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Seismic Activity in Madagascar: Study of the Origins of Moderate Magnitude Earthquakes

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Presentation Date: 10 Sept 2025

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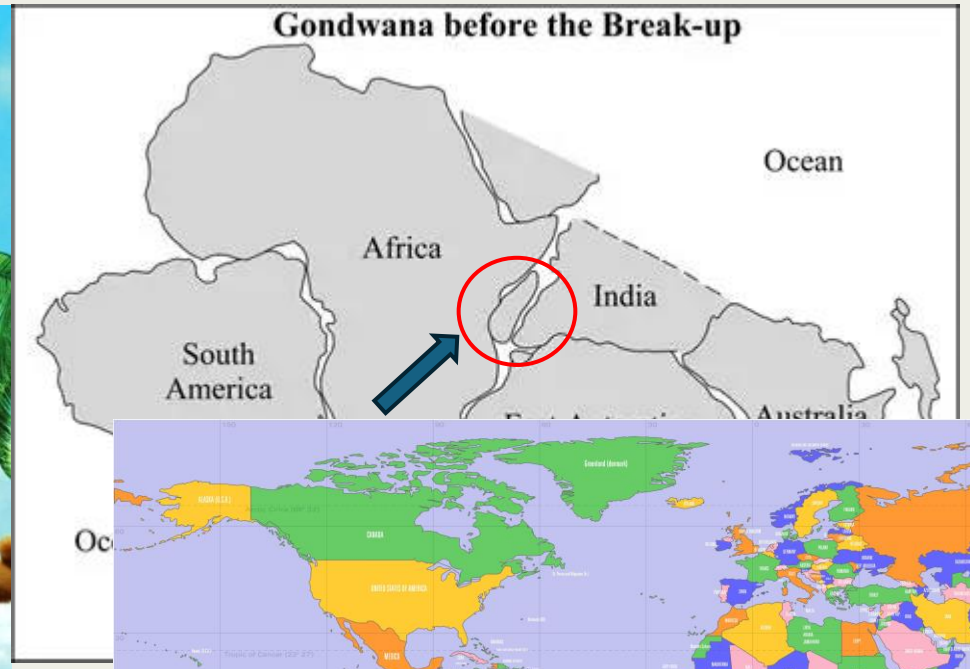
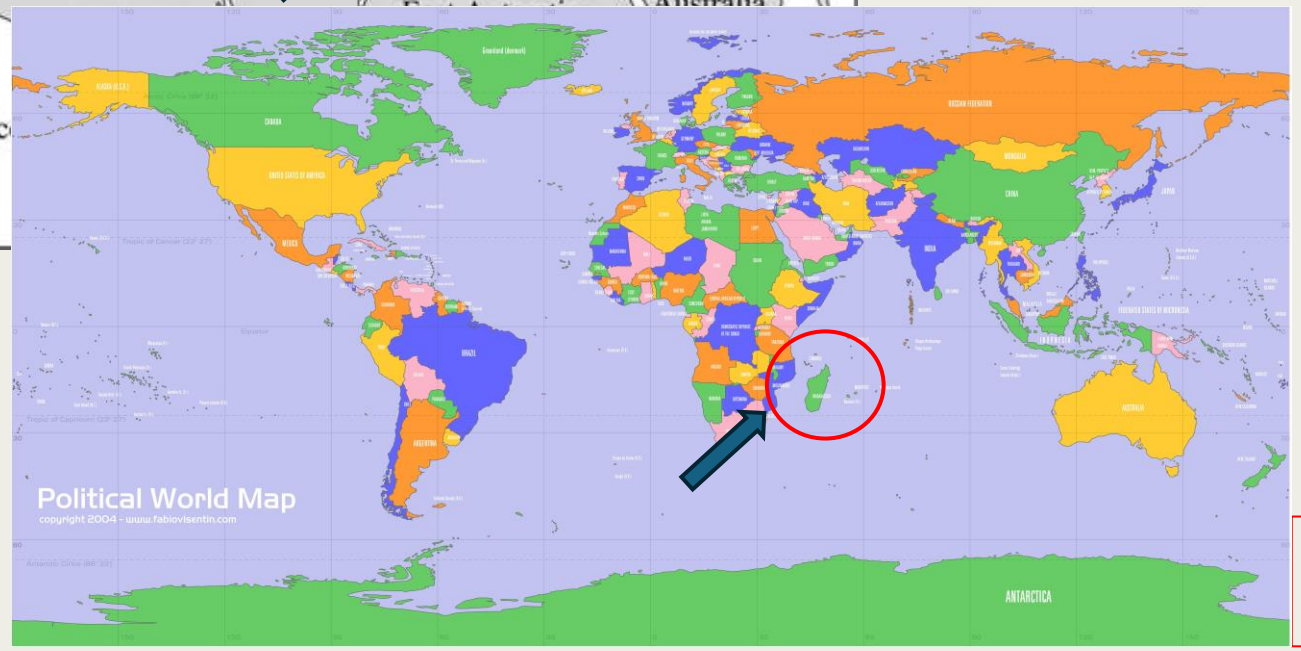
INTRODUCTION





Madagascar : from the breakup of Gondwana between Africa and India.

