

Noise in the Cretaceous Quiet Zone reveals plate tectonic chain reaction

Derya Güler^{1,2}
Roi Granot³
Douwe J J van Hinsbergen¹

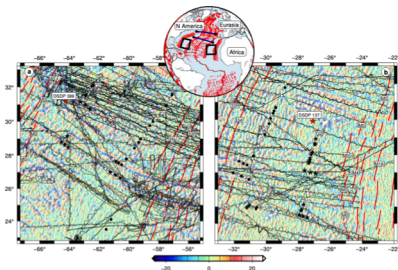


BACKGROUND

Plate motion changes drive formation of new subduction zones, but because plate motions themselves are primarily driven by slab pull, new subduction zones in turn drive plate motion changes. A major swing in relative Africa-Eurasia plate motion took place amidst a 'global plate reorganization' at ~105 Ma¹. However, identifying the causes and effects of tectonic events is hampered by the lack of magnetic reversals during the Cretaceous Normal Superchron (CNS, 126-83 Ma).

METHODS

We show a new Africa-Eurasia plate kinematic model calculated by identifying **two intra-Cretaceous Quiet Zone magnetic features** related to geomagnetic paleosecular variations².



Central Atlantic quiet zones, magnetic anomaly and fracture zone picks used to calculate the CNS pole parameters

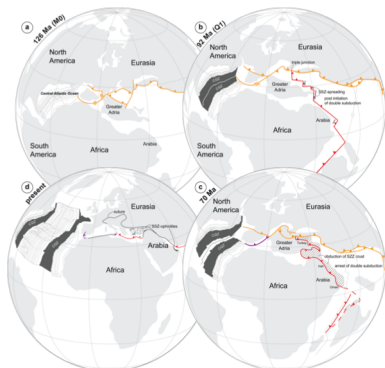
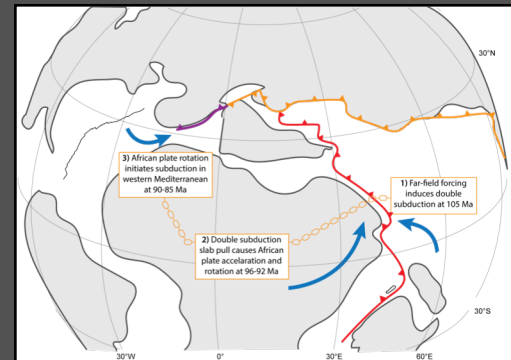


Plate boundary evolution in the Neotethys between Africa and Eurasia

A plate tectonic chain reaction between Africa and Eurasia took place in the Cretaceous Normal Superchron.

Chain of tectonic events

that lead to African-Eurasia plate motion changes as the dynamic response to ...



1) induced subduction initiation at ~104 Ma³, followed by ...

2) the ~96-92 Ma onset of African plate acceleration and rotation⁴ caused by **double in-line slab pull**, leading to ...

3) subduction initiation in the western Mediterranean⁵ at ~90-85 and finally, ~85-70 Ma arrest of double, in-line slab pull

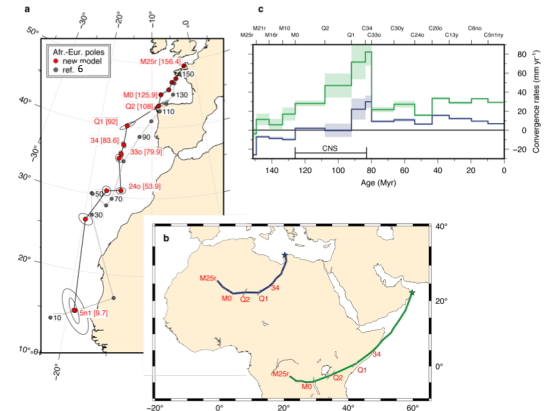


@geoceanic

Derya.Guerer@uq.edu.au

RESULTS

- Africa/Arabia-Eurasia convergence rates **accelerated** from prior to the CNS and until Q2, followed by a spike between Q1 and C33o.
- Peak in **convergence rates is up to twice as fast** as previously inferred⁶ from interpolating plate motion change across the CNS.



Africa-Eurasia relative plate motions. a) Finite rotation poles of Africa vs. Eurasia. b) trajectories of Africa motion vs. Eurasia. c) convergence rates along trajectories in b).

CONCLUSION

- The changes in plate motion rate are **effects**, not causes of Intra-Neotethyan subduction initiation.
- Plate reorganizations may be best viewed as a **chain of events**, which we term 'plate tectonic chain reactions' – rather than a sudden, isolated revolution.
- The dynamically underpinned plate tectonic chain reaction we reveal here opens a novel avenue towards unraveling still-enigmatic drivers of regional and global plate reorganizations.

References

- Matthews et al., 2015
- Granot et al., 2012
- Guilmette et al., 2018
- Dewey et al., 1989
- van Hinsbergen et al., 2020
- Rosenbaum et al., 2002

¹ Utrecht University, The Netherlands
² The University of Queensland, Australia
³ Ben-Gurion University of the Negev, Israel

