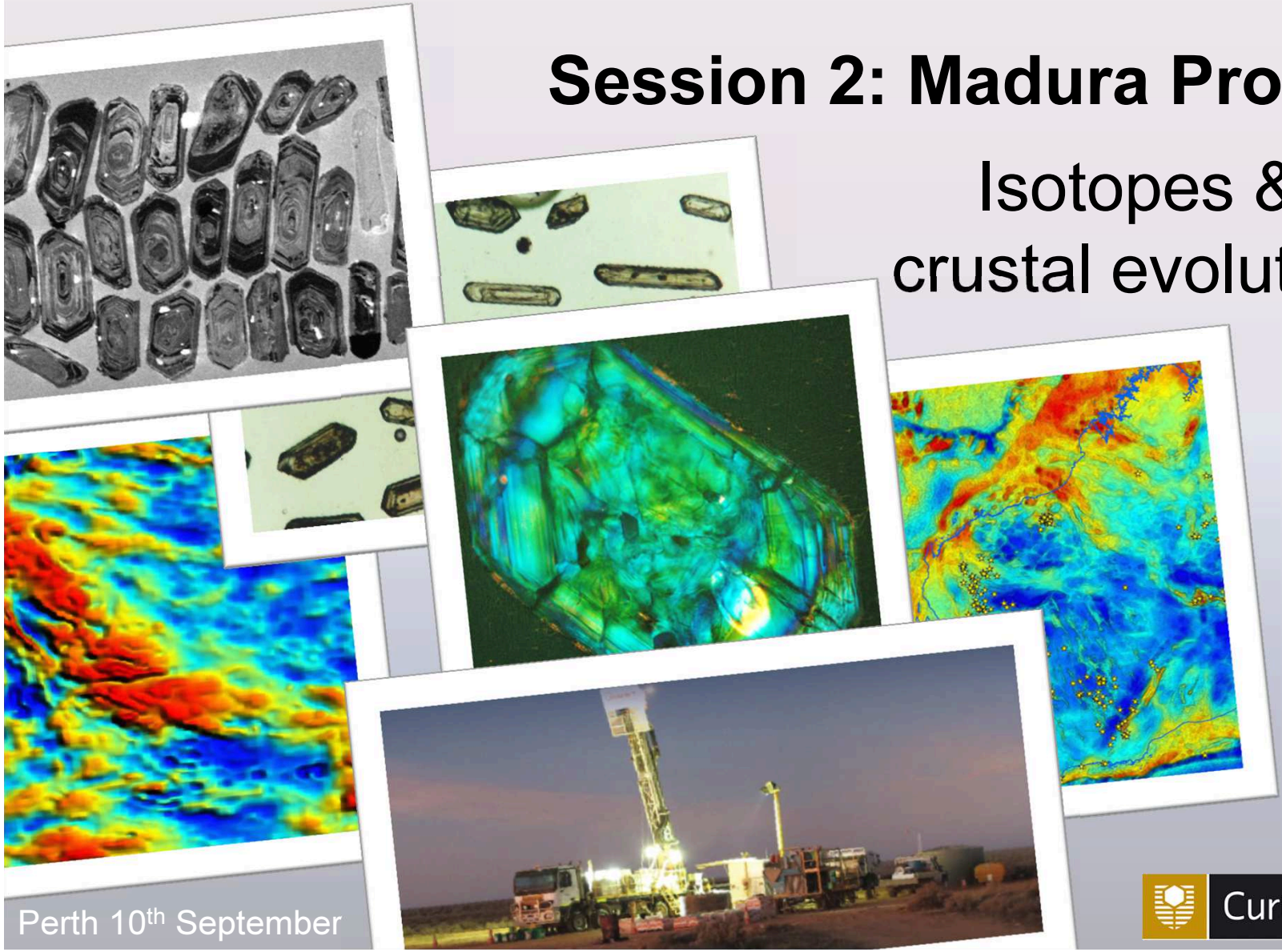
Eucla Basement Stratigraphic Drilling – Results Release

Session 2: Madura Province

Isotopes &
crustal evolution



GEOLOGICAL SURVEY WESTERN AUSTRALIA

CCFS

ROYALTIES FOR REGIONS
EXPLORATION INCENTIVE SCHEME

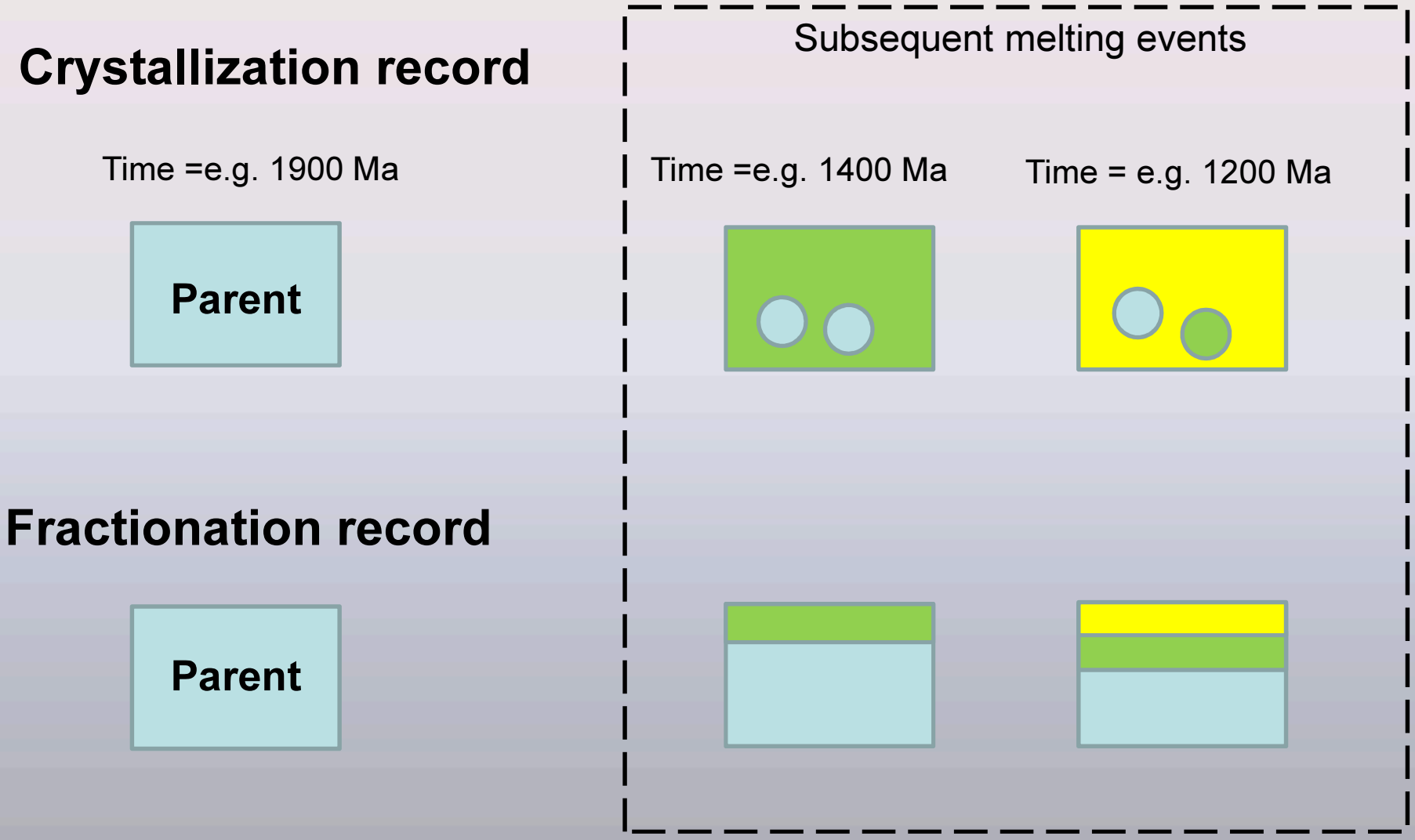
John de Laeter Centre
Isotope Research for the Earth and Environment