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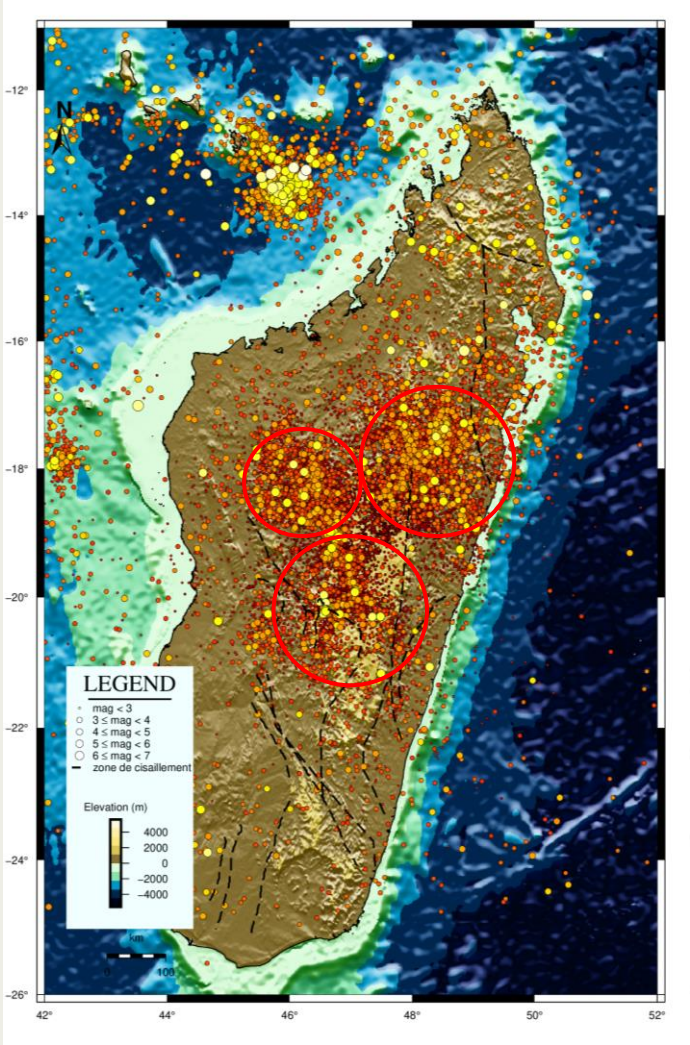
SEISMICITY

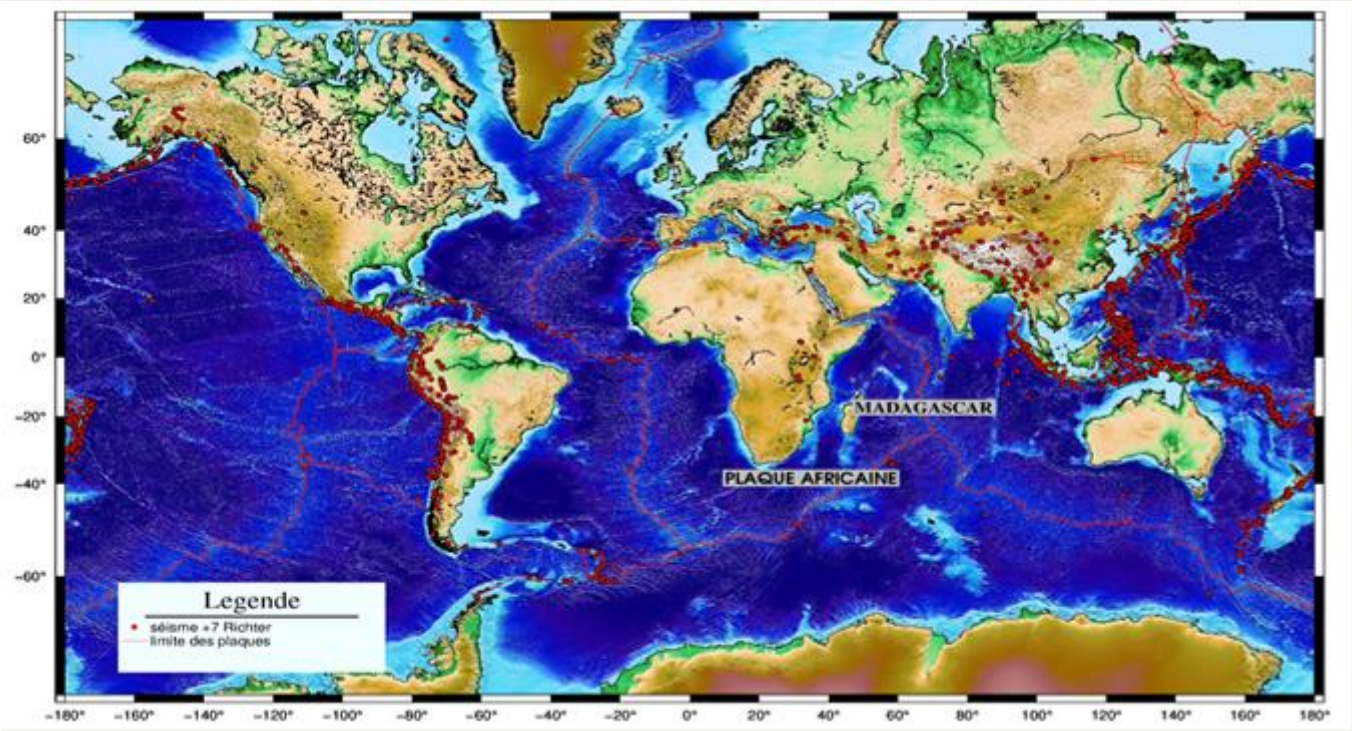
Presence of dense seismic activity in the centre.

