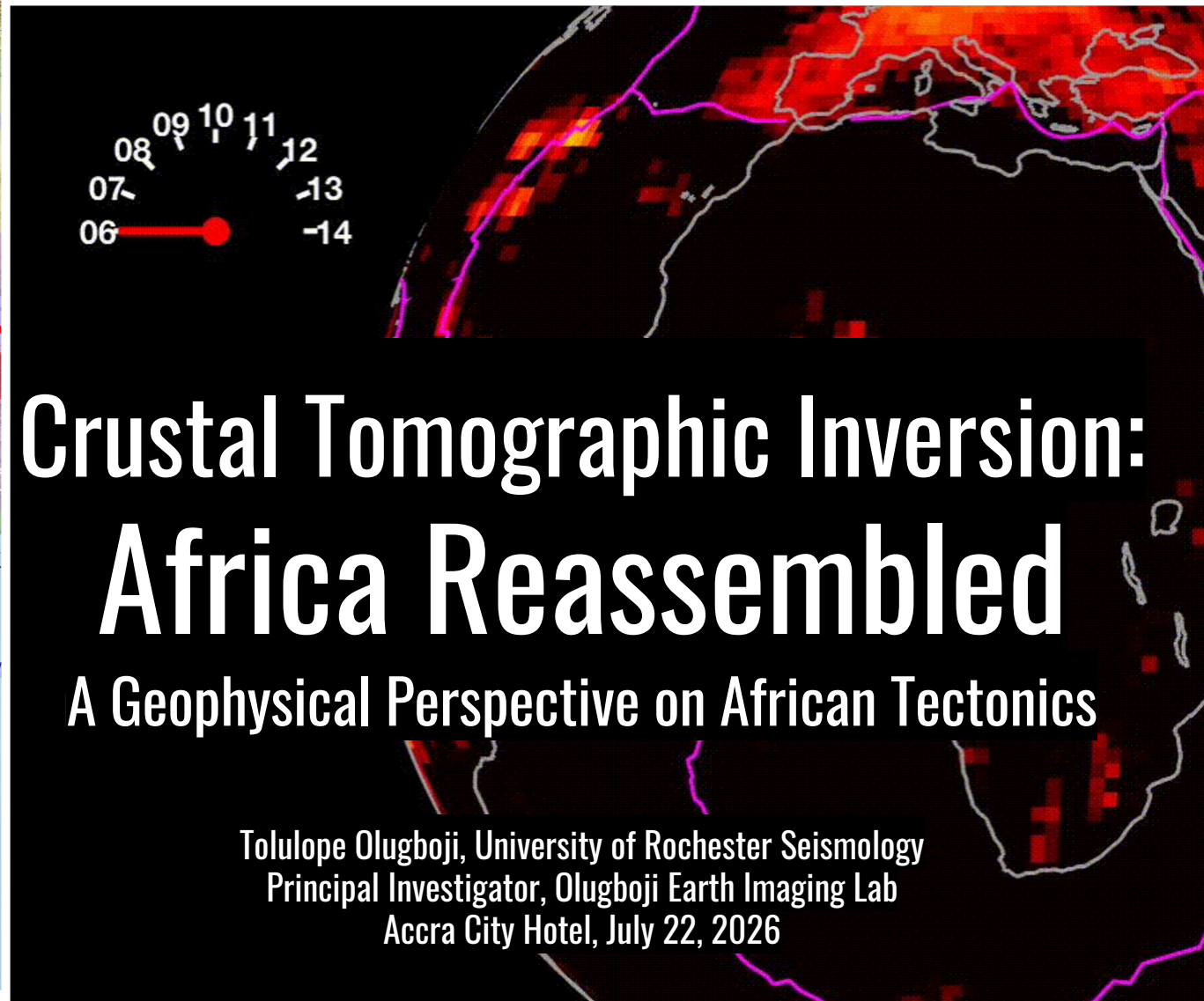


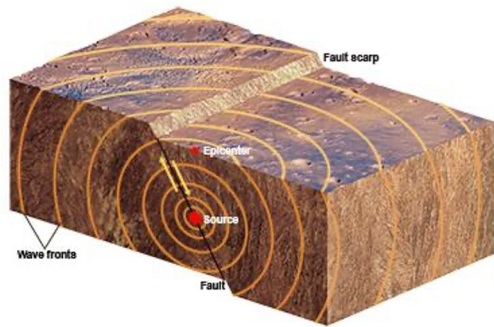
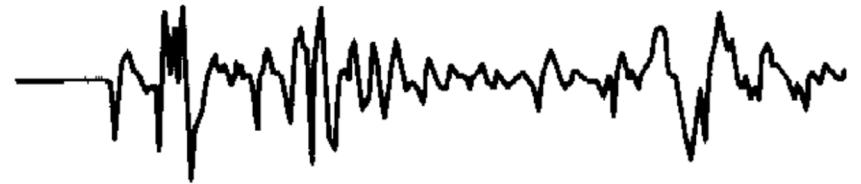
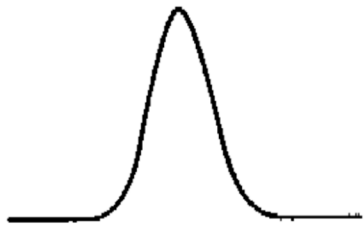


III Parts

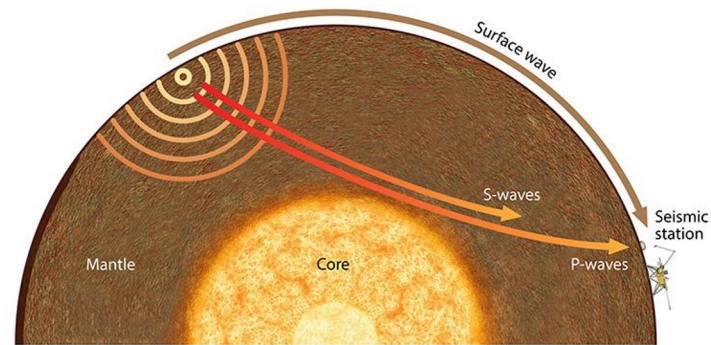
- 1: Planetary Imaging with Seismology
- 2: Africa's Crust with Noise
- 3: Outreach and Opportunities

Planetary Vibrations (Seismology)

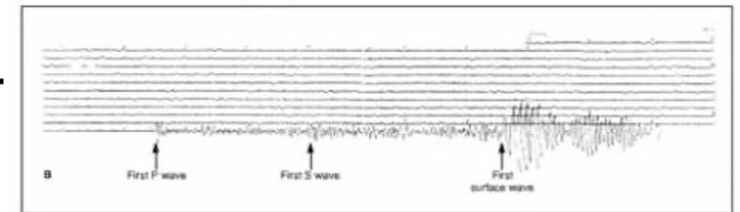
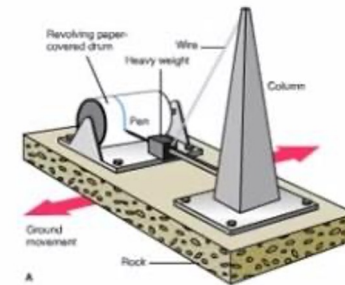
Study of elastic waves (ground vibrations) that propagate through planetary interiors – gives info on the medium (rocks) through which the waves propagate as well as info about the source that created the waves



