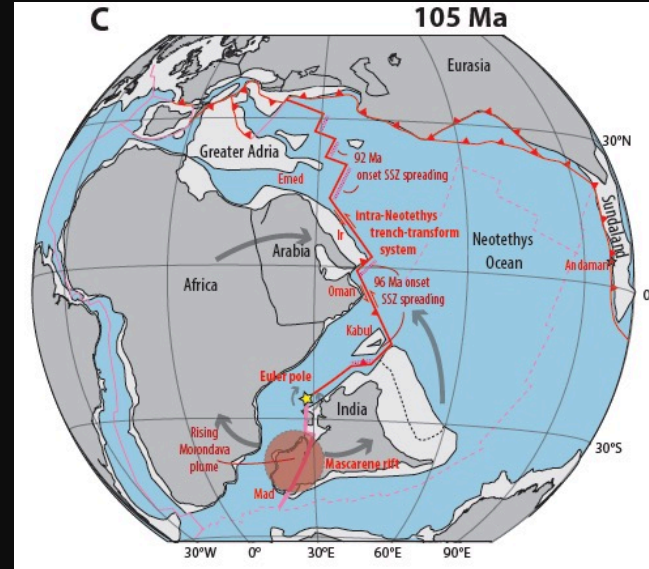
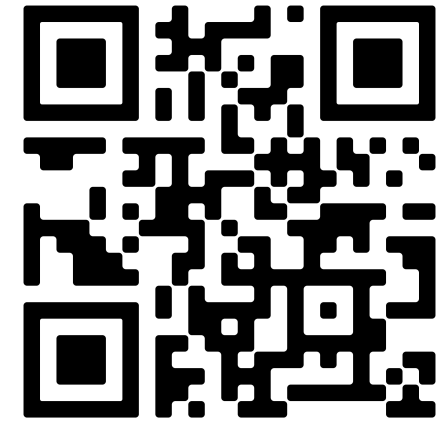


A record of plume-induced plate rotation triggering seafloor spreading and subduction initiation

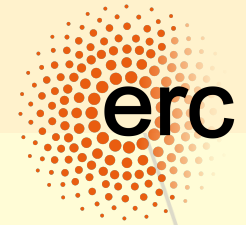
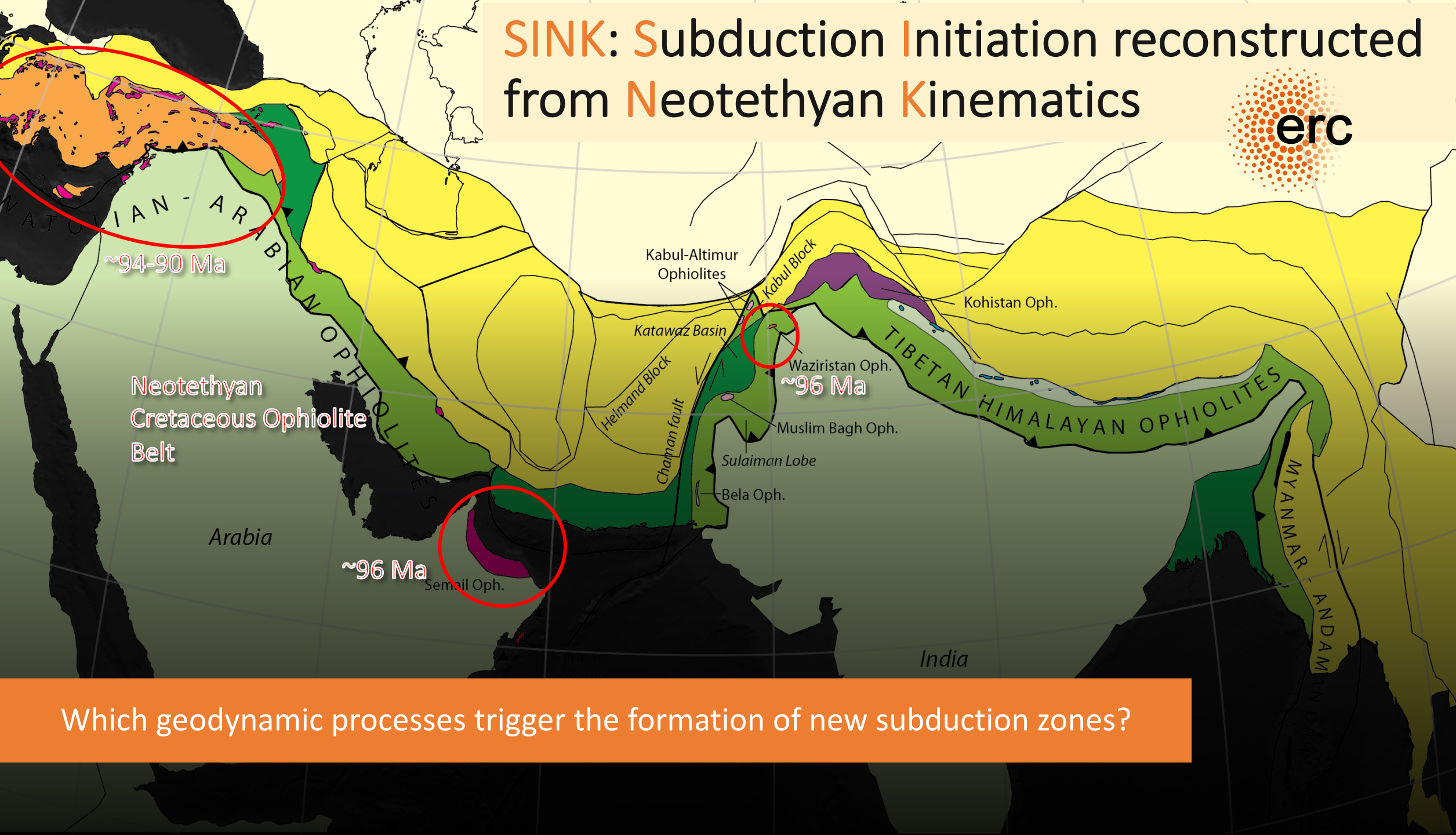
Douwe J.J. van Hinsbergen, Bernhard Steinberger, Carl Guilmette, Marco Maffione, Derya Gürer, Kalijn Peters, Alexis Plunder, Peter J. McPhee, Carmen Gaina, Eldert L. Advokaat, Reinoud L.M. Vissers, and Wim Spakman

