

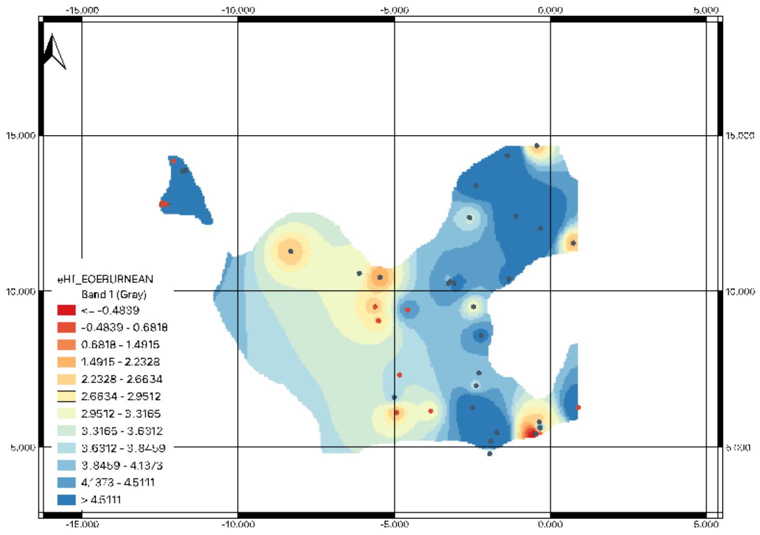
2120 to 2095 Ma

Ongoing reworking of crust during the Eburnean Orogeny.