Centre for EXPLORATION TARGETING

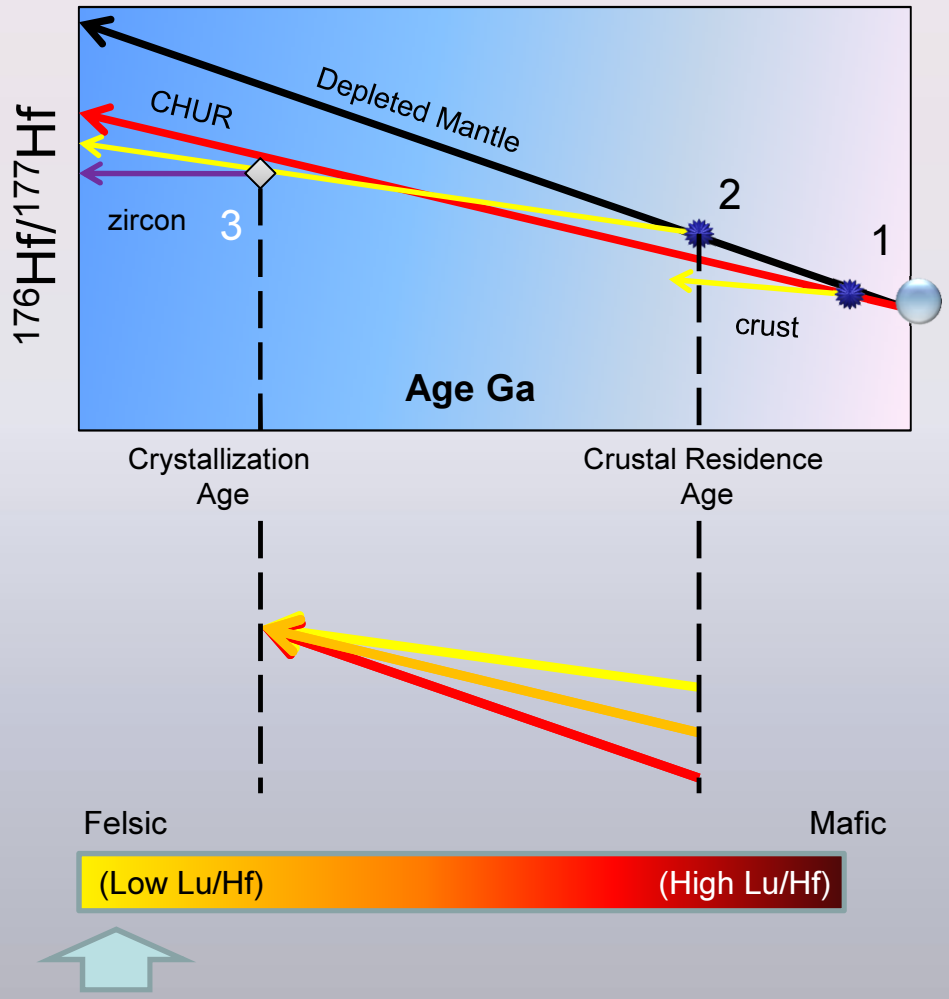
Curtin University

Perth 10th September

Difference between the fractionation and crystallization record



Crustal evolution and the development of Lu-Hf reservoirs



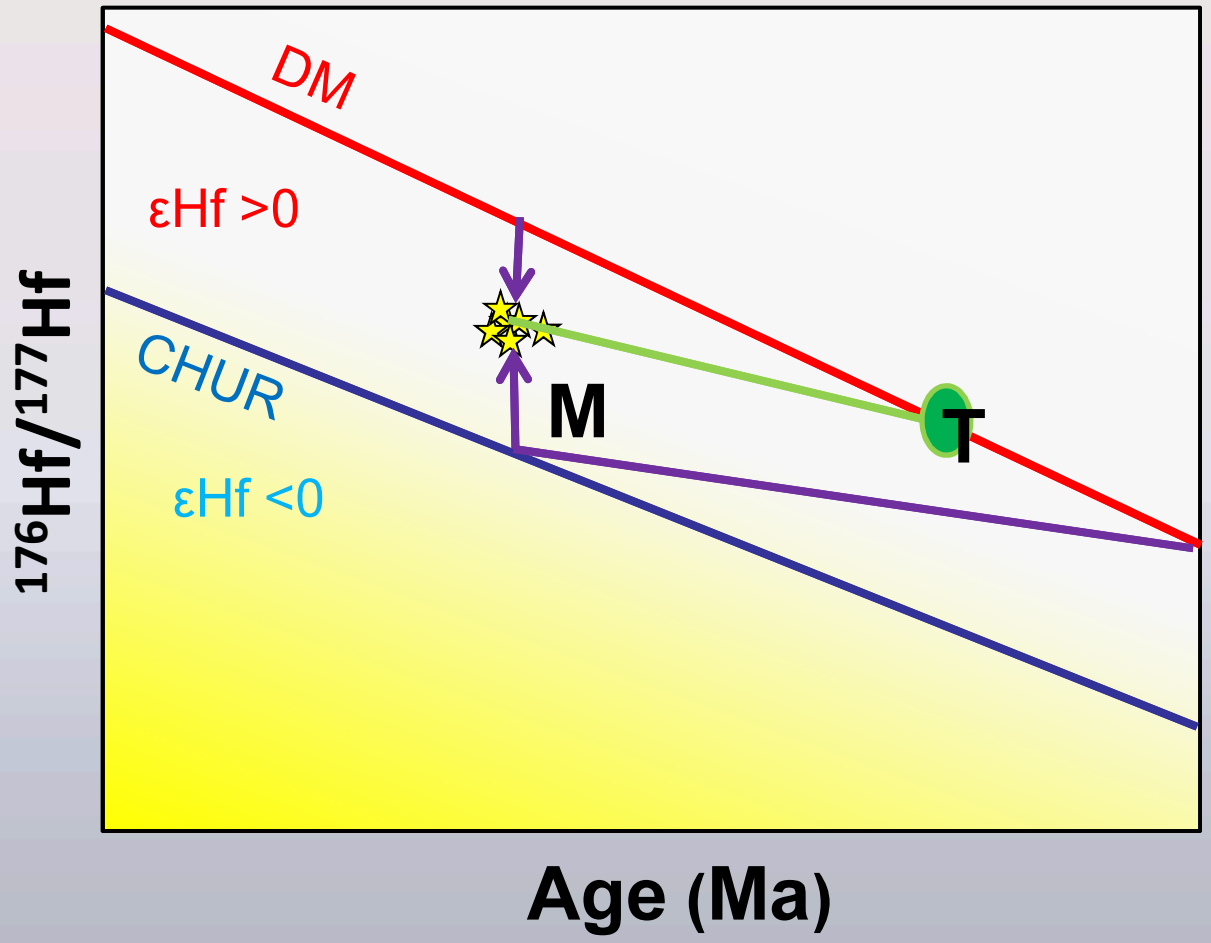
1/ Episode of partial melting.
Hf fractionates into melts more strongly. Newly generated crust (low Lu/Hf = little ^{176}Lu) and a complementary residual mantle (high Lu/Hf = most of the ^{176}Lu).

2/ Episode of partial melting in the depleted mantle. Hf fractionates into crust leaving more depleted mantle

3/ Crust melts & crystallizes zircon

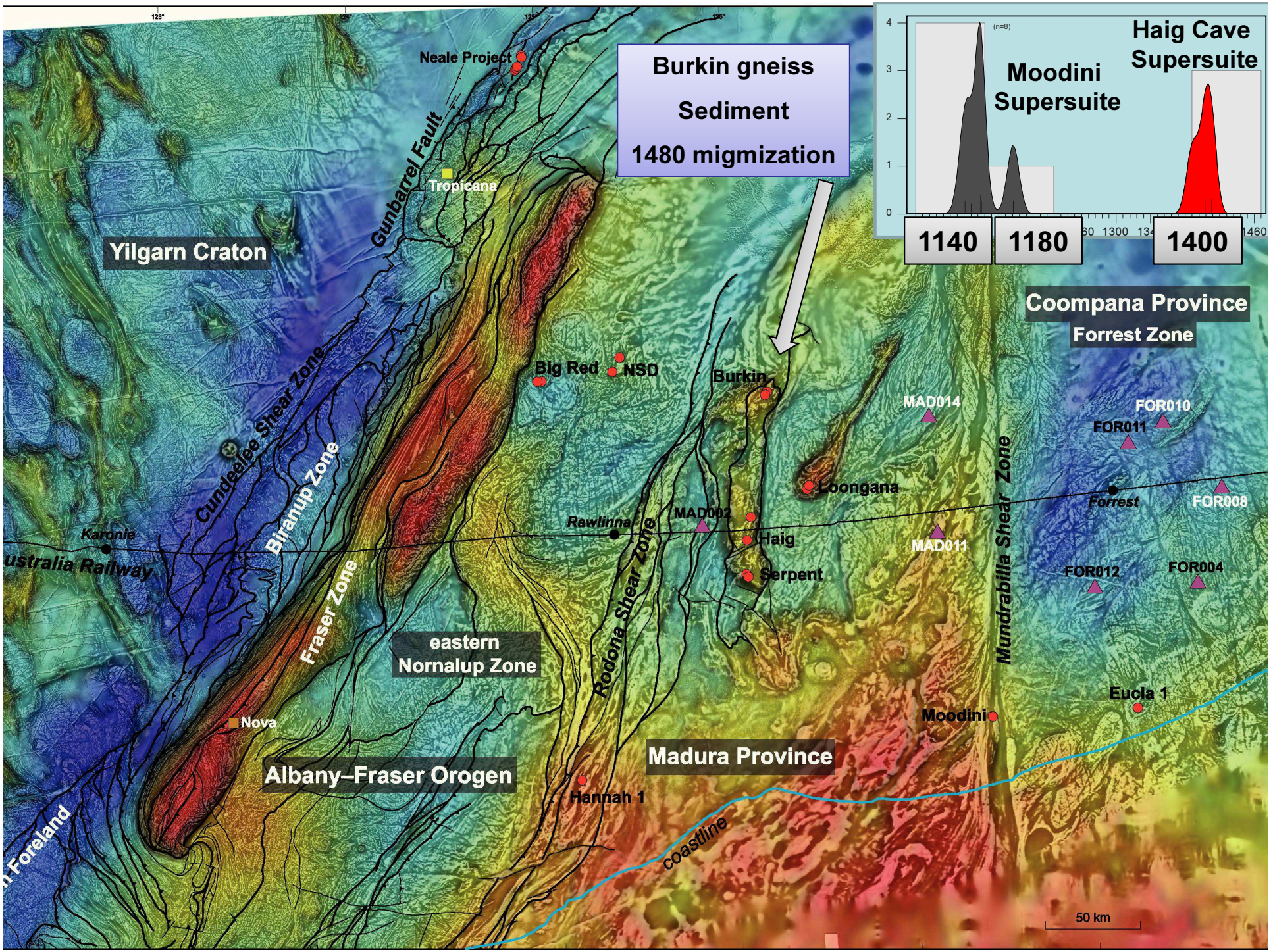
Hence assuming a Lu/Hf ratio for the crust allows an estimate of the crustal residence for the melt that produced the zircon