In the:

- West
- East
- South

No large event, ml less than 7 in the highland.





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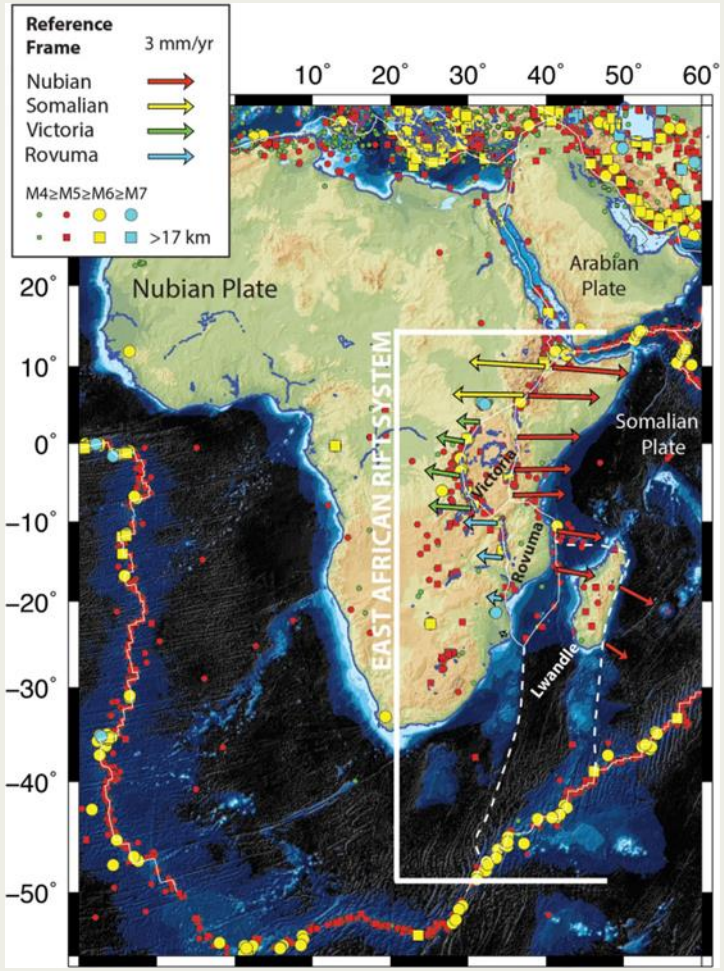
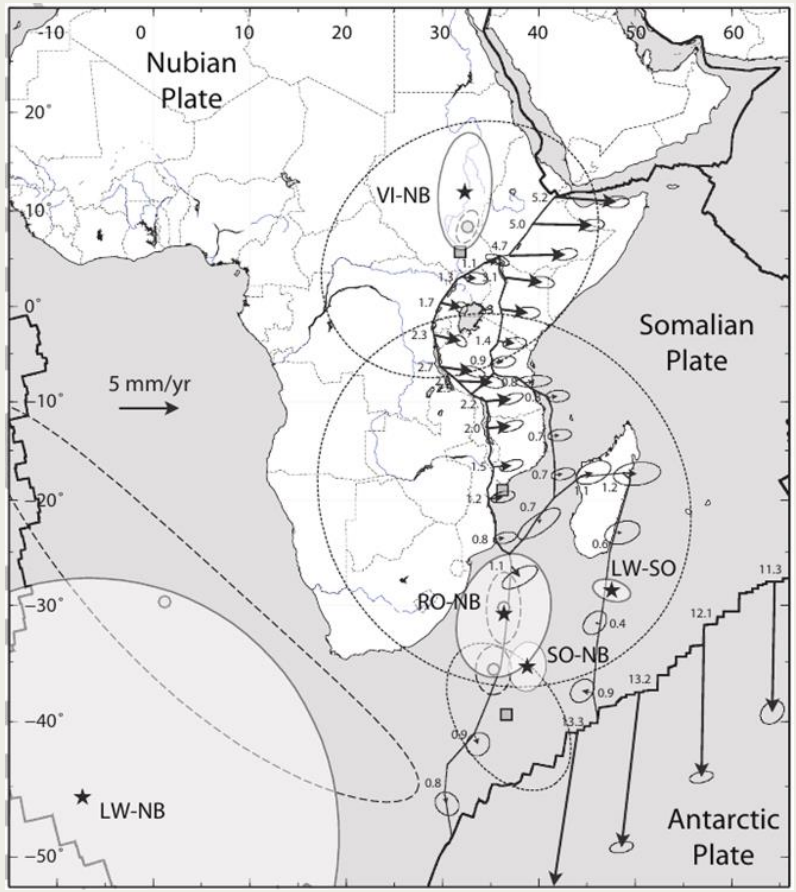
PREVIOUS STUDIES



Stamps et al.