Nature Geoscience, in press



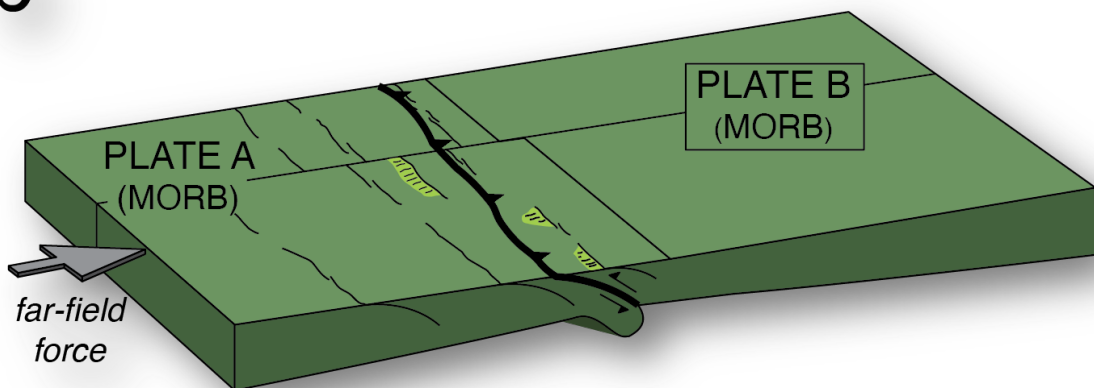
SCAN ME

SINK: Subduction Initiation reconstructed from Neotethyan Kinematics



Which geodynamic processes trigger the formation of new subduction zones?