Interpretation of Hf isotopes

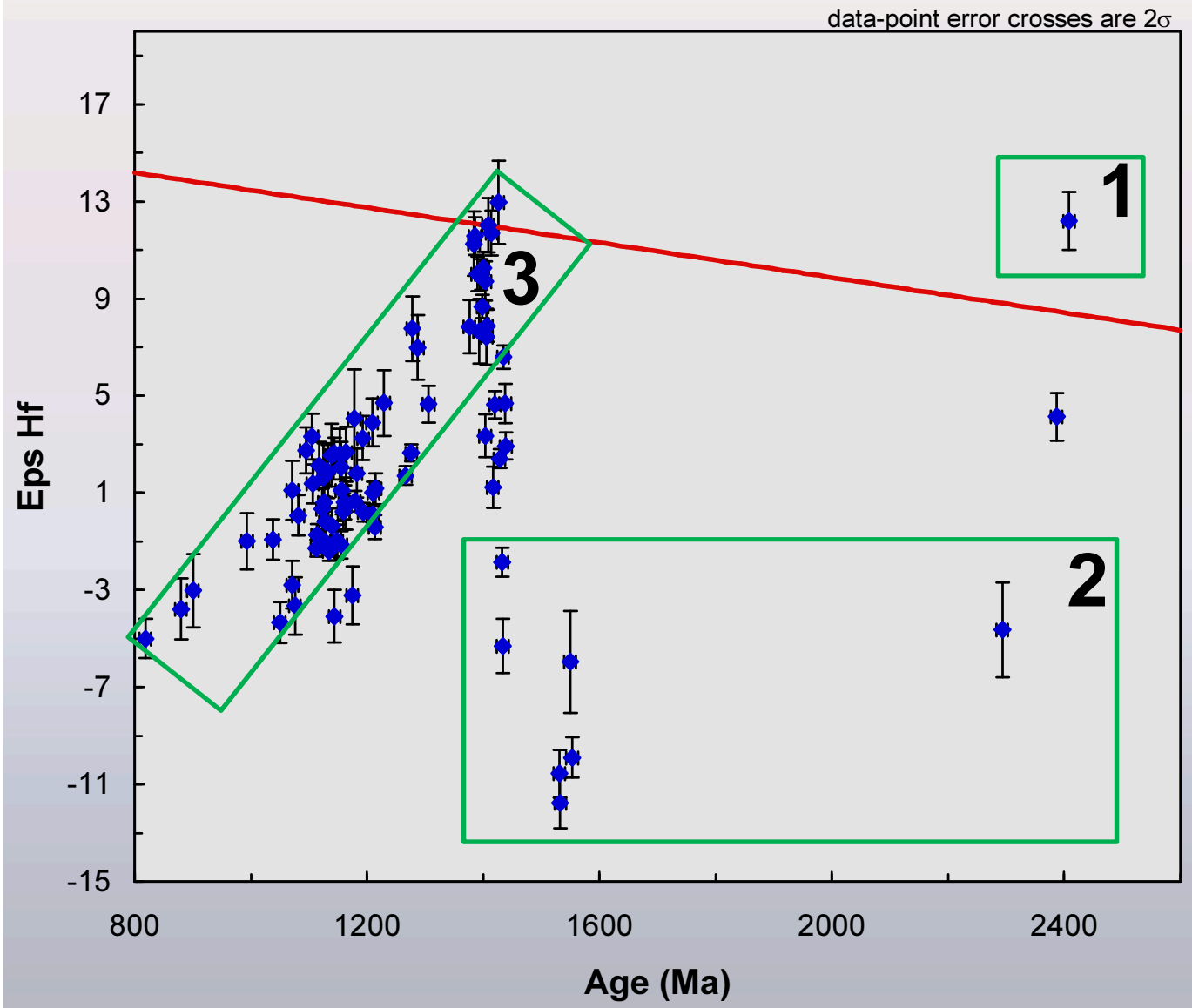


Hf integral part of the zircon lattice (very resistant to Hf mobility)

Very high Hf content of zircon (= low $^{176}Lu/^{177}Hf$ ratio) essentially sets the ratio of the source magma

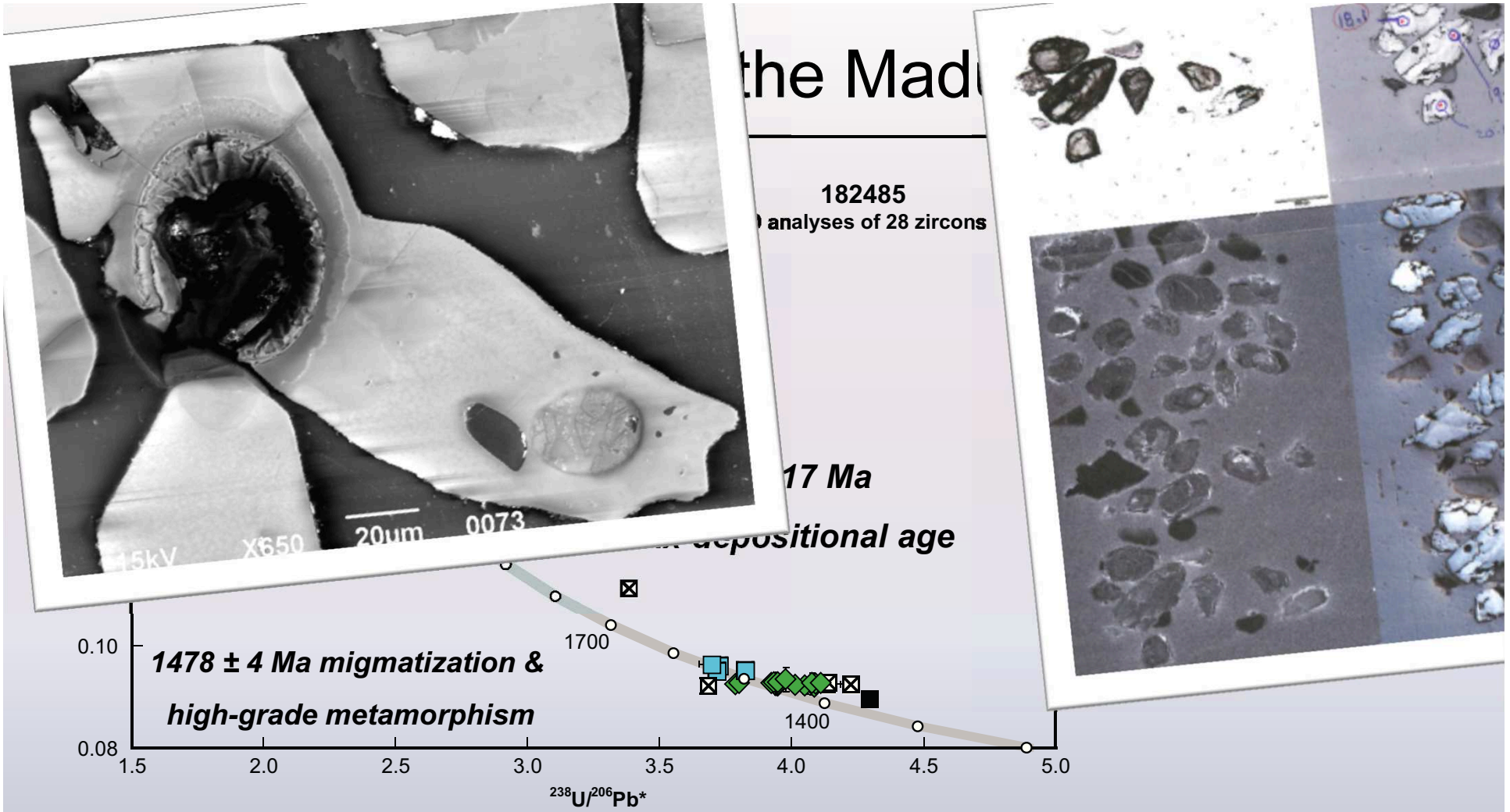

Burkin gneiss
Sediment
1480 migmization
Haig Cave Supersuite
Moodini Supersuite
(n=8)
1140
1180
1400
Yilgarn Craton
Gunbarrel Fault
Neale Project
Tropicana
Cundeelee Shear Zone
Biranup Zone
Fraser Zone
Rodona Shear Zone
Mundrabilla Shear Zone
Coompana Province
Forrest Zone
Big Red
NSD
Burkin
MAD014
FOR010
FOR011
Forrest
FOR008
Loongana
Rawlinna
MAD002
Haig
MAD011
Serpent
FOR012
FOR004
Karonie
ustralia Railway
eastern
Nornalup Zone
Nova
Albany–Fraser Orogen
Madura Province
Hannah 1
Moodini
Eucla 1
coastline
50 km

Hf isotopic signature of the Madura Province



Aspects of the dataset

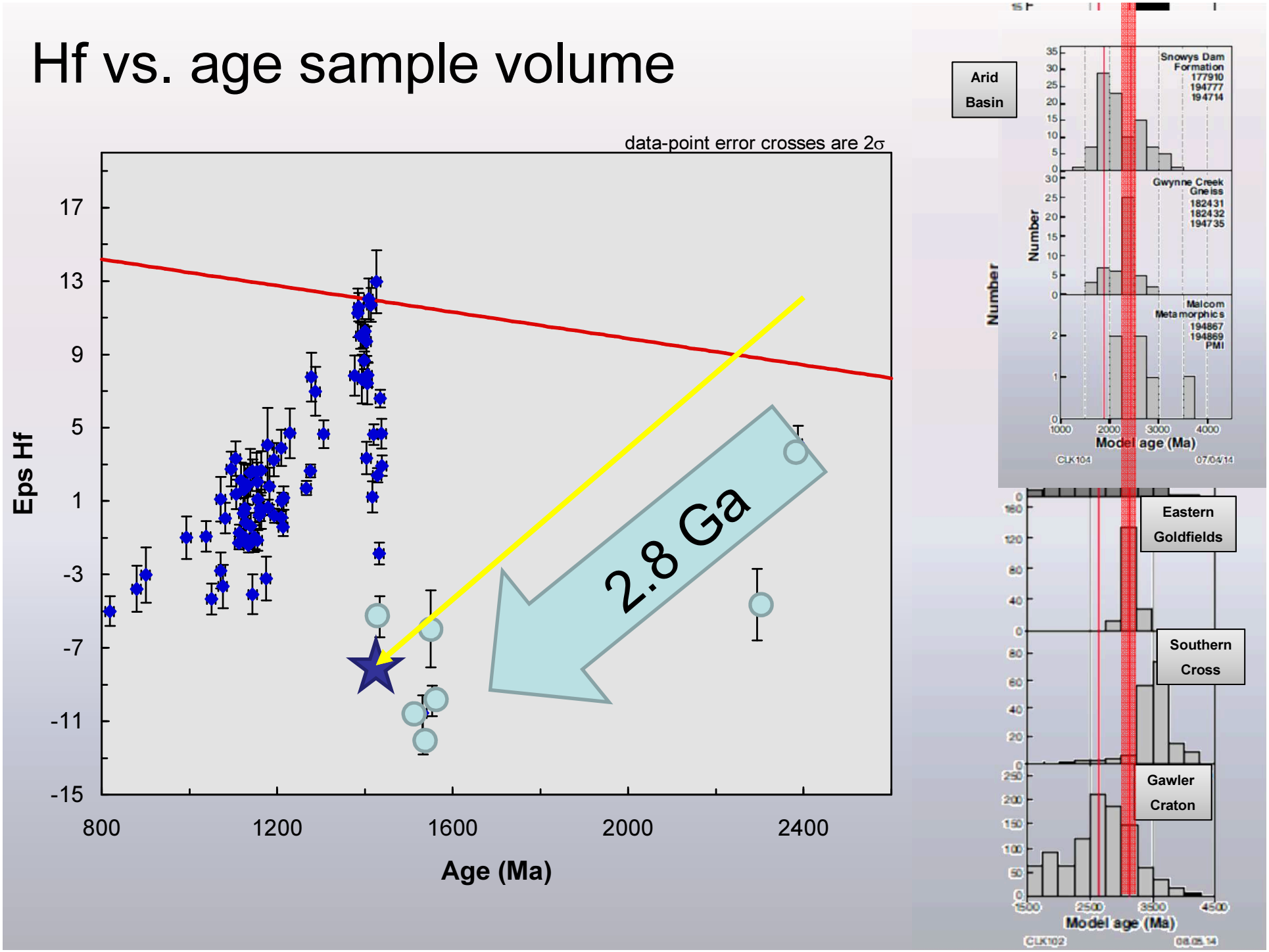
1. Age vs. Hf sampling volume
2. Apparent evolution array
3. Evolved components



Migmatitic gneiss, BKD2, 271.38 – 272.08 m

Zircons are subhedral, generally rounded, and light brown to black. In CL images, some crystals display faint indications of oscillatory zoning and homogeneous patches with little CL response. Some crystals contain younger rims.