Saria et al

Many theories for Madagascar lithosphere, seismicity, tectonics.

- Presence of microplate (Lwandle) as Hartinady et al. (2002) proposed,
- Stamps et al. (2008, 2018) with the east-west extension in Madagascar
- Saria et al.(2013, 2014) east-west extension in Madagascar
- Rindraharisaona et al. (2013) with the east-west extension,

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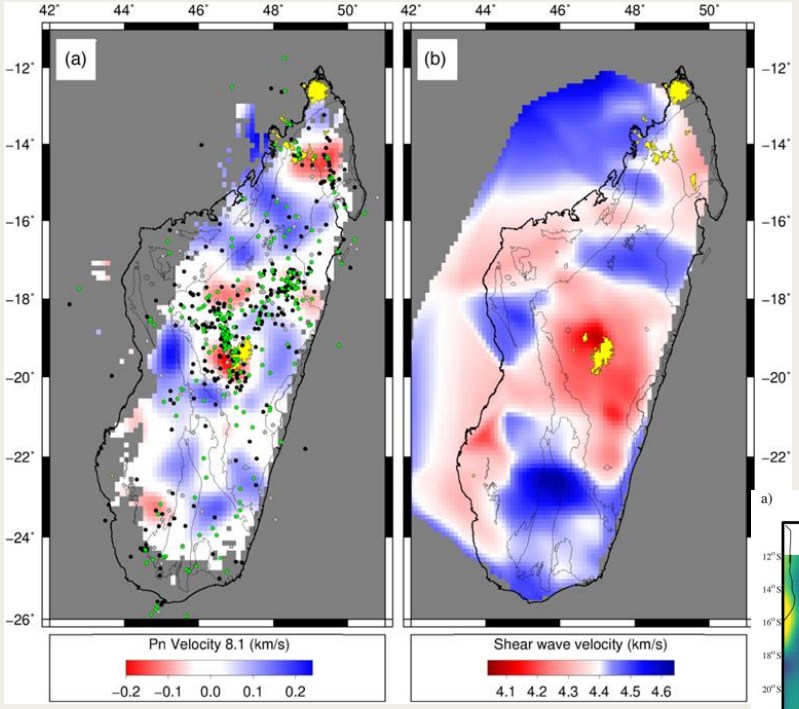
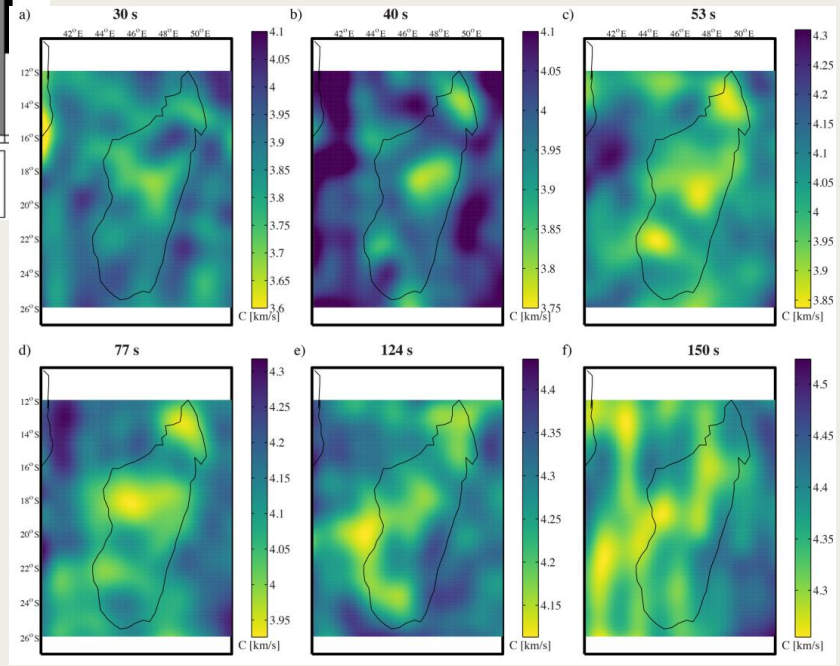


Pn and S velocity by Andriampenomanana et al. (2017)

S velocity by Pratt et al. (2016)



- Rajaonarison et al. (2019): east-west extension caused by mantle flow and upwelling,
- Andriampenomanana et al. (2017) with the structure of the mantle of Madagascar,
- Pratt et al. (2016) with the structure of the lithosphere of Madagascar using Vs,
- And many others

With the thin lithosphere of Madagascar in the centre, it is stretching (deforming) due to many forces acting to it.

