Constrains on the Timing of Surface Uplift of the Iranian Plateau (Arabia-Eurasia Collision Zone) from Clumped Isotope Thermometry on Pedogenic Carbonates

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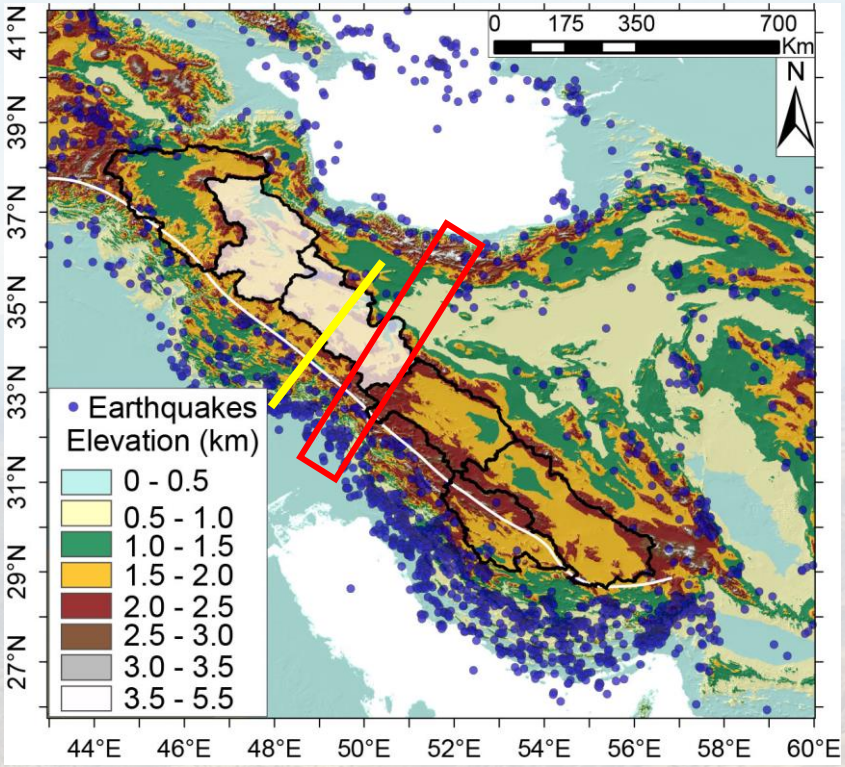
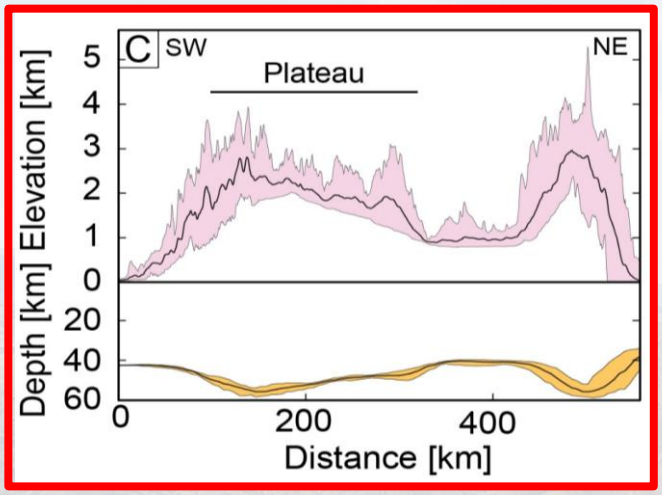
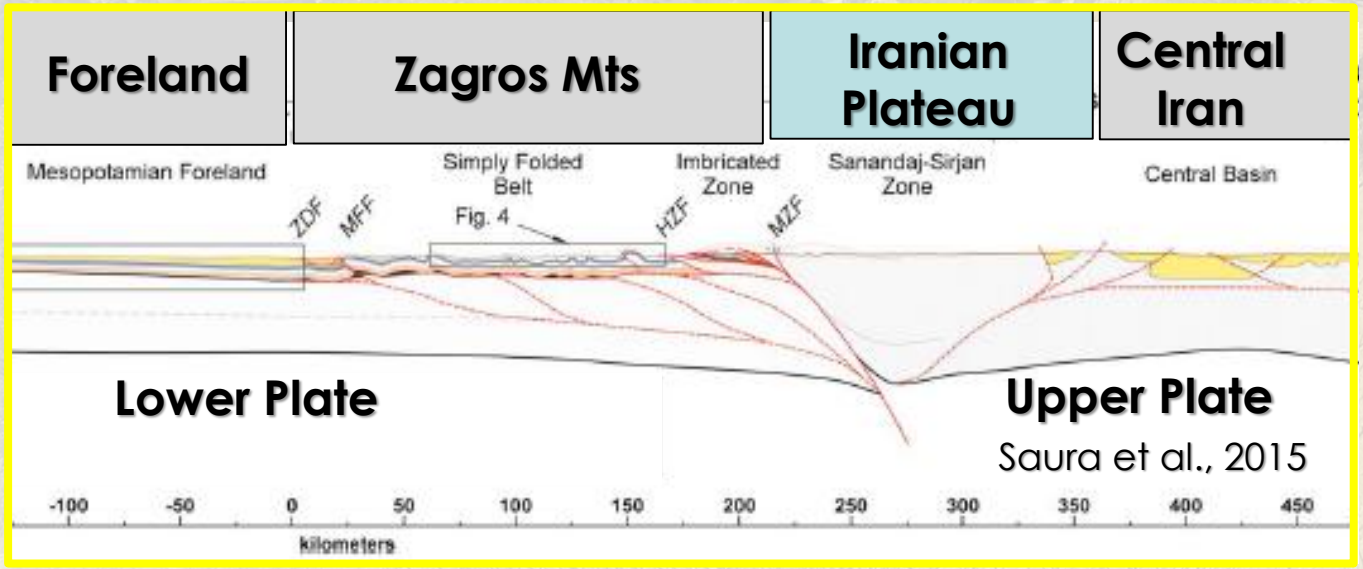
The Iranian Plateau