Hf vs. age sample volume

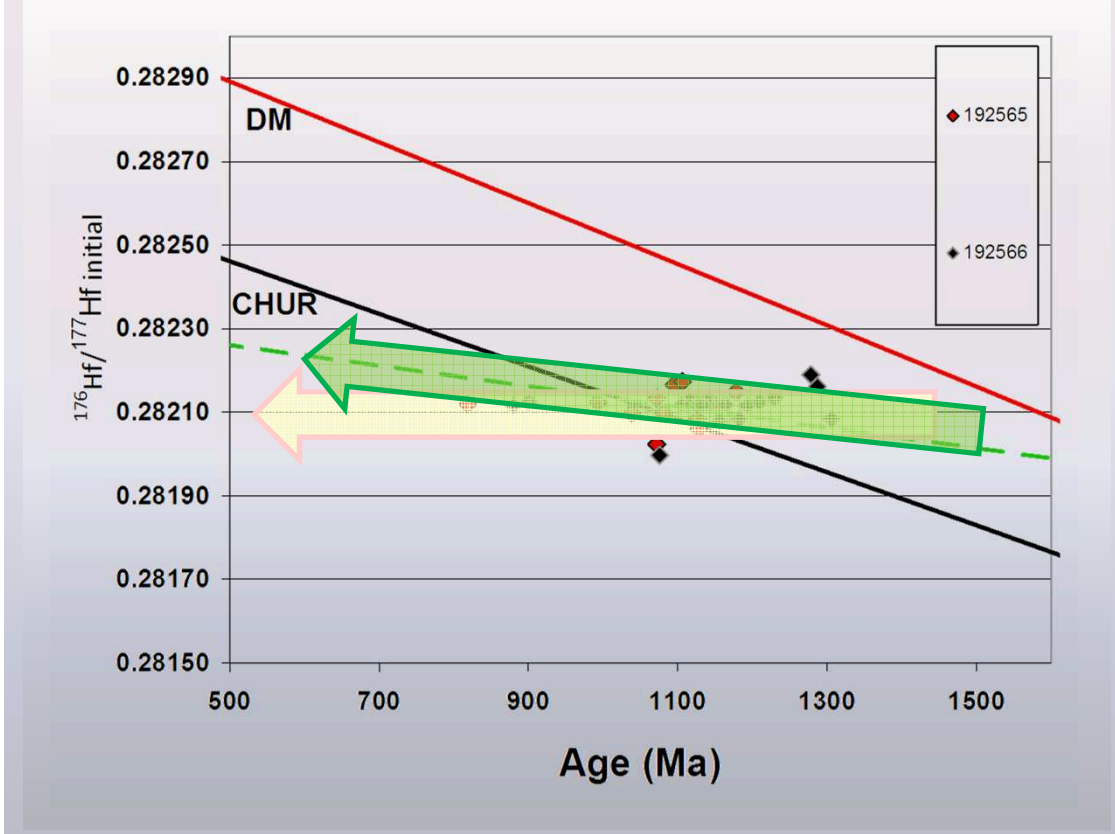


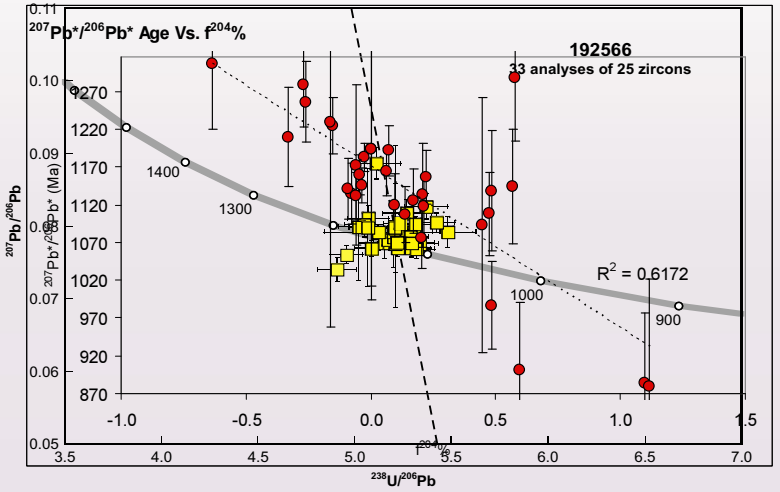
Apparent evolution lines

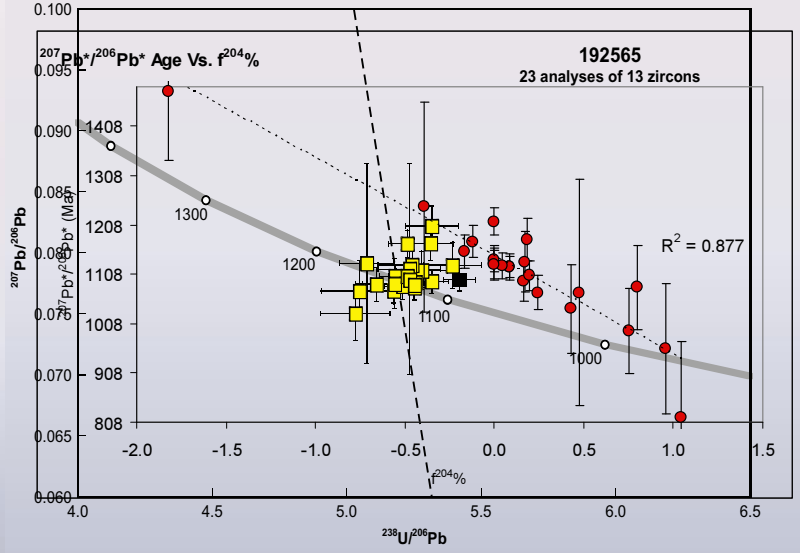
Fictitious evolution arrays:

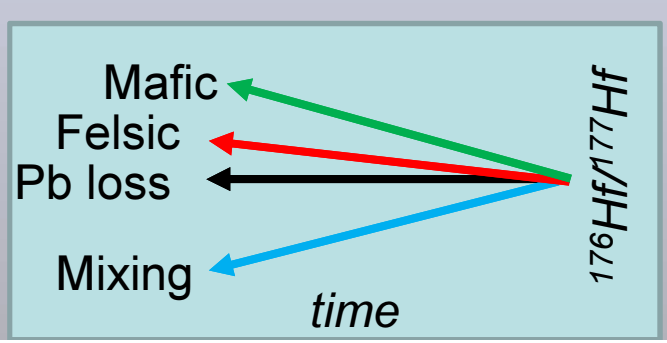
Can be due to radiogenic-Pb loss

Common Pb correction

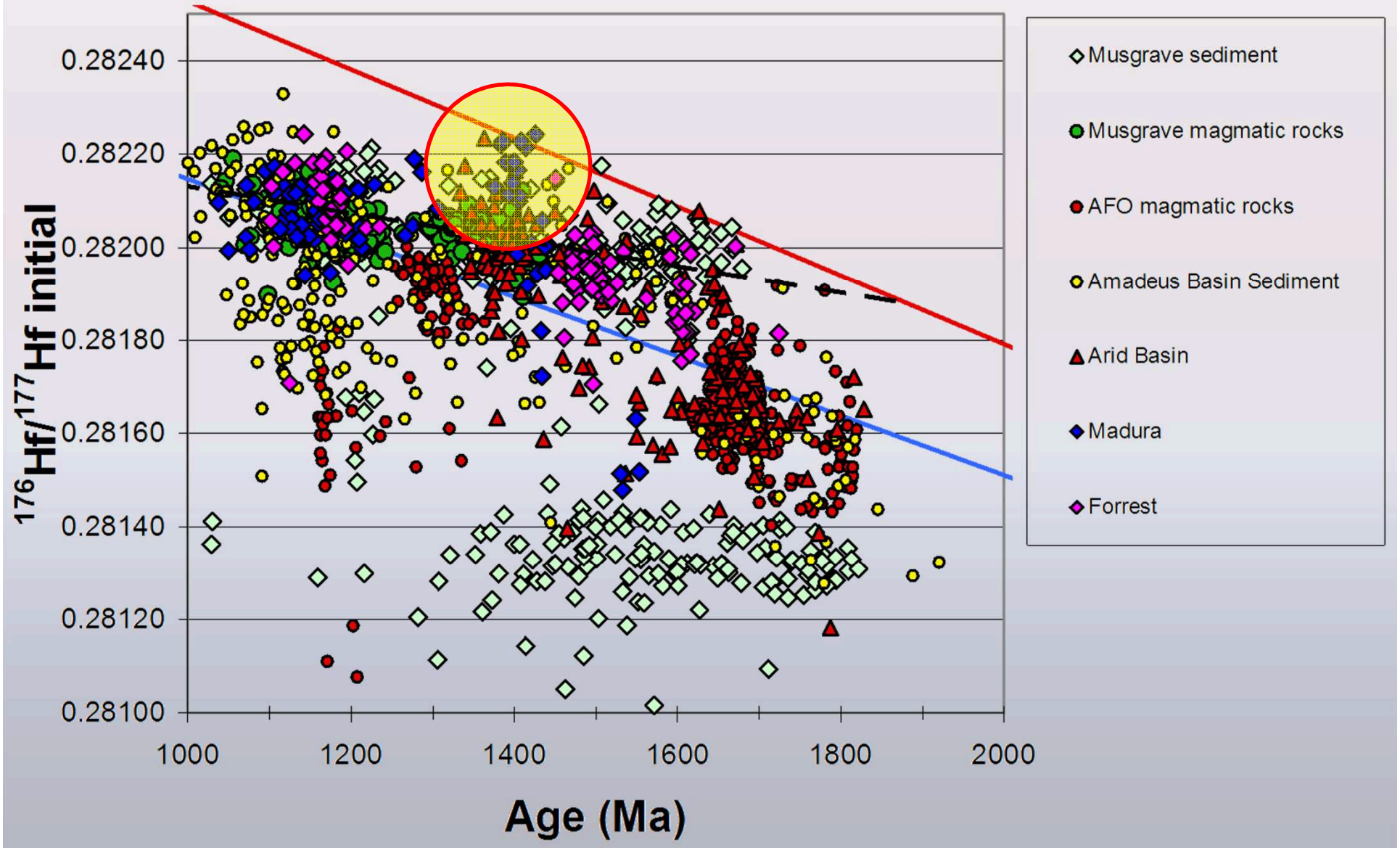








Hf evolution pattern of the Madura Province



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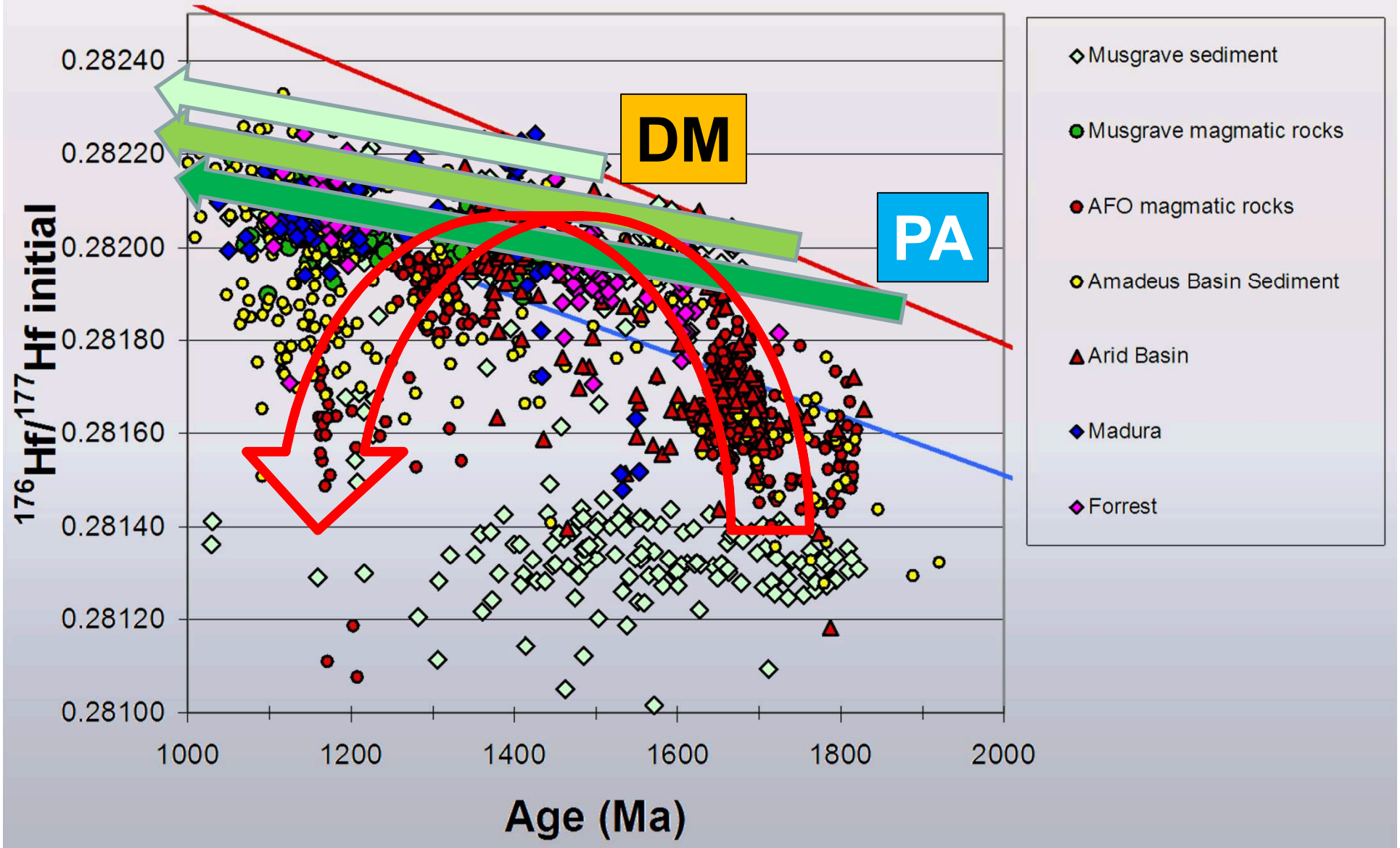
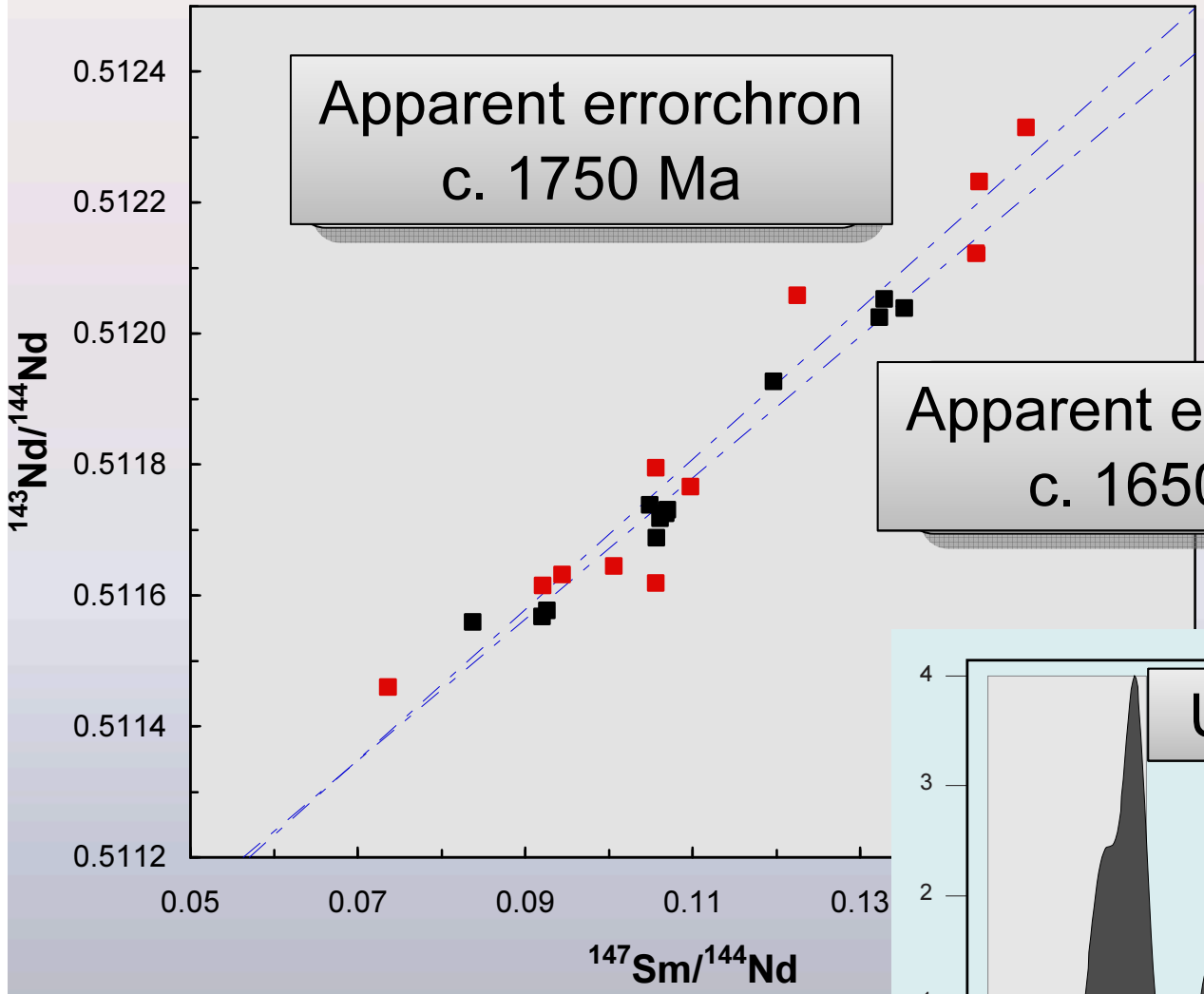
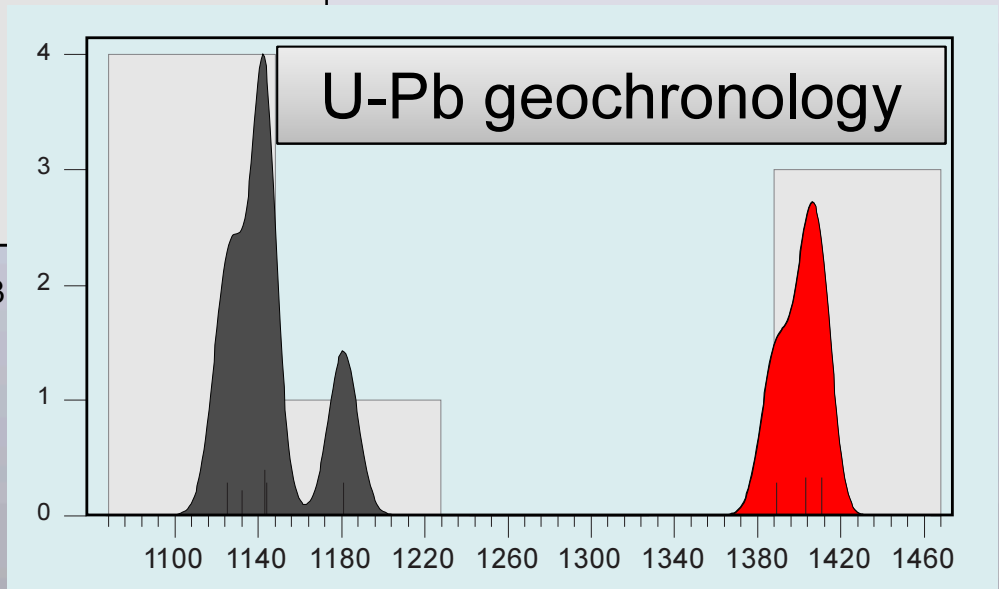