b

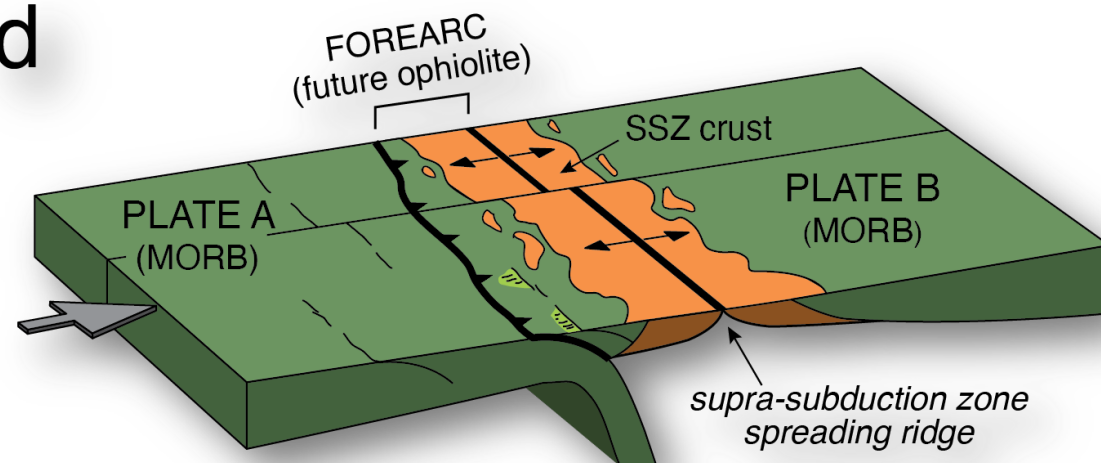


Lu/Hf ages of metamorphic soles:

Oman: 104 Ma (Guilmette et al., Nature Geo 2018)

Turkey: 104 Ma (Peters et al., in prep; Pourteau et al., Geosci Front 2019)

d



U/Pb, Ar/Ar ages of metamorphic soles & SSZ forearc crust:

Oman: 96 Ma (Guilmette et al., Nature Geo 2018; Rioux et al., EPSL 2016)

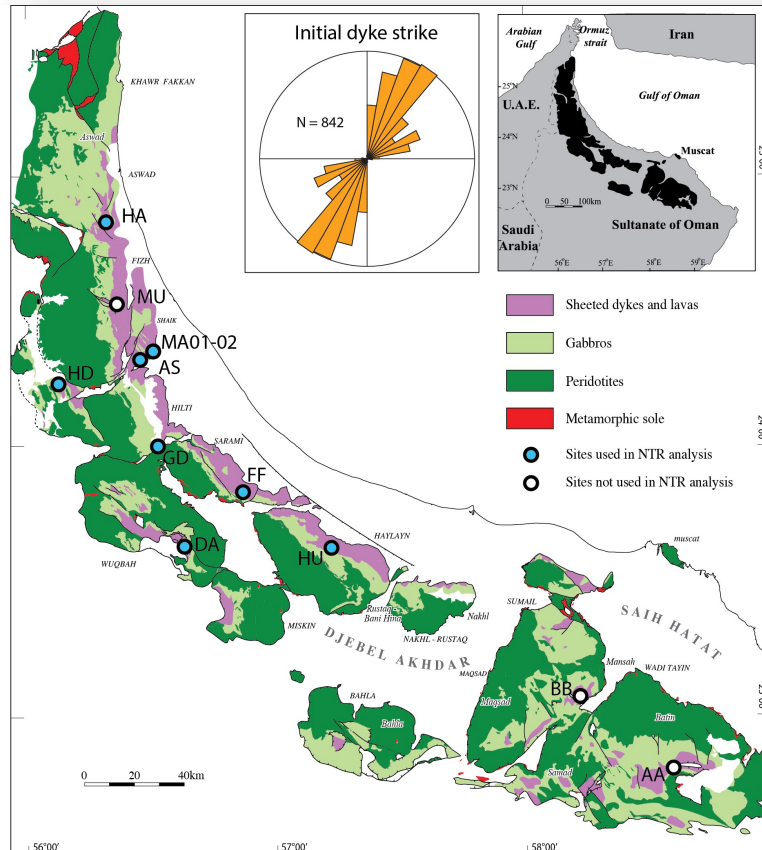
Turkey: 92 Ma (Peters et al., in prep; Parlak, J Earth Sci 2016)