Eburnean

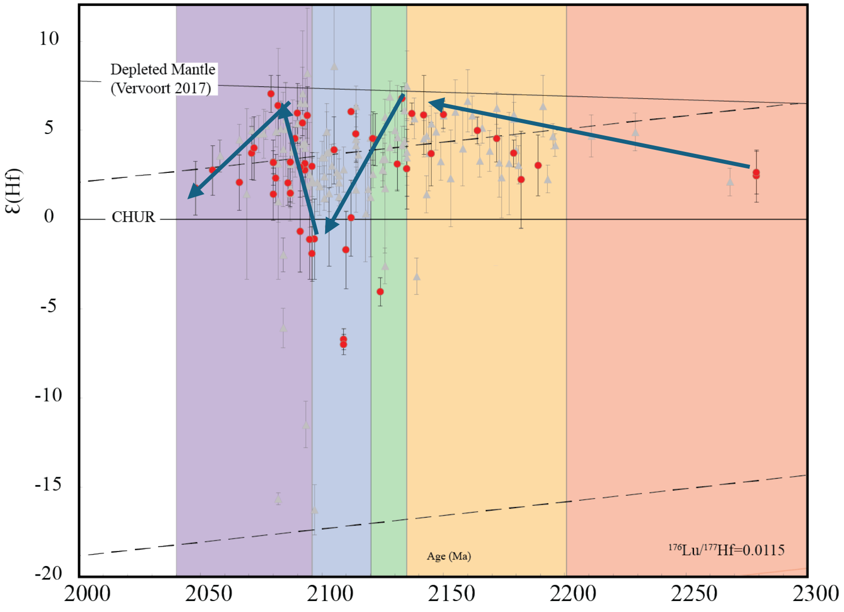


Eoeburnean magmatism



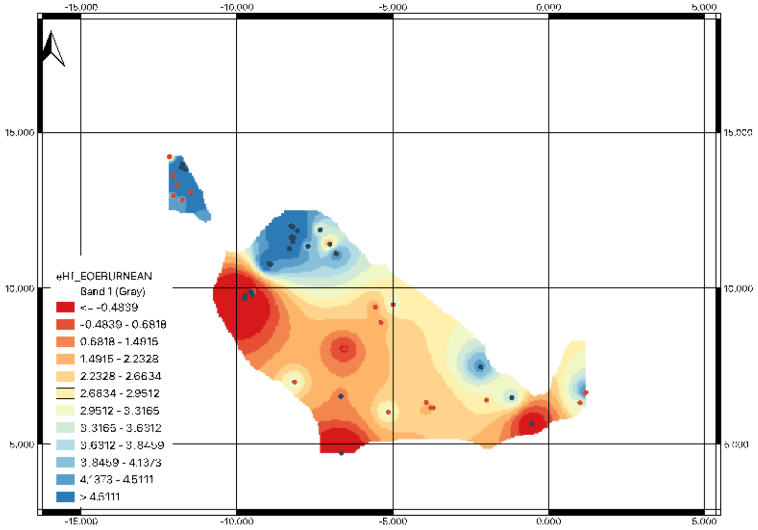
Thébaud et al., 2026

sWAC crustal growth and evolution during the Rhyacian

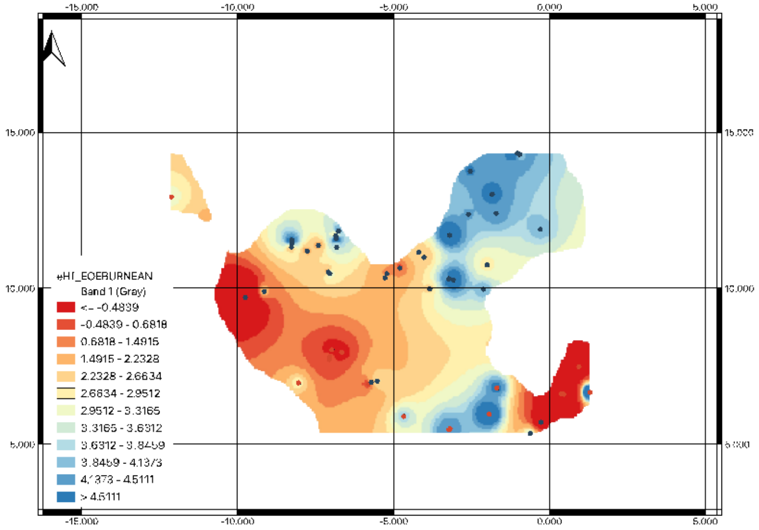


2095 to 2040 Ma
Renewed late orogenic juvenile input
(Delamination of thickened lithosphere or roll back? Eglinger et al., 2017)