Whole rock Nd of granites in the Madura Province



Totally meaningless apparent ages! However indicate an important process



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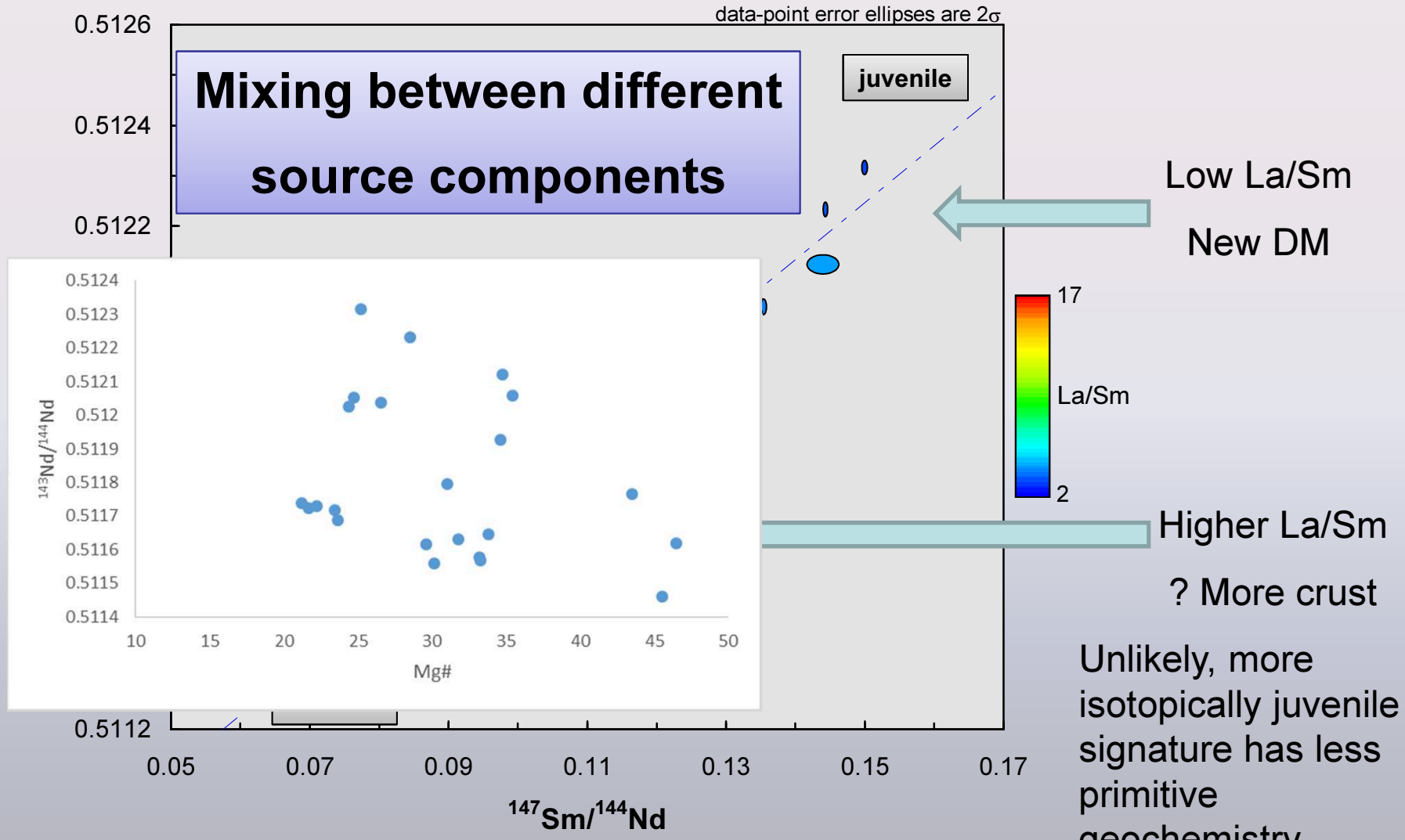
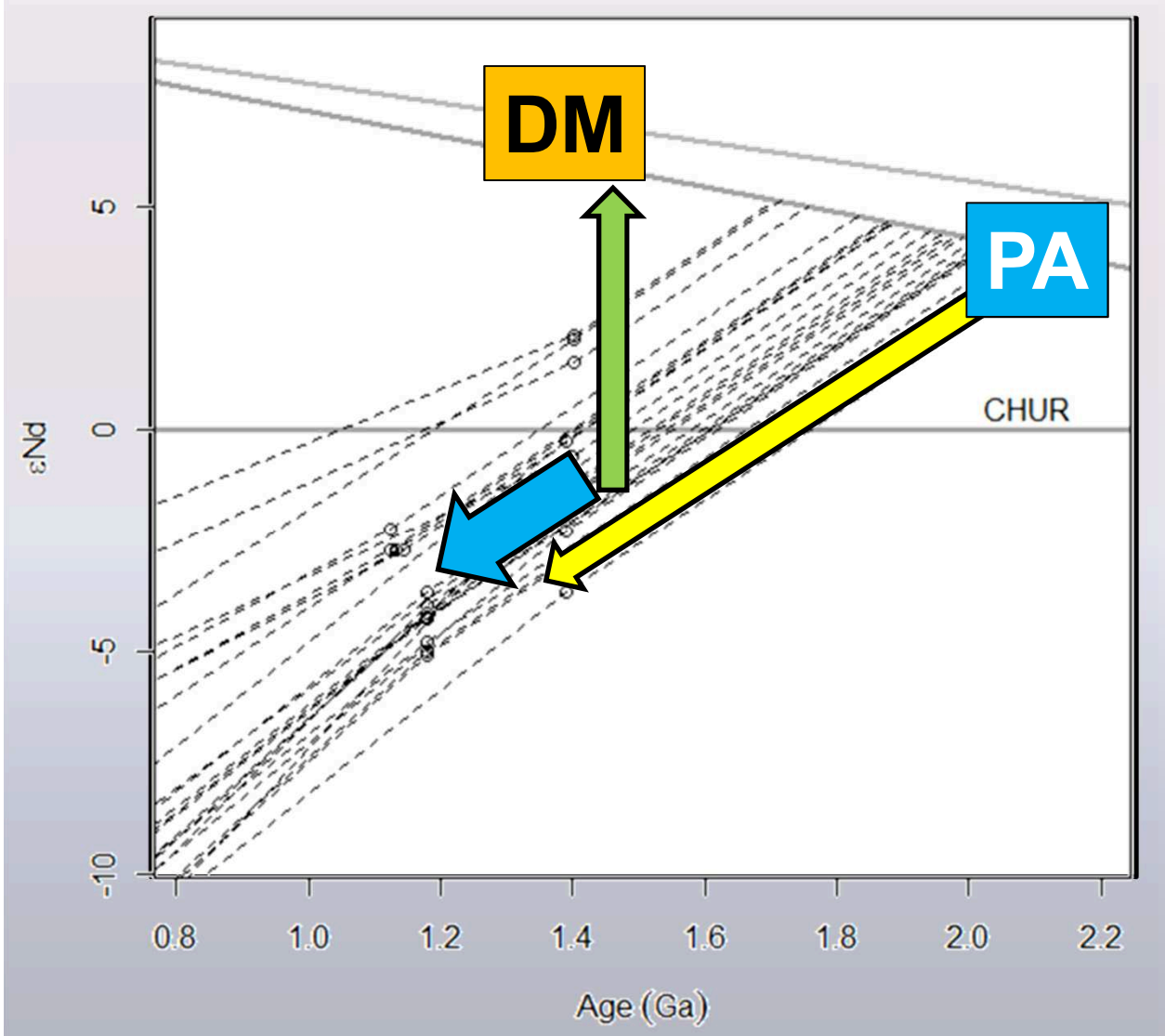


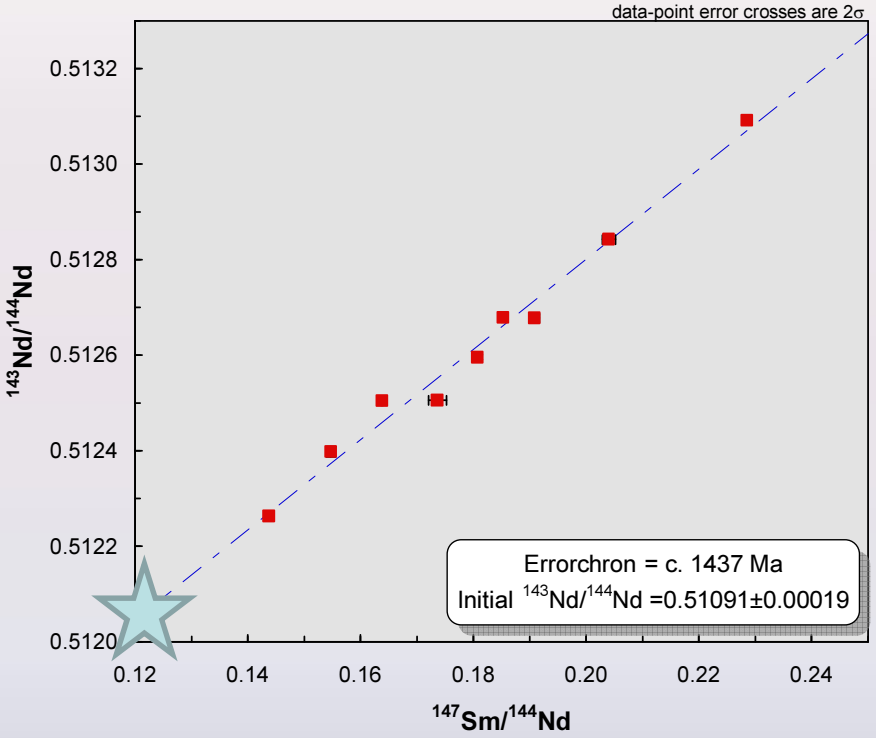
Whole rock Nd of granites in the Madura Province