Origin time



Travel time



Arrival time

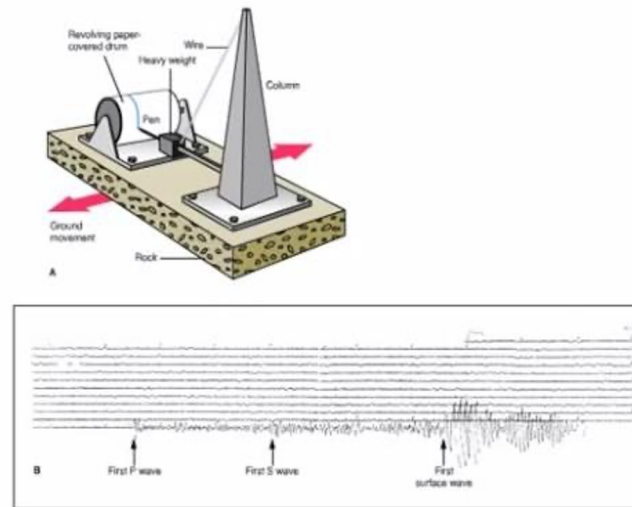
Milestones in Seismology

Oldest Devices



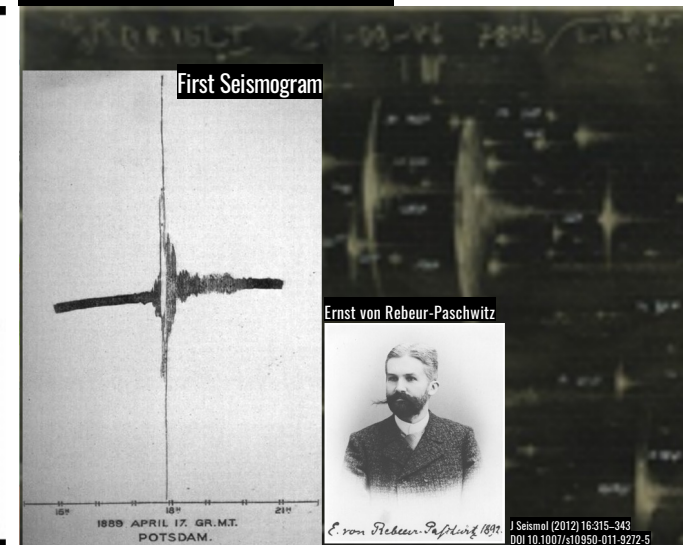
China, 132 BC (Zhang)

Instruments + Recording Device



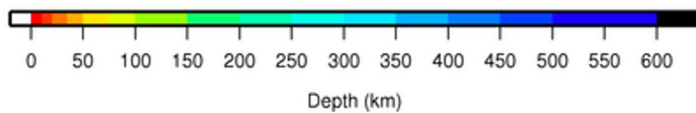
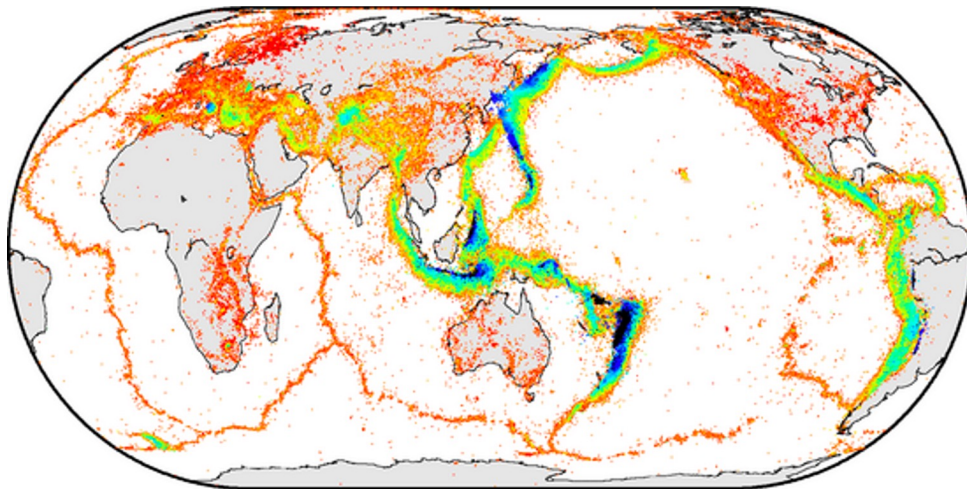
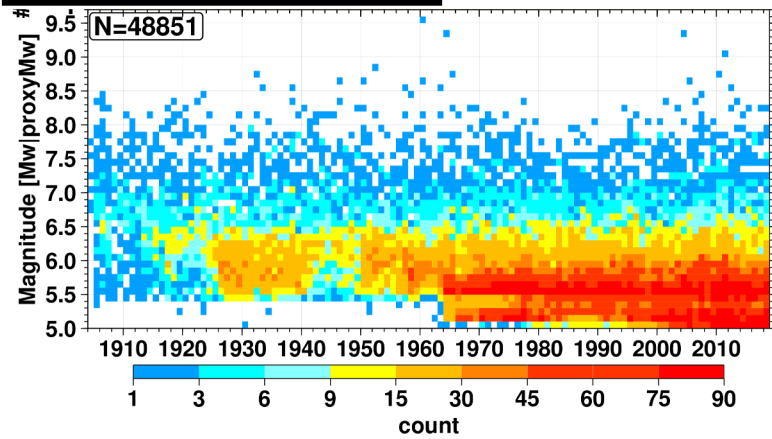
Spring-mass Pendulum