Ballato et al., 2017 and reference therein



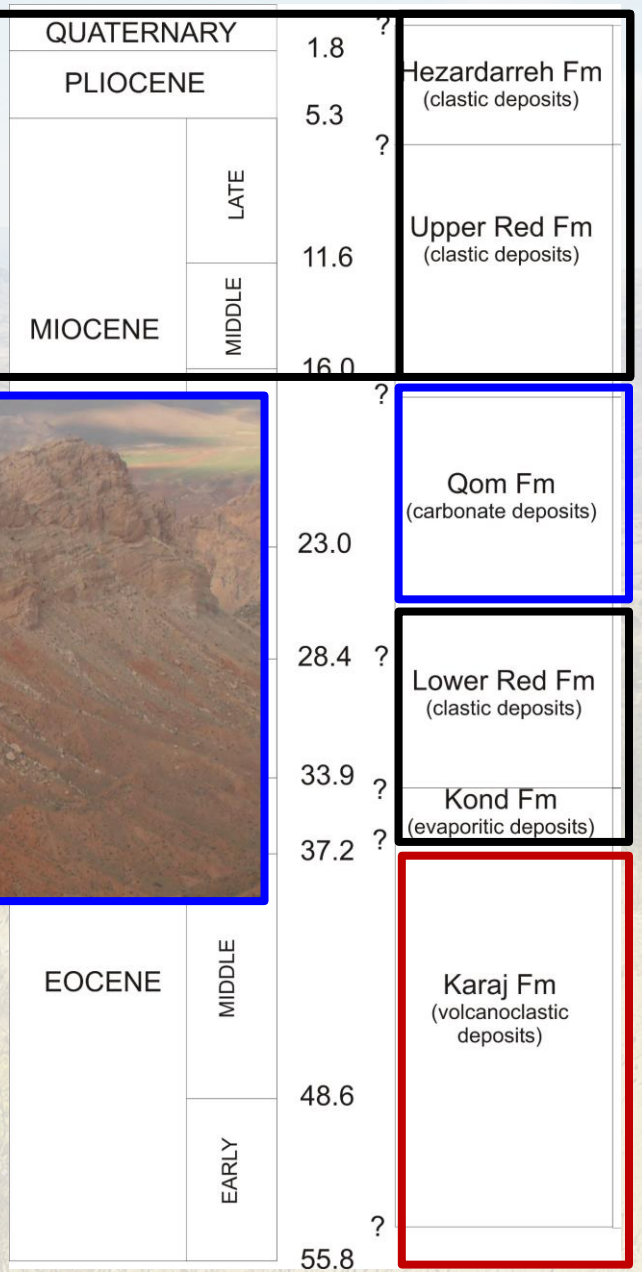


Saura et al., 2015

The Iranian Plateau is **mostly built on the upper Eurasian plate**, has a mean elevation of ca. 1.8 km and **includes a series of endorheic basins** (or recently captured basins; see white areas)