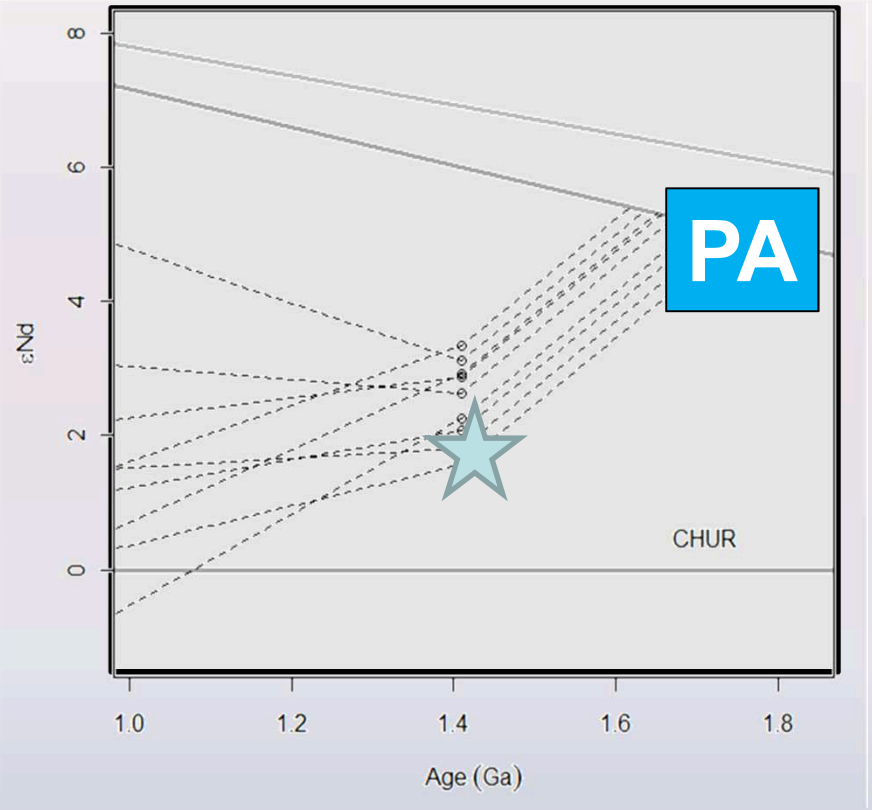


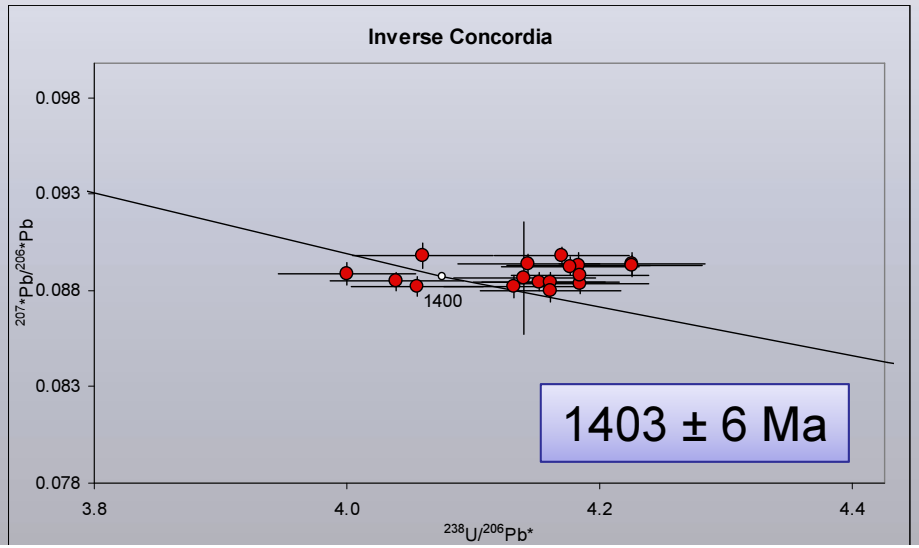
1.9-2.0 Ga primitive Hf array: complex mix of “oceanic” magma sources.

New addition of mantle material at c. 1400 Ma

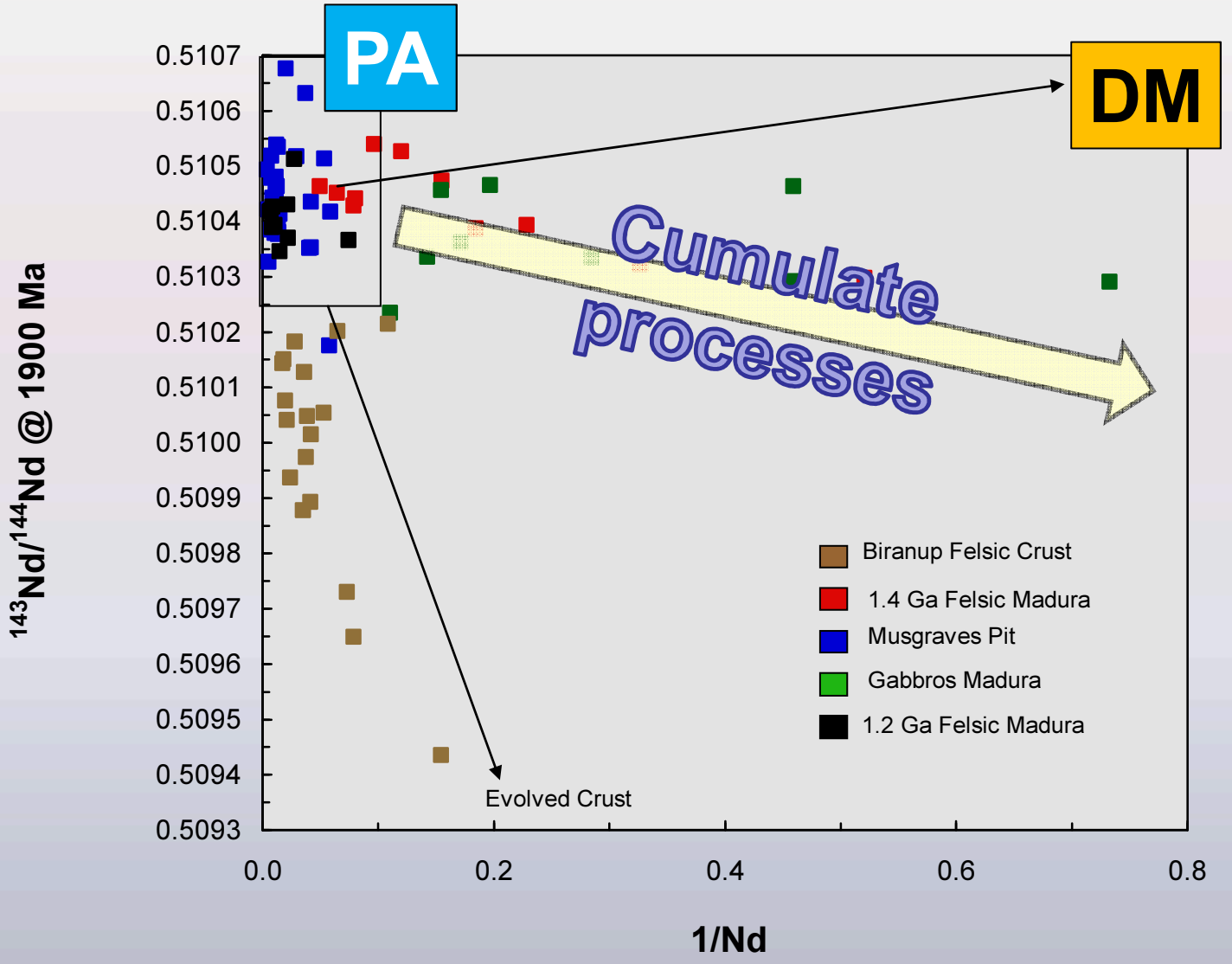
Whole rock Nd of gabbro of the Madura Province





