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 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).
**Plateau uplift is younger than 17 Ma, and postdate** the Arabia-Eurasia continental collision.
Age and Elevation of our Pedogenic Carbonate Nodules Samples

- Low Elevation Samples: 0.4 to 0.6 km, 13.1 to 7.6 Ma (Miocene)
- Plateau Samples: 1.1 to 1.9 km, 19.8 to 1.5 Ma
- Quaternary Samples from different sectors: 0.6 to 2.2 km

Legend:
- Clumped samples
- Elevation (m)
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 in 10 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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01 July 2020 Abstract (not mandatory)
01 November 2020 Manuscript (you can submit before this deadline if your manuscript is ready)
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

\[ \frac{dh}{dt} = \frac{dT}{L} L \alpha \]
\[ L = 120-140, \quad dT = 200-300^\circ C \]
\[ \alpha = \text{coefficient of thermal expansion} \]
 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

\[ \frac{dh}{dt} = \frac{p\mu - p_c}{p_c} \frac{dH}{dt} = \frac{1}{5.5} \left( \frac{UH}{W} \right) \]
\[ H = 35-40 \text{ km}, \quad U = 5-10 \text{ mm/yr}, \quad W = 400 \text{ km} \]
 Assuming isostasy and no erosion
(Garzione et al., 2006)