Tectono-Stratigraphy of the NW Iranian Plateau

Plateau uplift is **younger than 17 Ma**, and **postdate** the Arabia-Eurasia continental **collision**



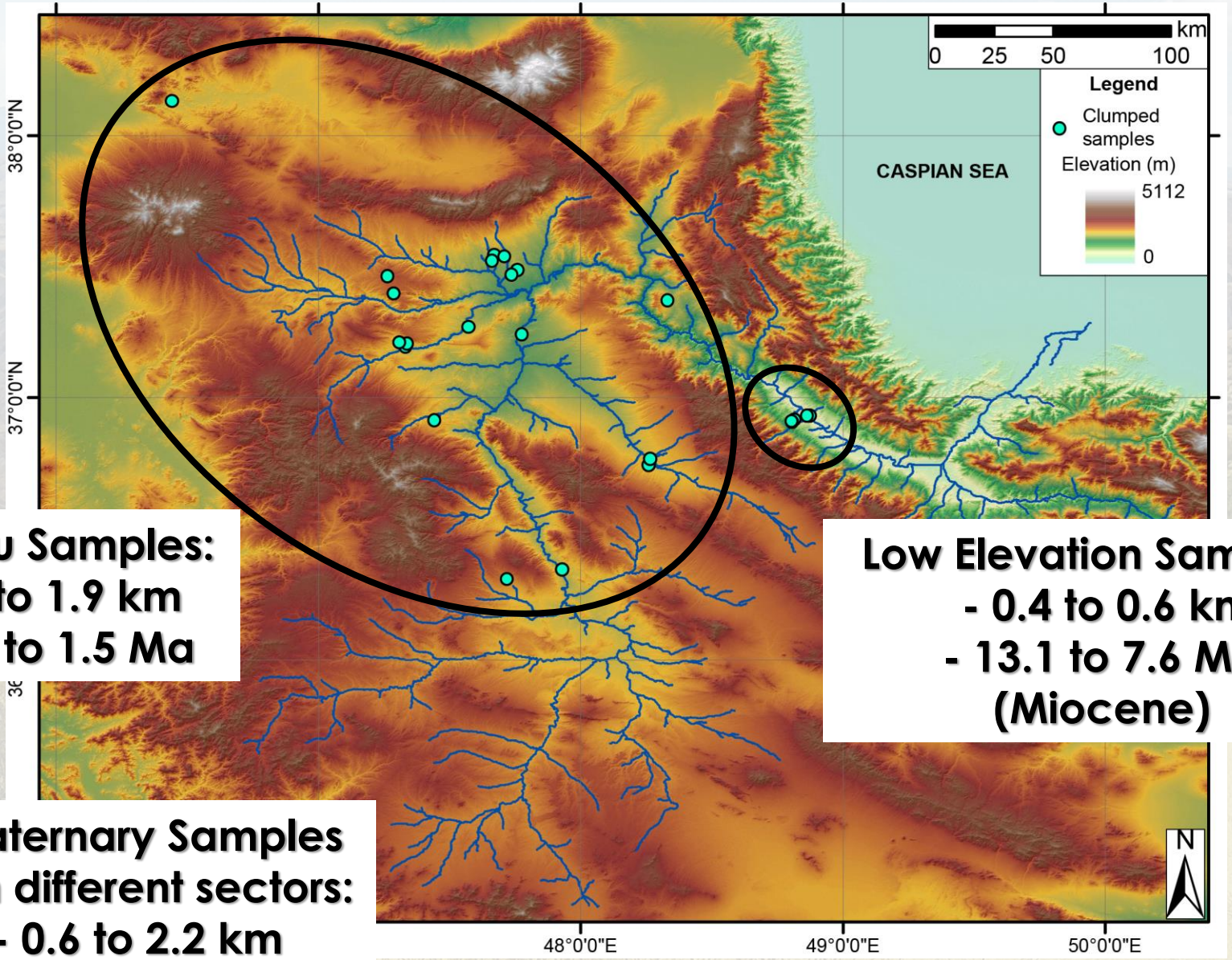
Collisional Deformation

Marine Transgression

Collision?