Subduction in
Neotethys resulted
from far-field forcing

Thrusting recorded in metamorphic soles
predated upper plate extension

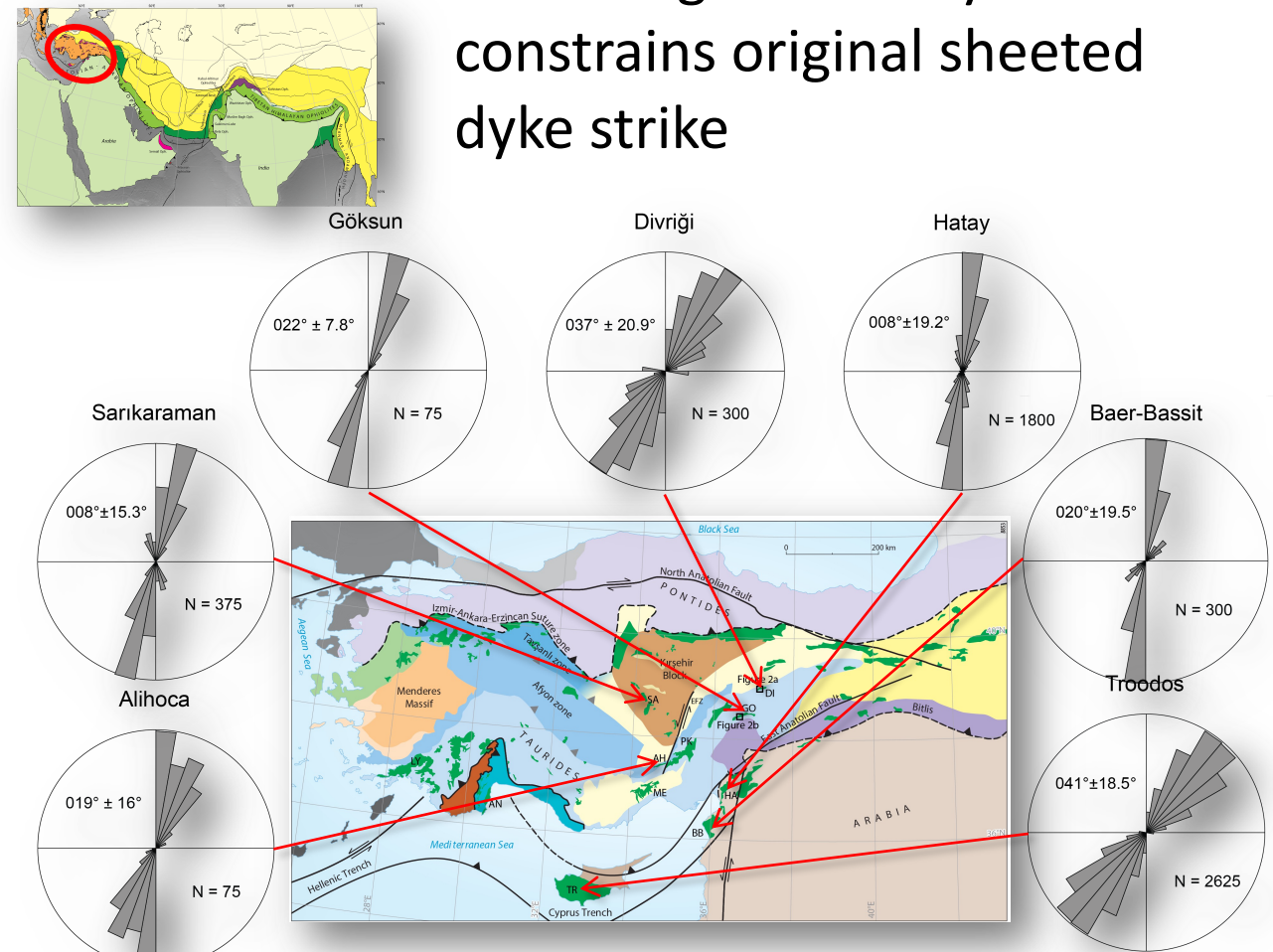
This precludes spontaneous subduction
initiation