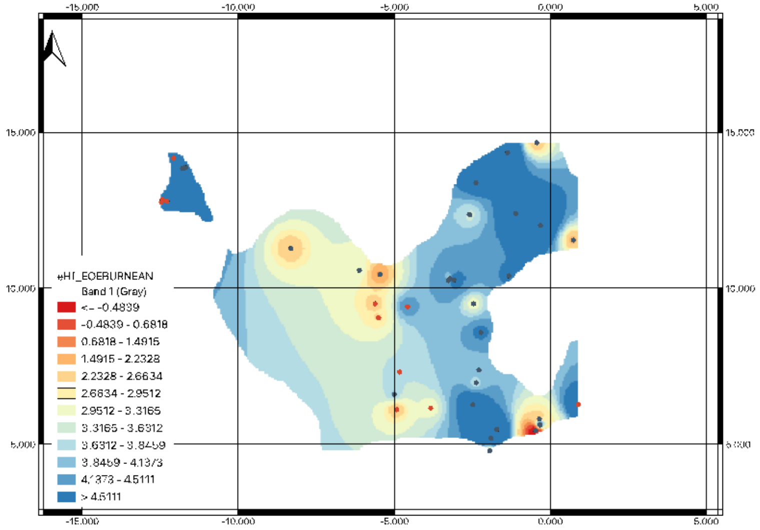
Late orogenic magmatism



Eburnean



Eoeburnean magmatism



Thébaud et al., 2026

Towards a geodynamic model for the WAC

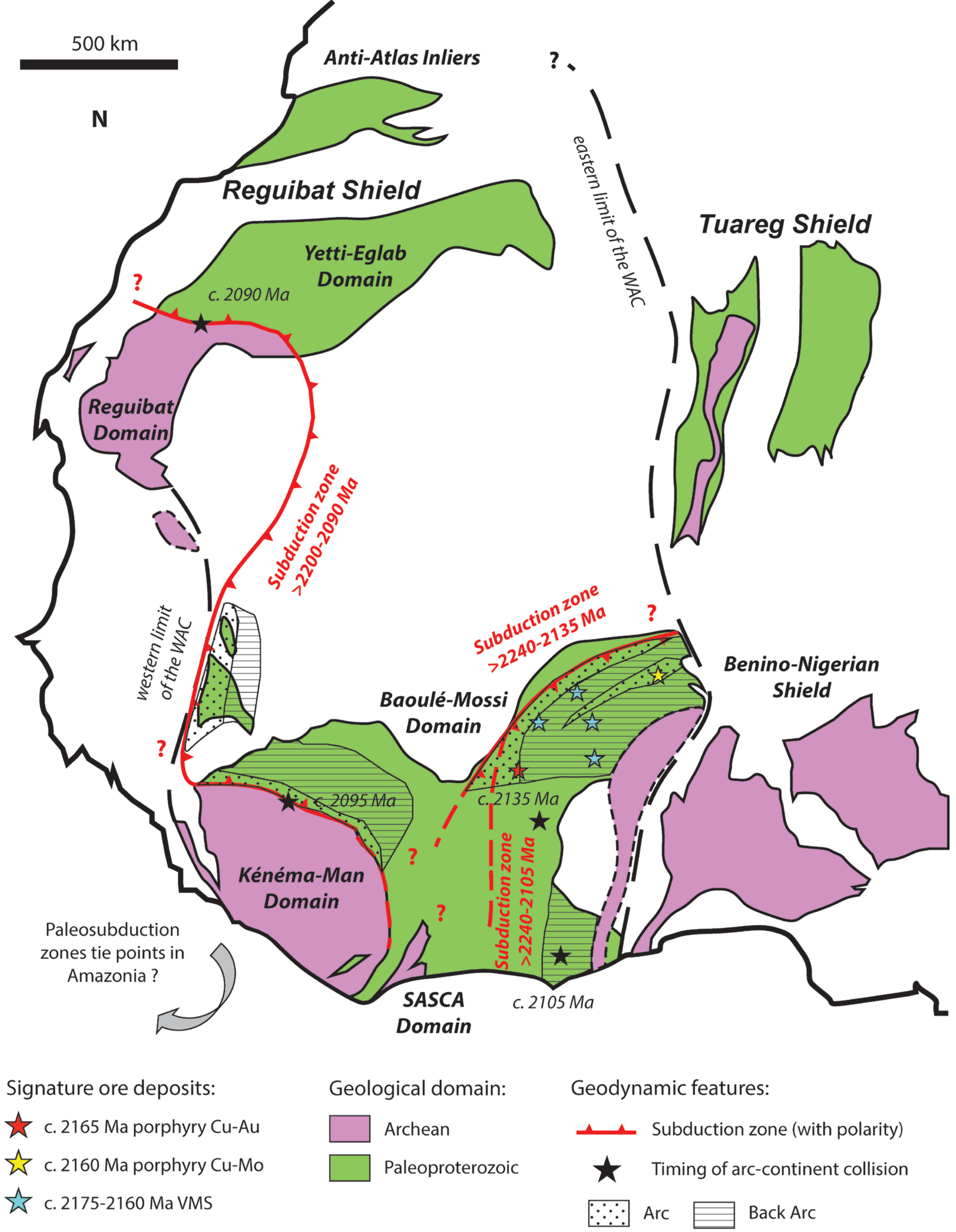
Opening of an oceanic basin at c. 2350 Ma (~3,500 km wide).

Two orogenic cycles, the Eoeburnean (~2150-2135 Ma) and the Eburnean (~2120-2095 Ma), record the progressive closure of this basin through pulses of juvenile magmatism and reworking of Archean crust.