Arc Magmatism and Back-arc Extension

Age and Elevation of our Pedogenic Carbonate Nodules Samples

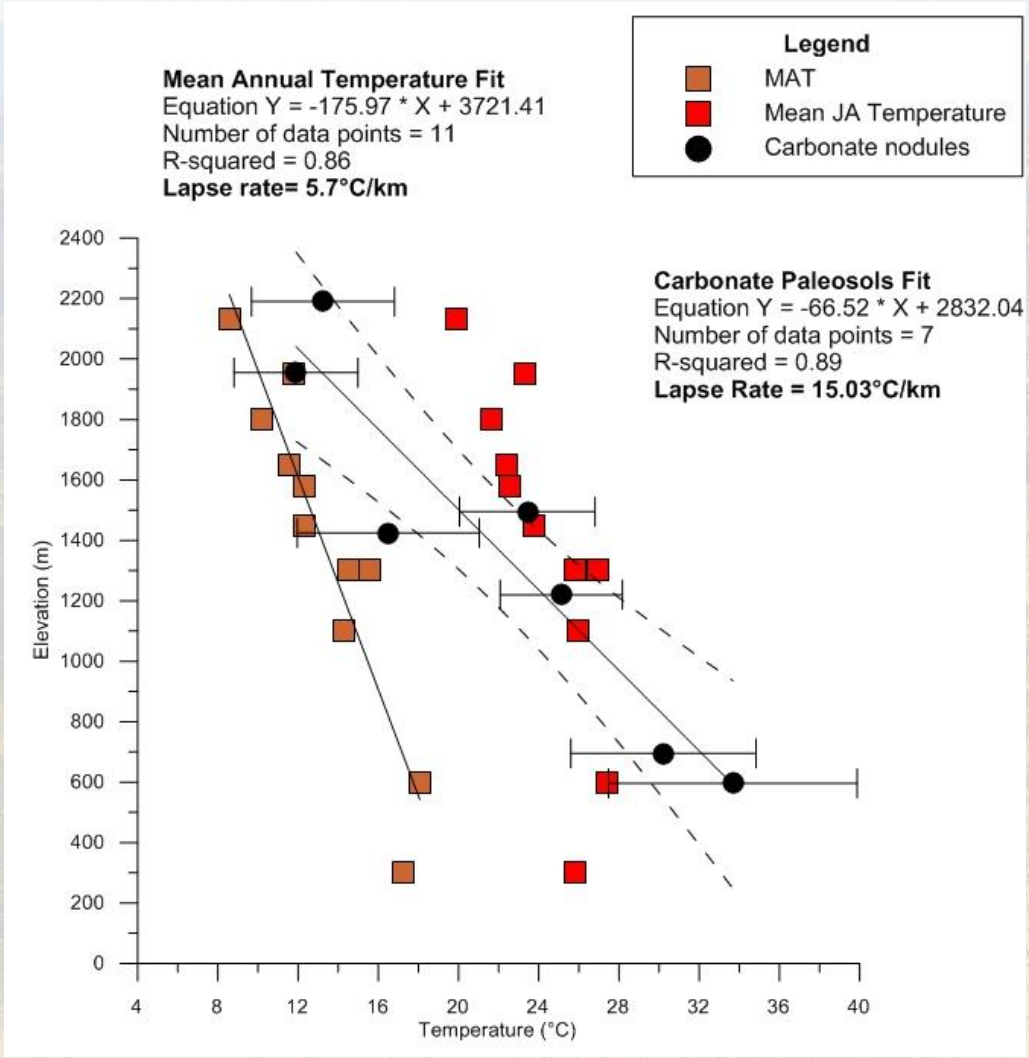


Plateau Samples:
- 1.1 to 1.9 km
- 19.8 to 1.5 Ma

Low Elevation Samples:
- 0.4 to 0.6 km
- 13.1 to 7.6 Ma
(Miocene)