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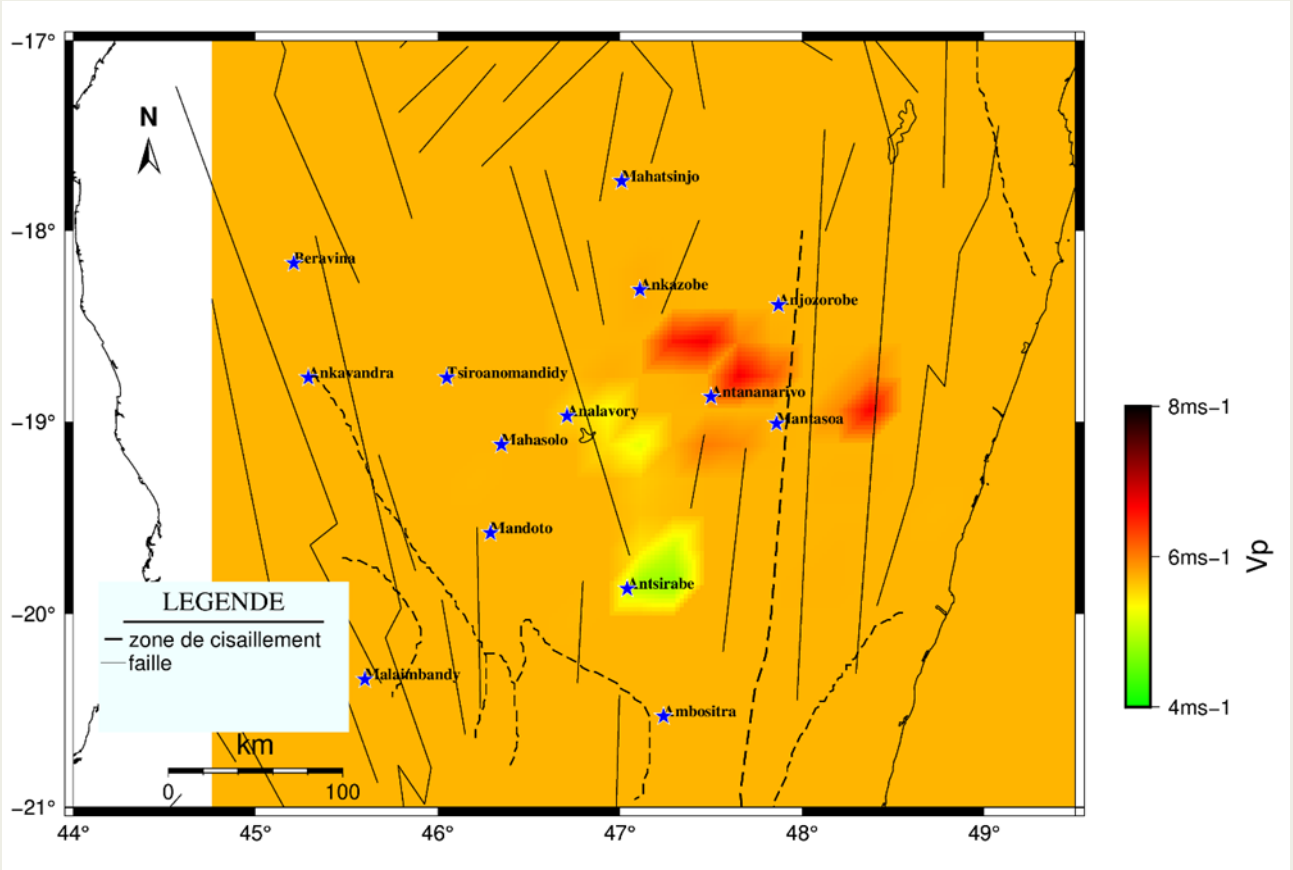

Tomography of P velocity

Thin lithosphere in the centre & low velocity (Vp and Vs) in the volcanic area of the centre,