Ophiolites formed at
~N-S trending SSZ
ridges and
subduction segments



Van Hinsbergen et al., EPSL 2019

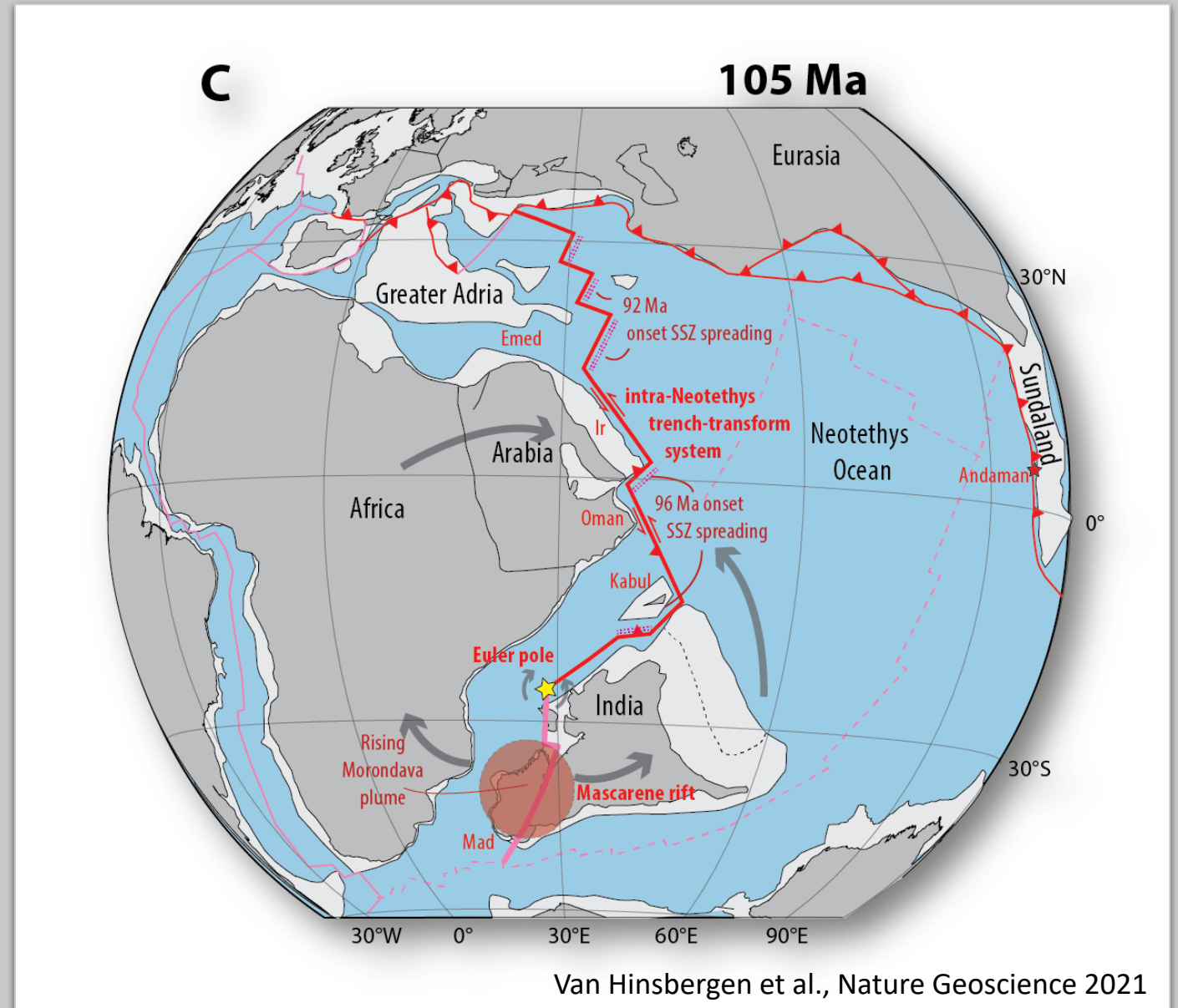
Paleomagnetic analysis
constrains original sheeted
dyke strike