Permanent Records

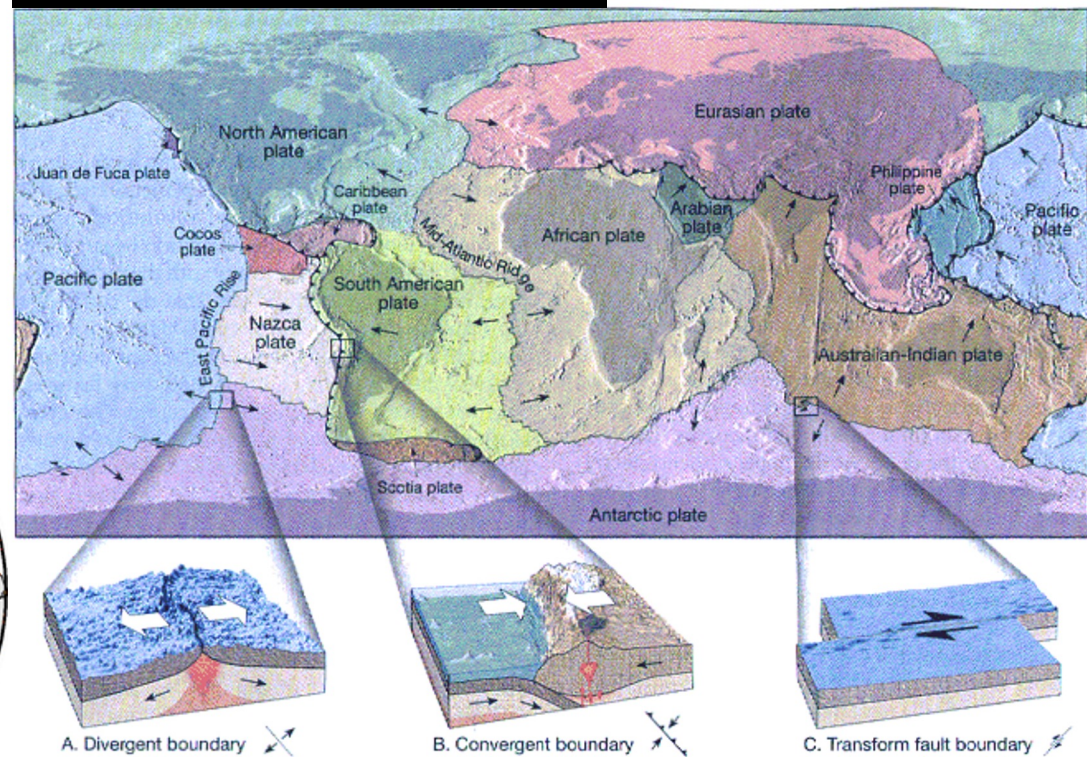


Potsdam Germany, 1889

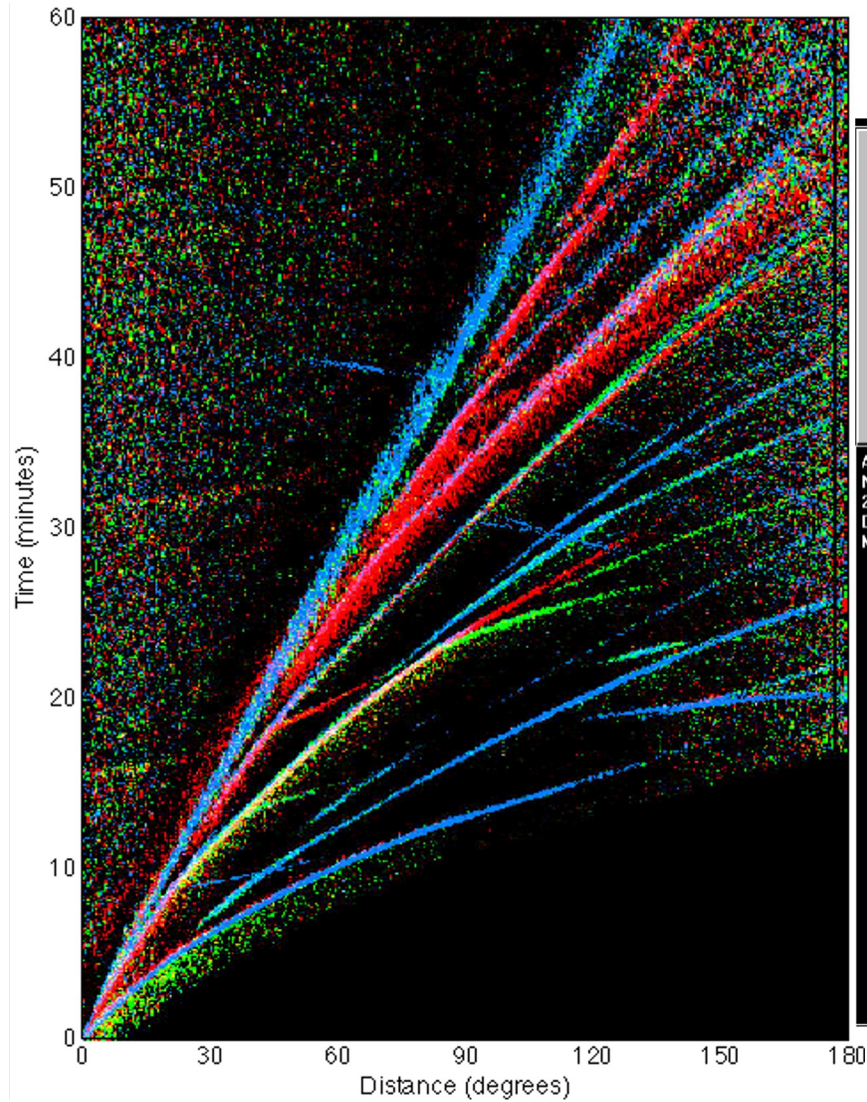
Location + Source



= Plate Tectonics

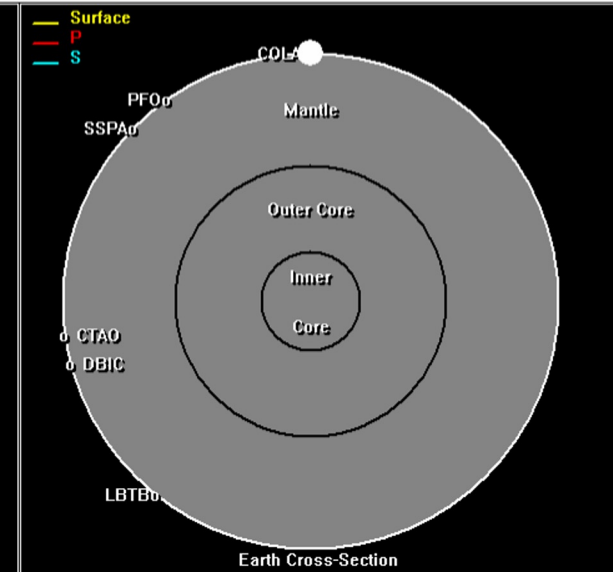
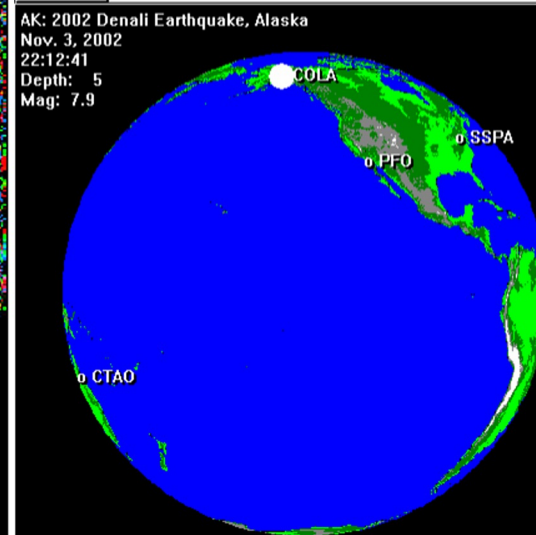


Global Coverage = Earth Structure



Seismic Waves generated by the 2002
Denali Fault, Alaska, Earthquake

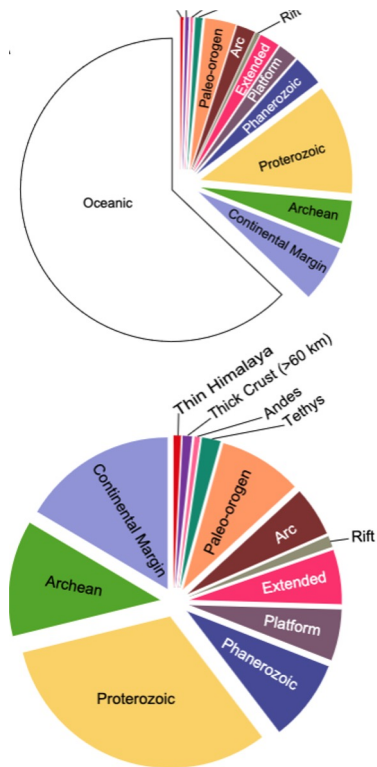
Screen capture from Alan Jones' Seismic
Waves program, which is freely available
from his web site.