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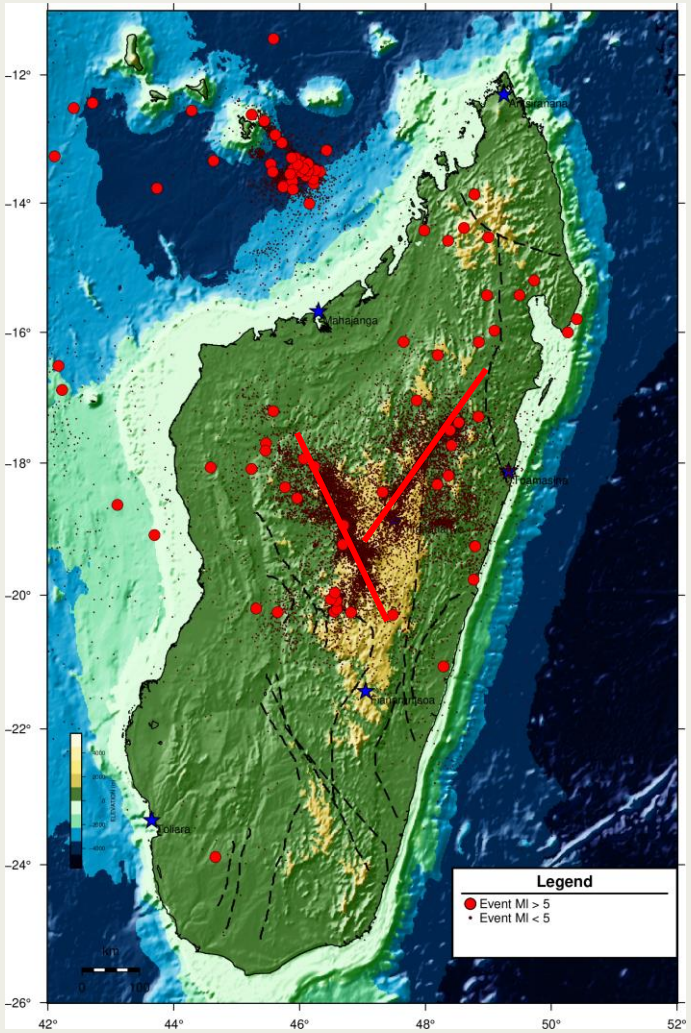
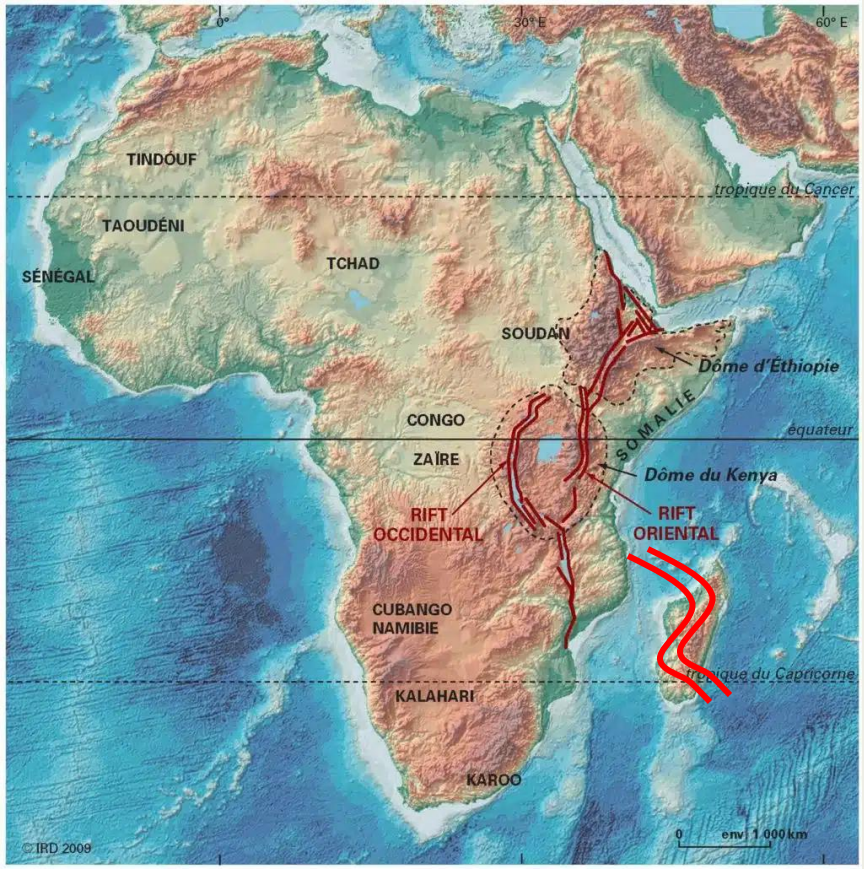


Seismic map with event ml≥5

TECTONICS

2 seismic lines: NW-SE and NE-SE

What really happened? East African Rift still extending or some microplates are moving?