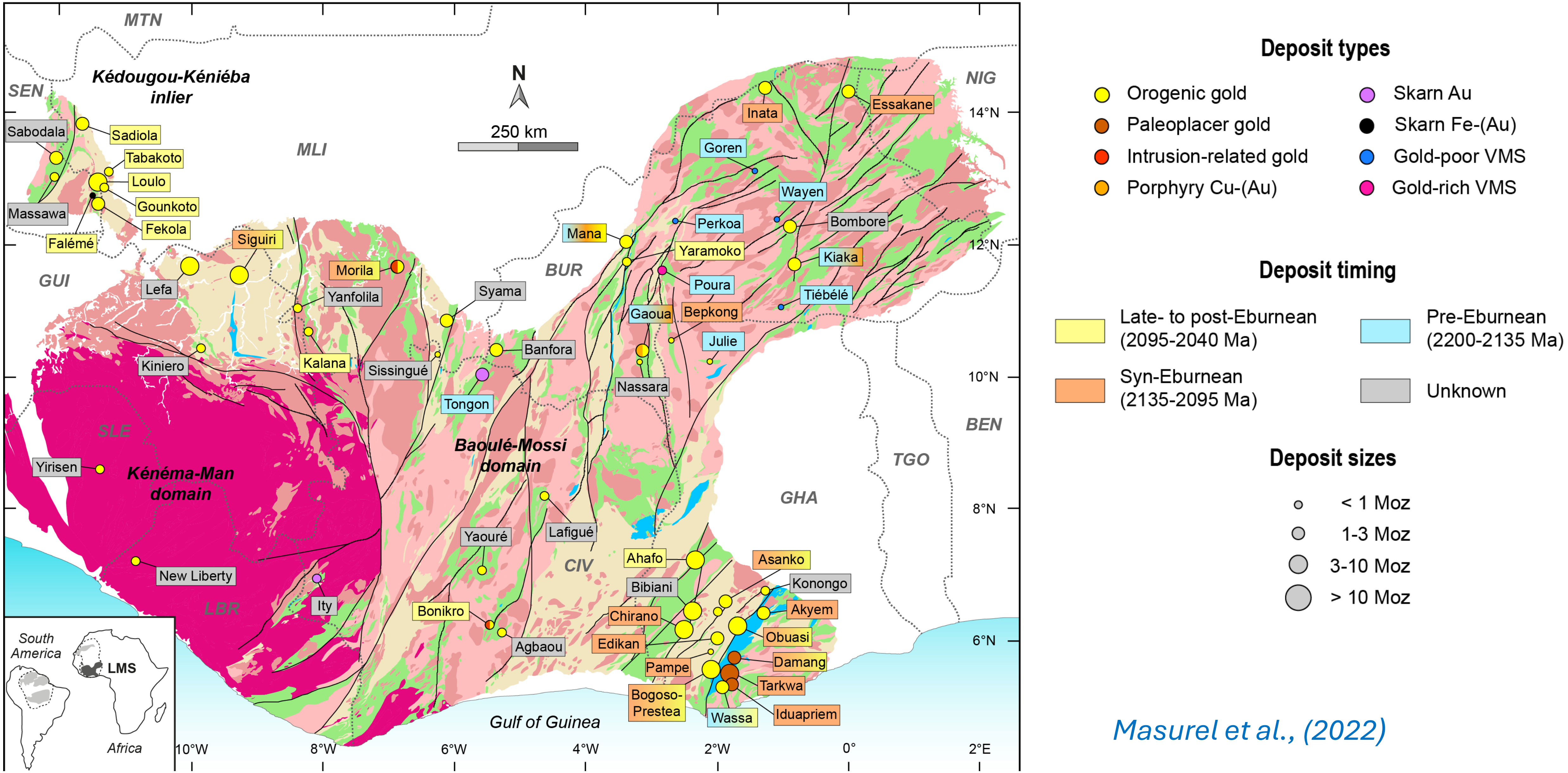
We propose a scenario whereby two partly synchronous subduction segments developed:

- An eastern, southeast-dipping segment (c. 2240-2135 Ma) that drove Eoeburnean collision between the Baoulé-Mossi Domain and the Archean BurGhana block,
- A western, east-dipping segment (c. 2210-2070 Ma) that extended north into the Reguibat Shield and drove Eburnean collision with the Kénéma-Man Domain.

Thébaud et al., 2026



South West African Craton gold endowment



Masurel et al., (2022)

A canvas to evaluate metal fertility

Au camps/districts appear to be coinciding with juvenile crustal domains (cf Yilgarn Craton, Superior).

Ni late intrusion plugs are also located at the interface or close to the interface between juvenile and evolve crustal domains.

Zn exhalative and Cu intrusion related mineralization located within the juvenile domain (arc position?).