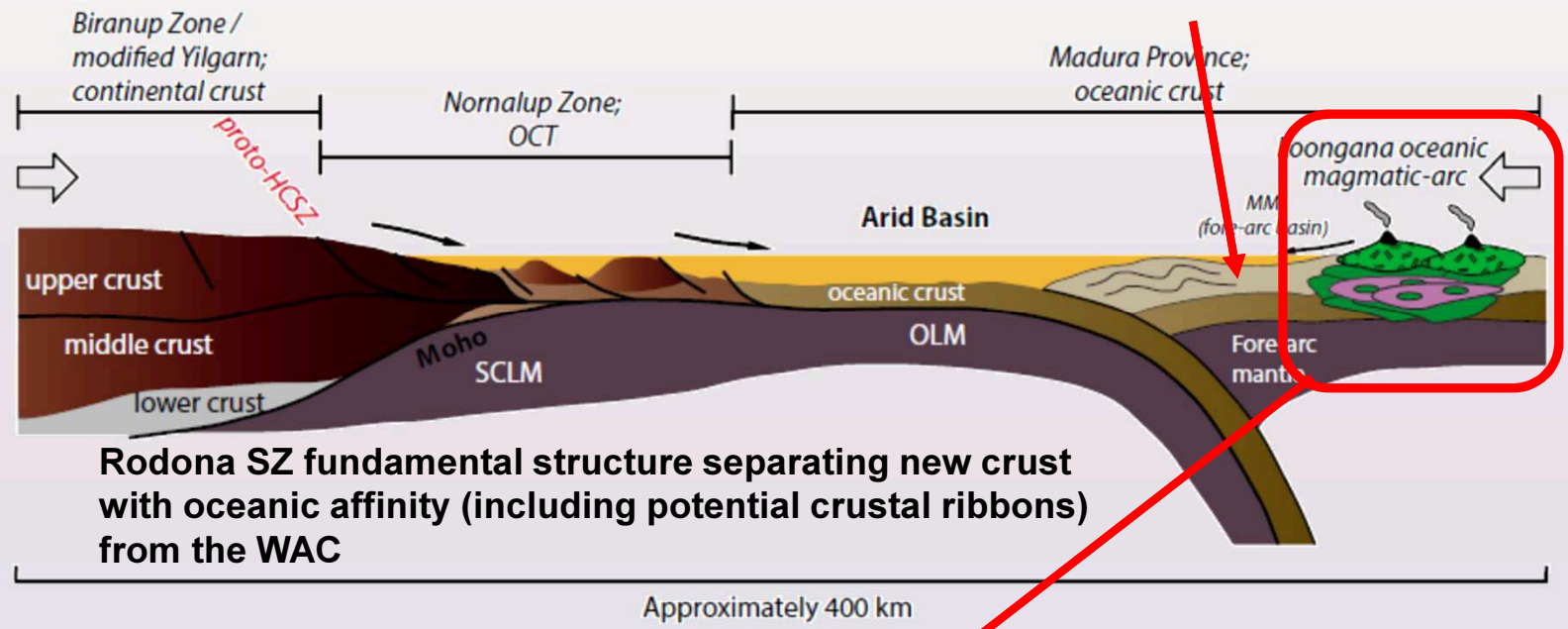


Initial ratios consistent with mixture between >1.8 Ga and DM sources

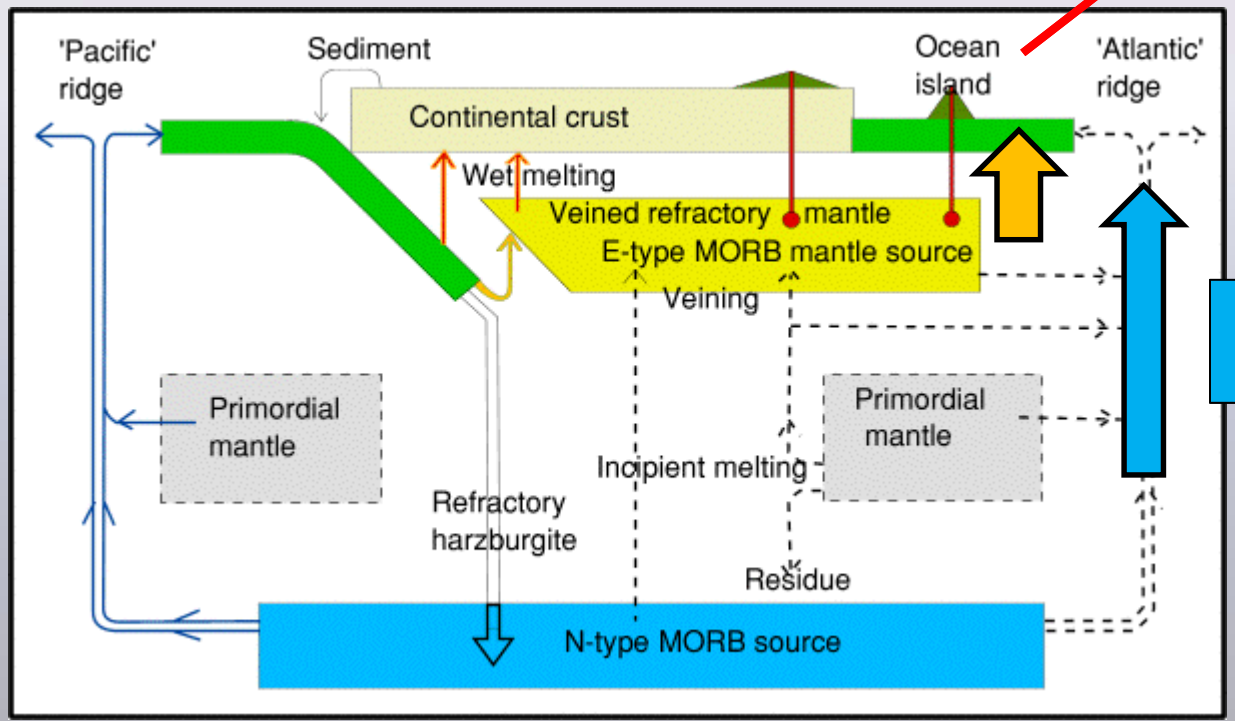


Trends in Nd consistent with at least two radiogenic (juvenile) sources with one component strongly similar to the deep basement of the Musgraves

Crustal ribbons Burkin



Rodona SZ fundamental structure separating new crust with oceanic affinity (including potential crustal ribbons) from the WAC

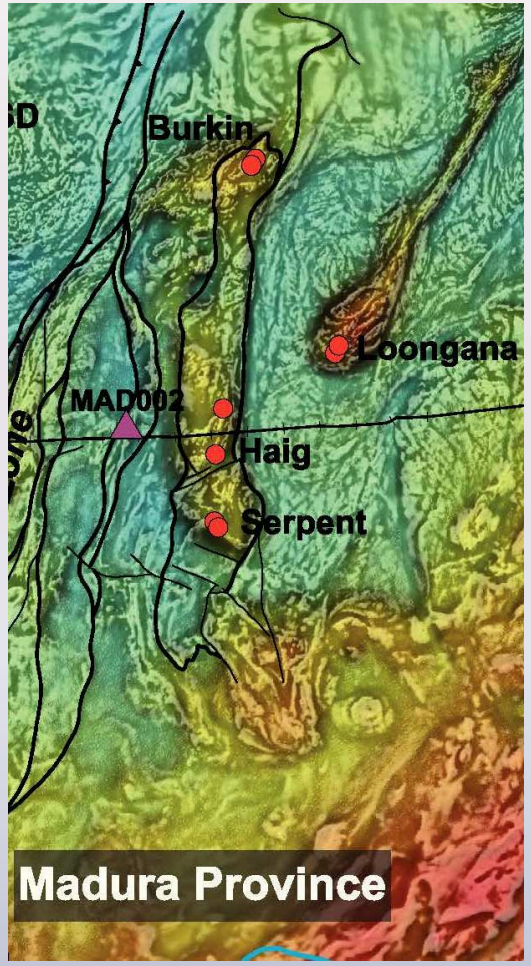


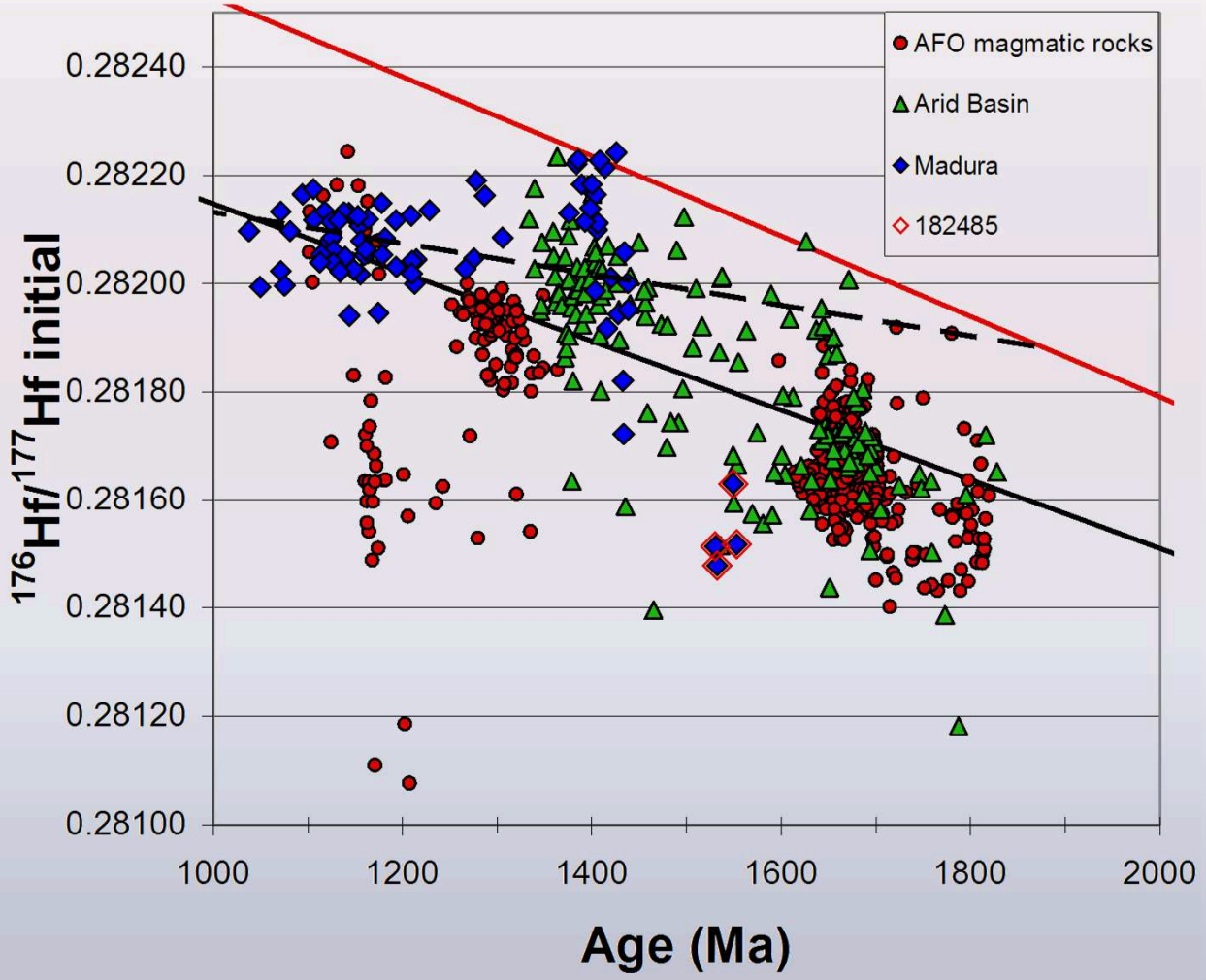
DM

PA

Mix of PA (generated continuously from 1.9 Ga) with "new" DM consistent with many aspects of the isotopic & geochemical signature

Evolved components





Burkin drill core includes zircon with age and isotopic signature similar to Arid Basin sediments; implying a link to the West Australian Craton.