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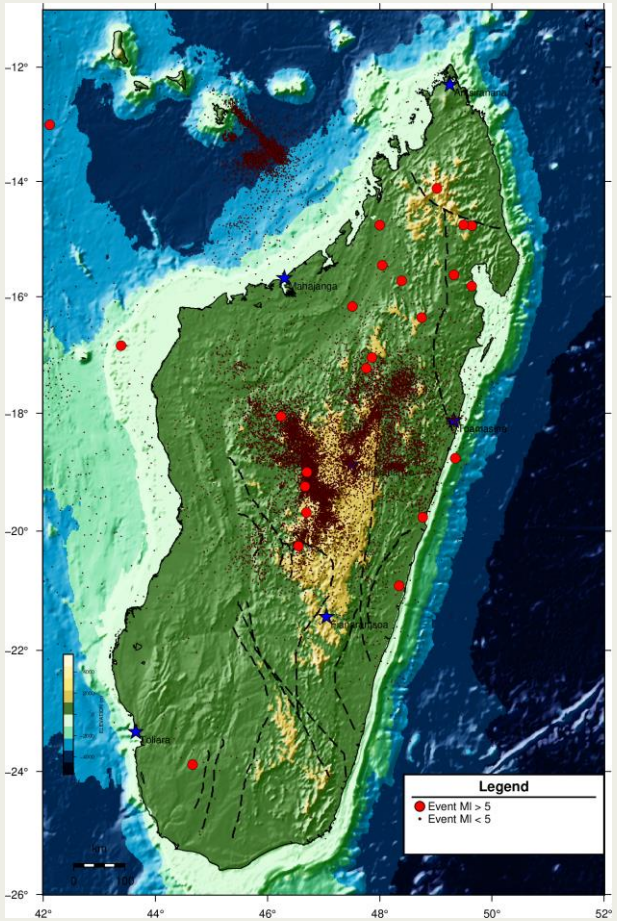
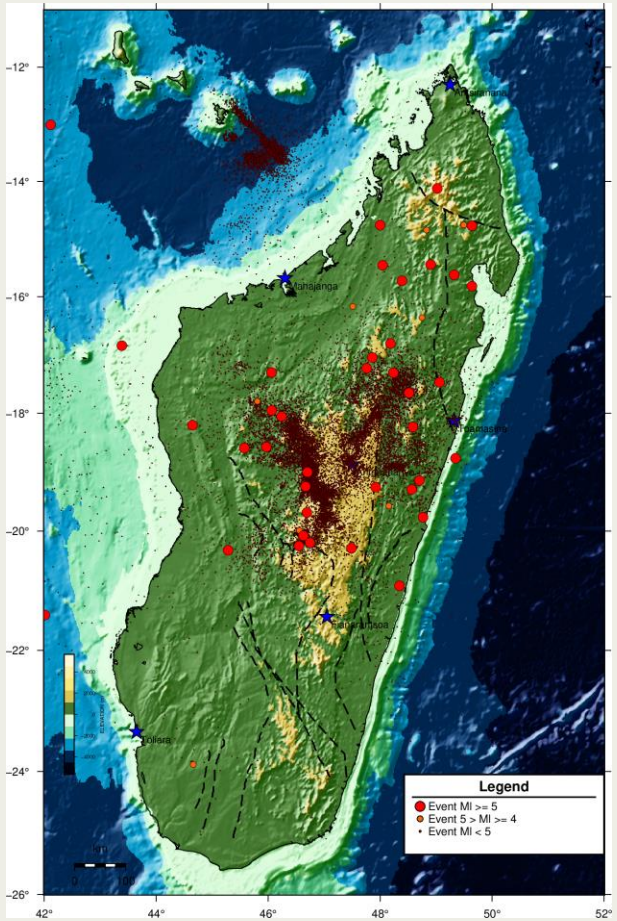
TECTONICS



Seismic map with event ml≥5 after relocation



Seismic map with all event relocated ml≥4

Number of moderate seismic relocated events decreases: some events had ml lesser than 5 after relocation, no waveforms available anymore.

Most of the moderate events are in the centre and in the north part.

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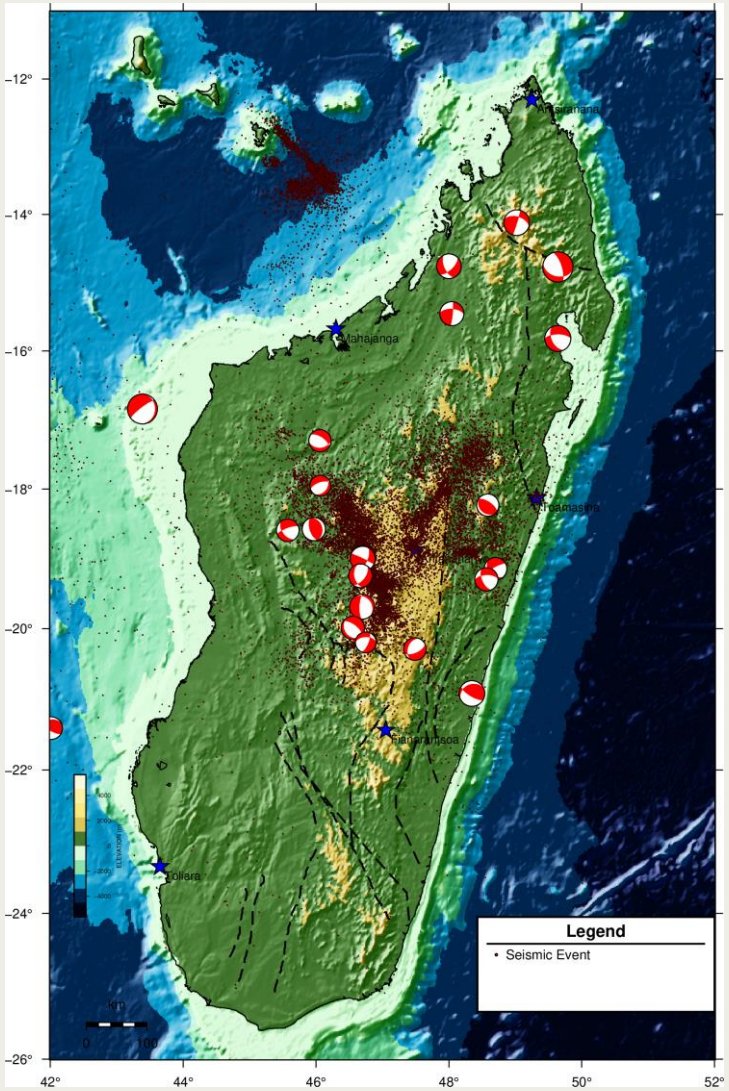