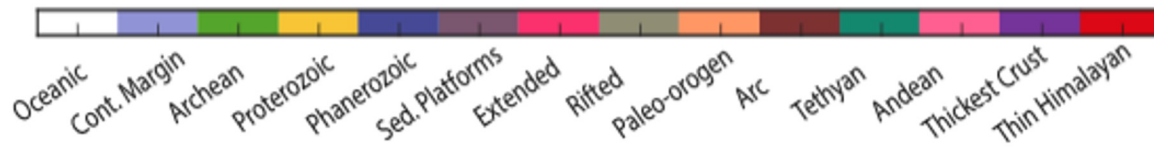
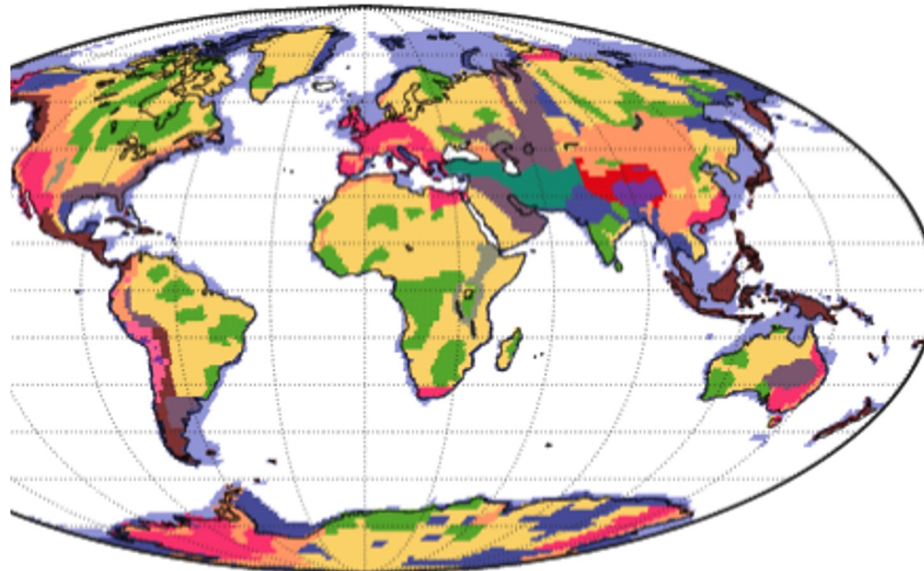
II:

Africa's Crust from Noise Maps

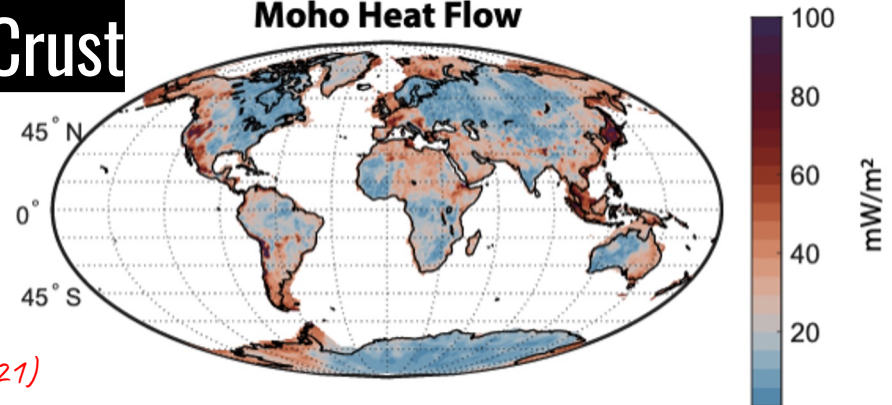
Structure & Composition of the Deep Crust