Maffione et al., JGR 2017

Kinematic restoration of new plate boundary at 105 Ma

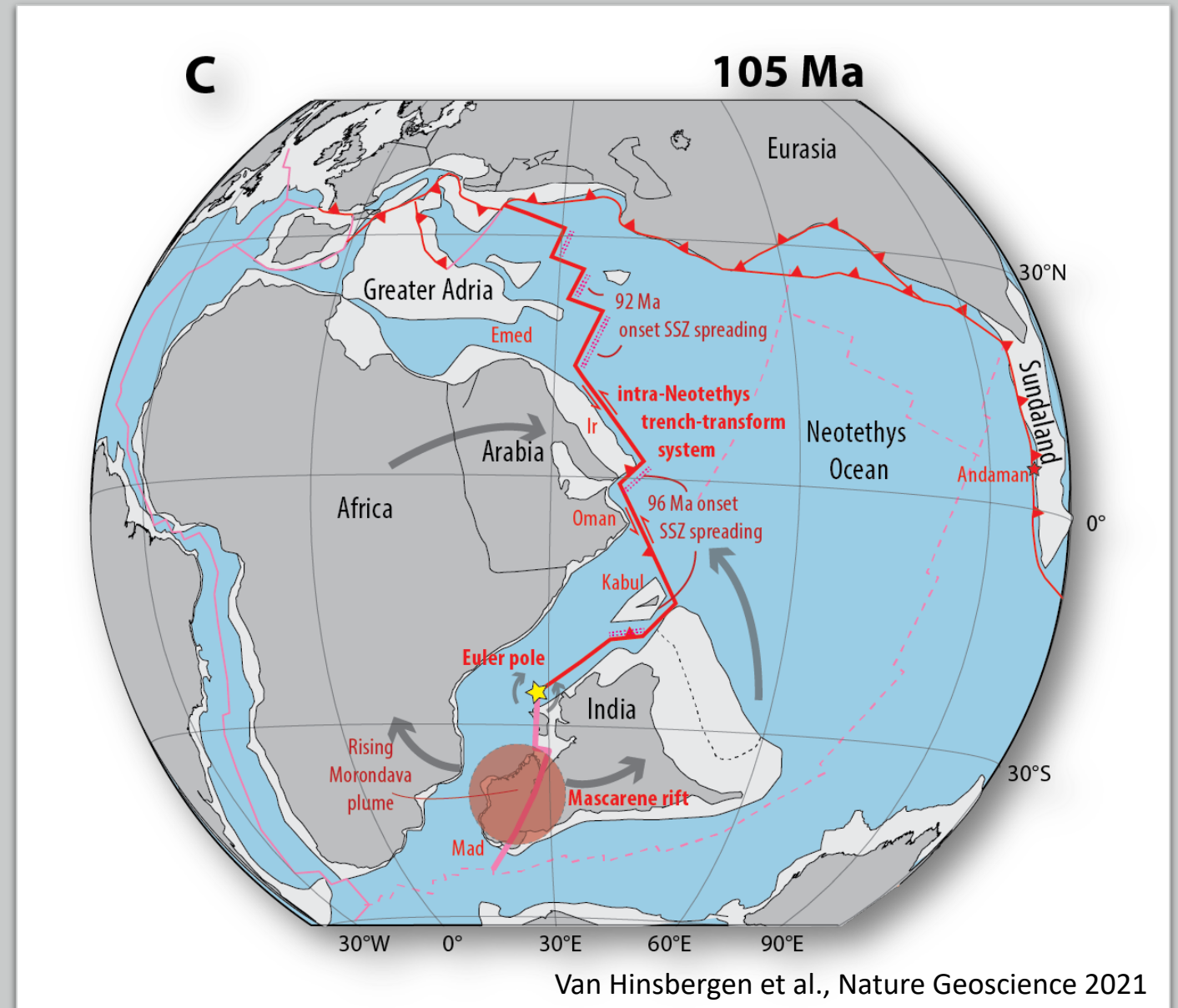
- Neotethys subduction zone runs from triple junction in eastern Mediterranean realm to western Indian ocean
- Transitions into rift/ridge that opened Mascarene Basin
- Subduction initiation predated Morondava LIP emplacement by ~10-15 Ma