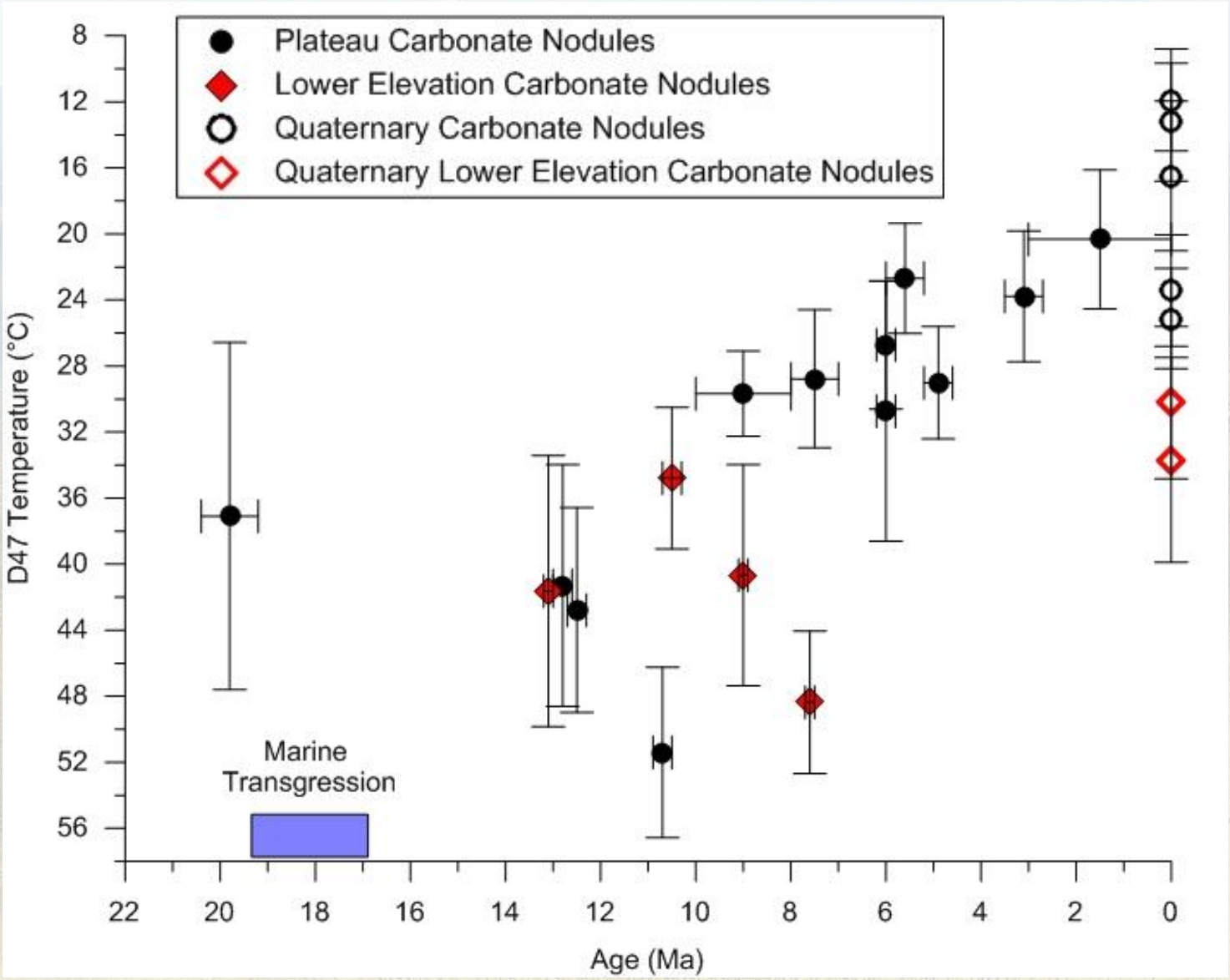
Quaternary Samples from different sectors:
- 0.6 to 2.2 km