Focal mechanism of event ml≥5 after relocation

TECTONICS

Most of the earthquakes are due to extension to the east-west as other study suggested.
Few are strike-slip and thrust but the majority are oblique or normal fault movements.

The east-west extension is not in the centre only but extend to the north.

Which theory is true: extension of the EAR system or existence of microplate or both?

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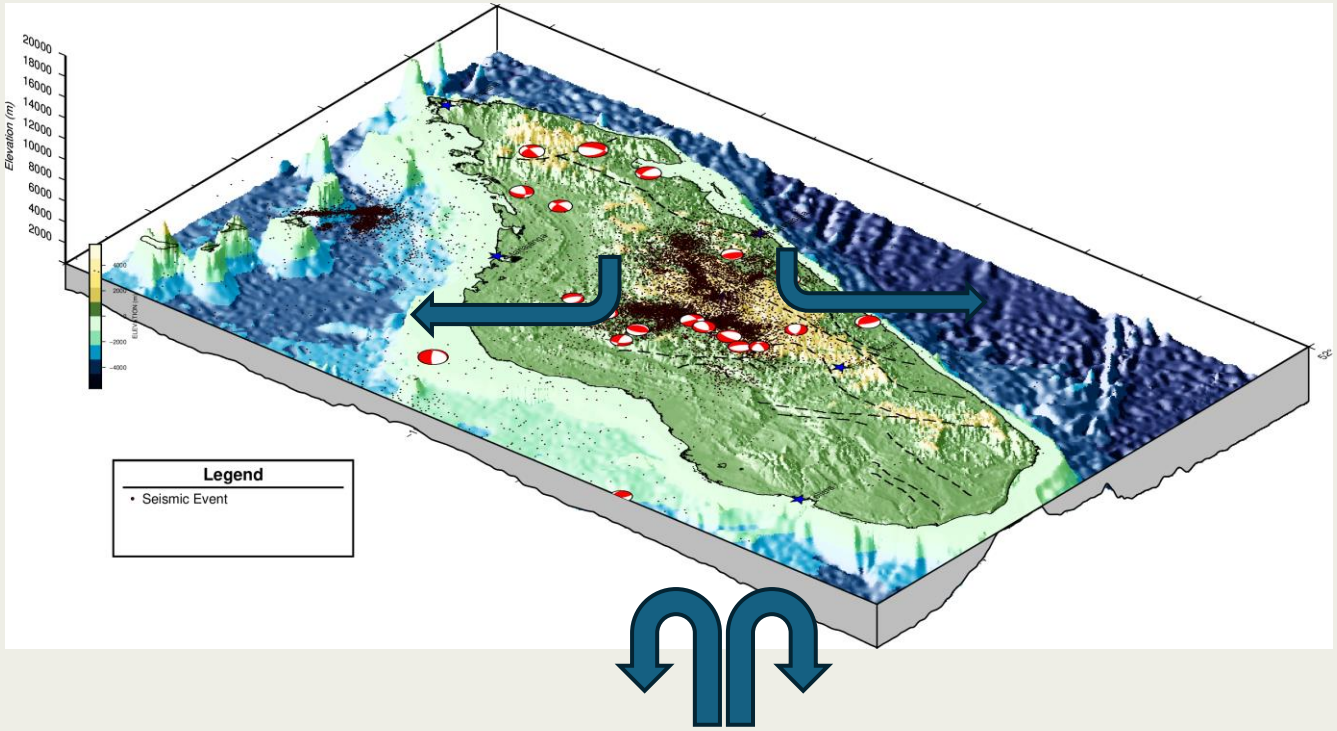
TECTONICS



Focal mechanism of event ml≥5 after relocation

Madagascar lithosphere is deforming like a toasting bread in the oven

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CONCLUSION

Despite these studies, it is unclear what really happening under Madagascar.
They are just theories from the results of many studies.

The only thing we can say is that there is really east-west extension in the lithosphere of Madagascar making it thin. These moderate events are caused by this extension (directly or indirectly)

The reactivation of volcanoes in Madagascar can not be excluded proved by the low velocity in the volcanic area and the continuous activity (seismic, forces, convection, …)

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THANK YOU!!!!

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