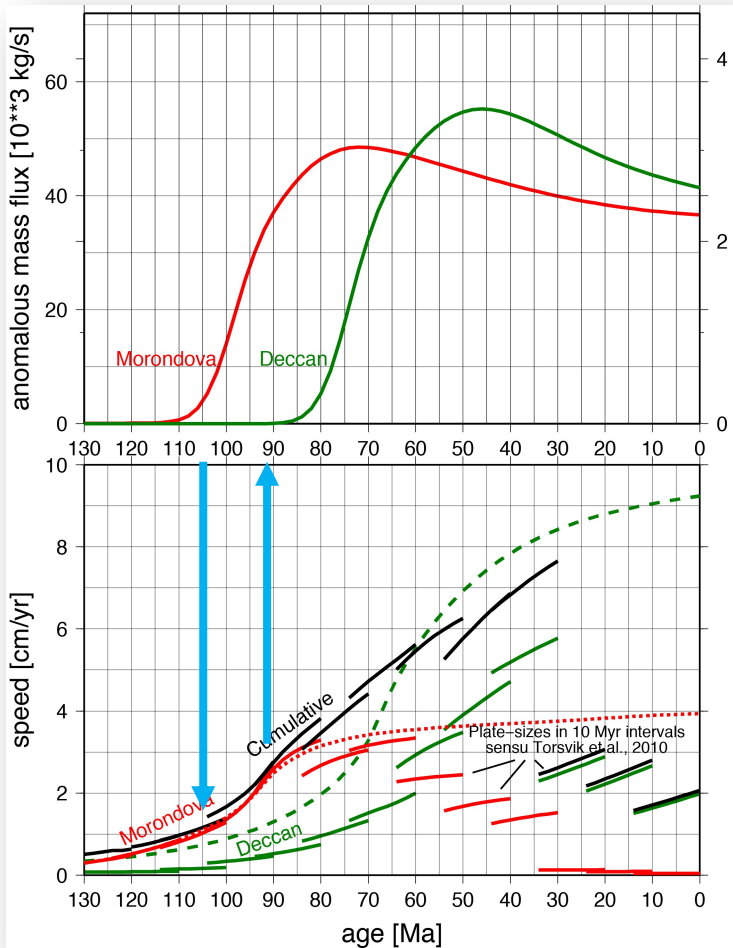
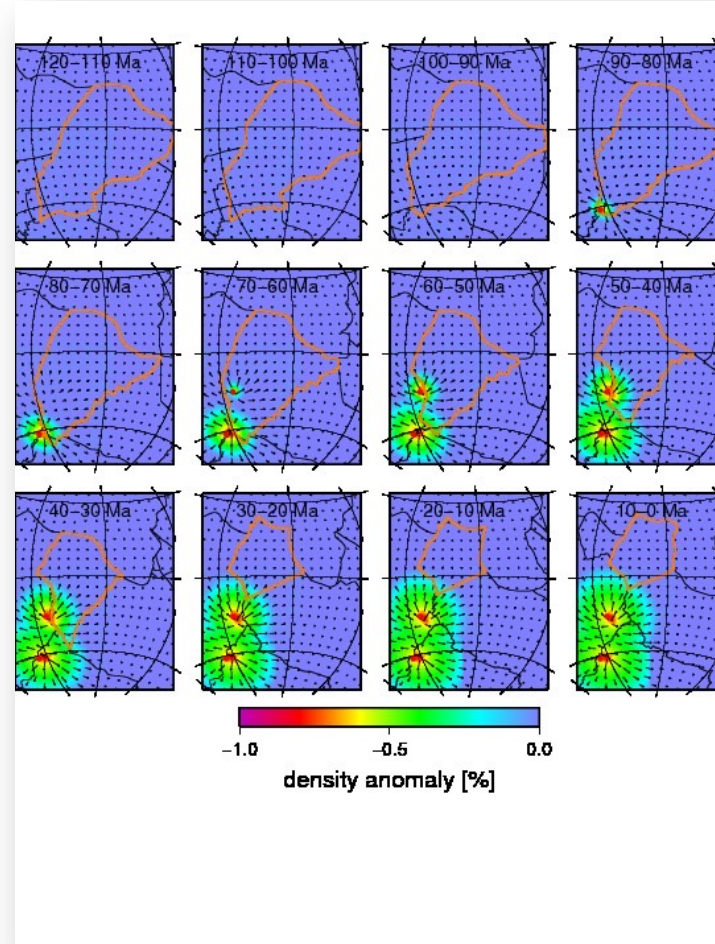
Morondava plume
cause of hemispheric
plate boundary
formation?

To develop slabs long enough
for self-sustaining subduction
(~100 km) requires only ~1° of
India-Africa rotation

Caused by Morondova plume
push?



Plume push: plume head spreading below plate may cause (subtle) acceleration of plate motion



Previous numerical models: plume push may start 10-15 Ma before LIP emplacement

New modeling:
cratonic keels of India
and Africa form pivots

~E-W India-Africa convergence
in Neotethys Ocean plausibly
explained by plume push

Plumes may drive the formation
of hemispheric plate
boundaries

Plumes may have played a role
in the formation of the
initiation of mosaic of tectonic
plates