Preliminary D47 Temperature from Quaternary Carbonate Nodules

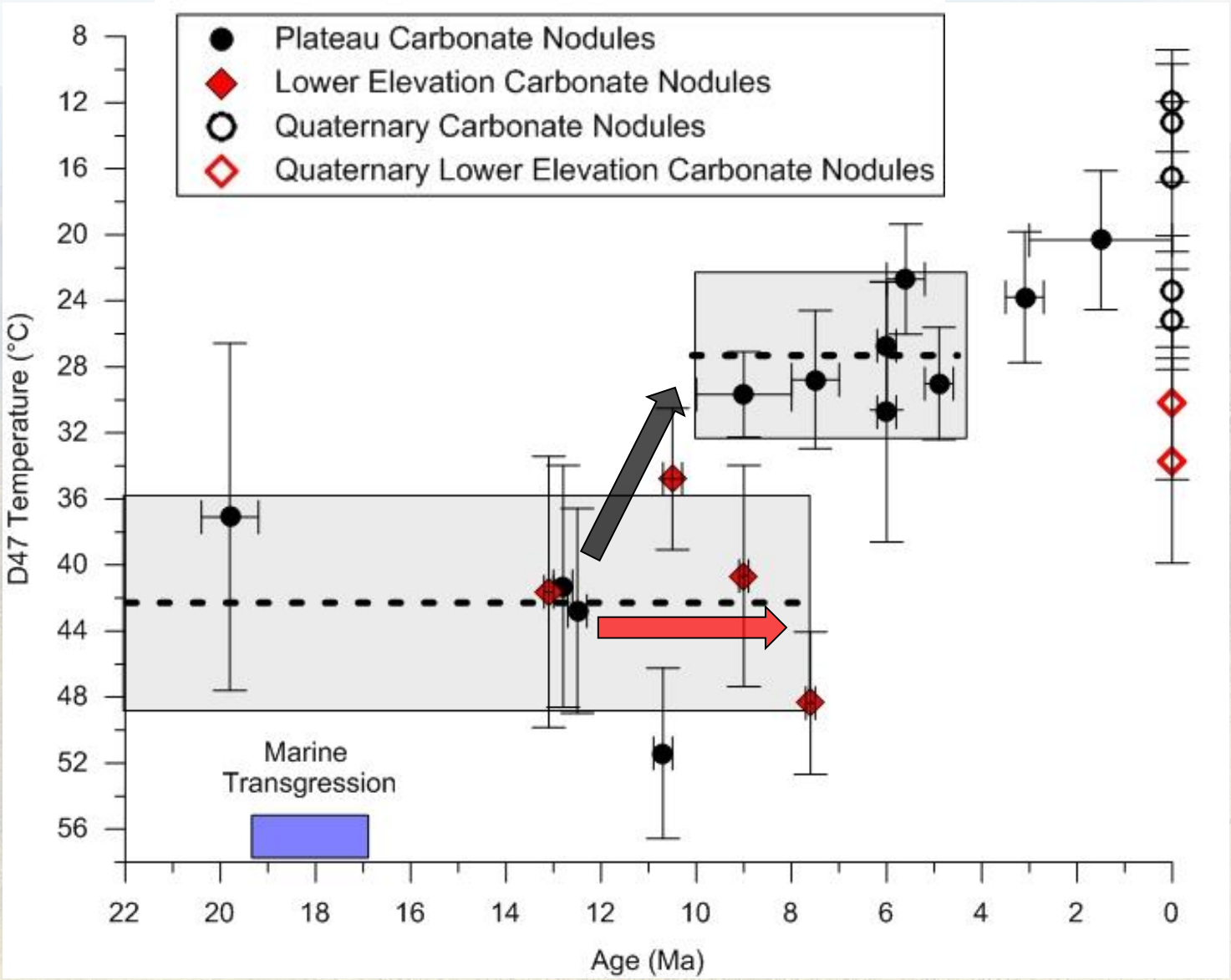


Our Quaternary Carbonate Nodules indicate a **Temperature Lapse Rate of 15 °C/km**

Preliminary Clumped Isotopes Results

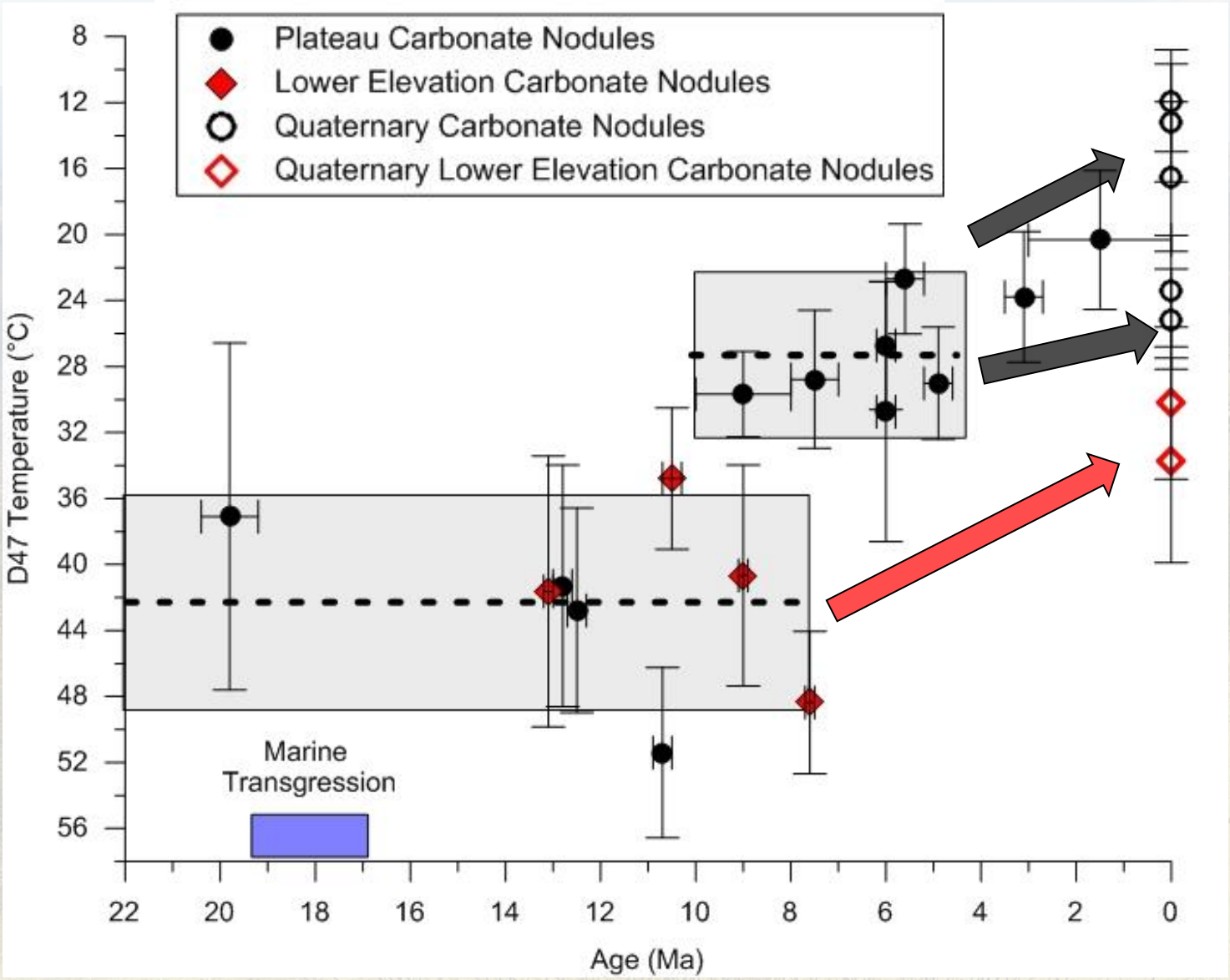


Preliminary Clumped Isotopes Results



14.4 °C of cooling in 3.5 or 1 My (12.5 or 11 to 10-8 Ma) implying **ca. 1 km of surface uplift** at rates of 0.25 to 1 mm/yr

Preliminary Clumped Isotopes Results



Recent Global Cooling (3-4°C)

Recent Cooling (10°C):

- 0.5 km Uplift
- Global Cooling

Models for Plateau Uplift

1) **Shortening and Thickening** (see appendix) can account for 0.8 to 1.8 km of surface uplift in10 My (0.08 to 0.18 mm/yr)

2) **Mantle Delamination** (see appendix) can account for 1.2 to 2.1 km in few My (possibly 3 to 5, implying rates of 0.25 to 0.7 mm/yr)

Conclusions

Our data document 14.4 °C cooling in 3.5 or 1 My (**from 12.5 or 11 to 10-8 Ma**) implying **1 km of surface uplift at rates of 0.25 to 1 mm/yr**

These rates suggest that **uplift may have been controlled by deep seated processes** (not necessary mantle delamination) rather than shortening and thickening

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Appendix

In case of Delamination

Rapid uplift 1.2 to 2.1 km possibly in 3-5 Ma at rates of 0.25 to 0.7 mm/yr

dh/dt= dT*L*a
L = 120-140, dT = 200-300°C
a= coefficient of thermal expansion
Assuming no erosion
(Molnar and Stock 2009)

In case of Shortening and thickening

Steady Uplift of 0.8 to 1.8 km in 10 My at Rates of 0.08 to 0.18 mm/yr)

dh/dt= (pm-pc)/pc * dH/dt=
1/5.5 * (U*H/W)
H = 35-40 km, U = 5-10 mm/yr, W = 400 km
Assuming isostsy and no erosion
(Garzione et al., 2006)