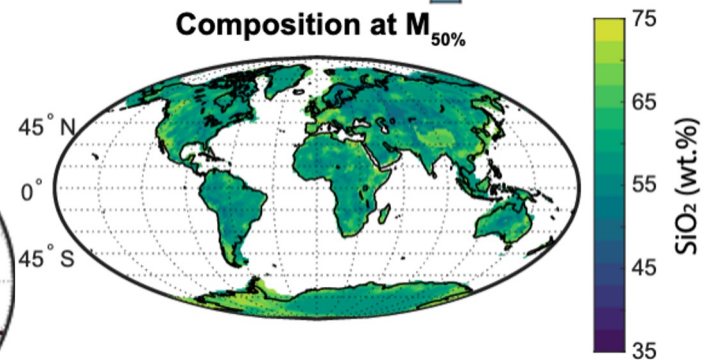
Sammon, McDonough & Mooney (Essoar, 2021)



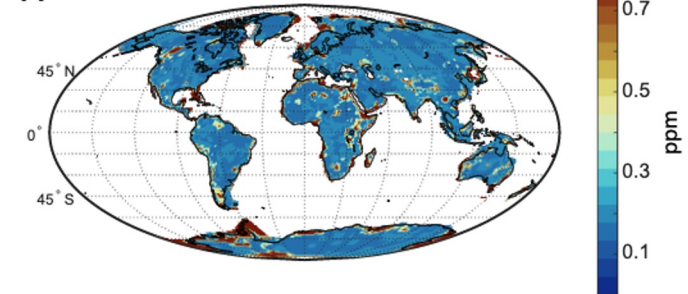
Moho Heat Flow



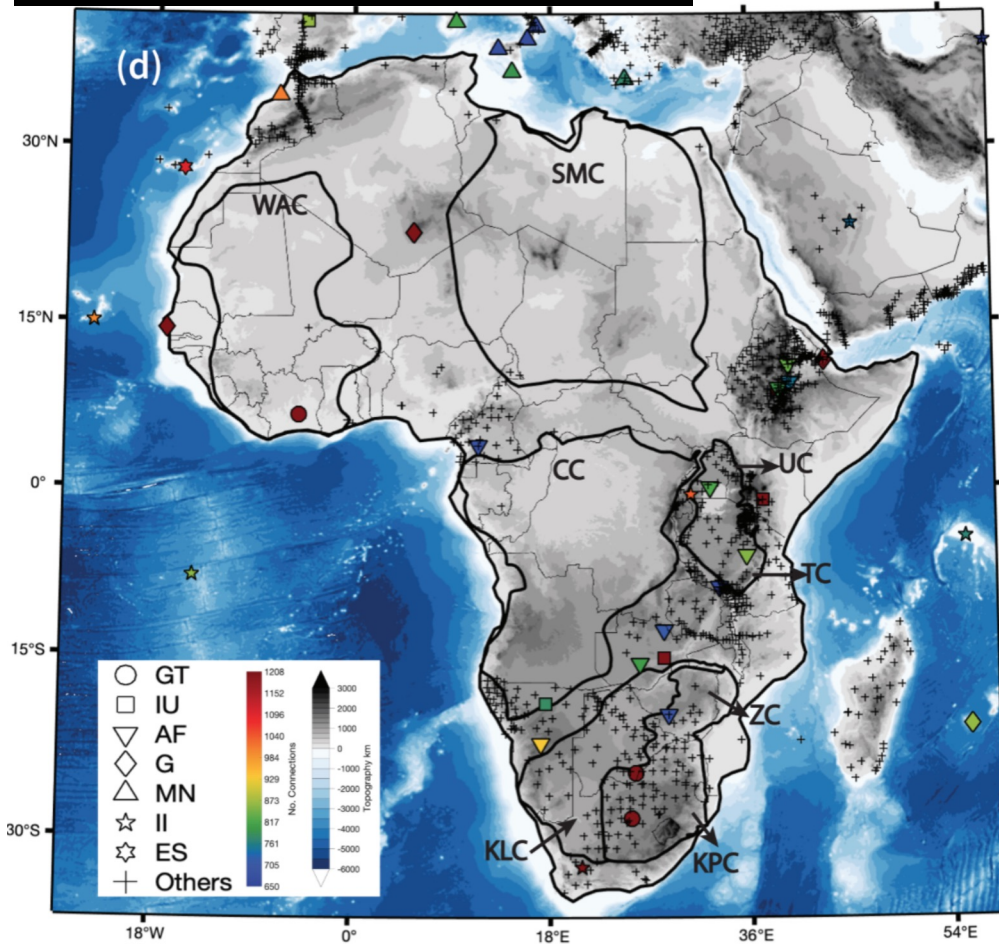
Composition at $M_{50\%}$



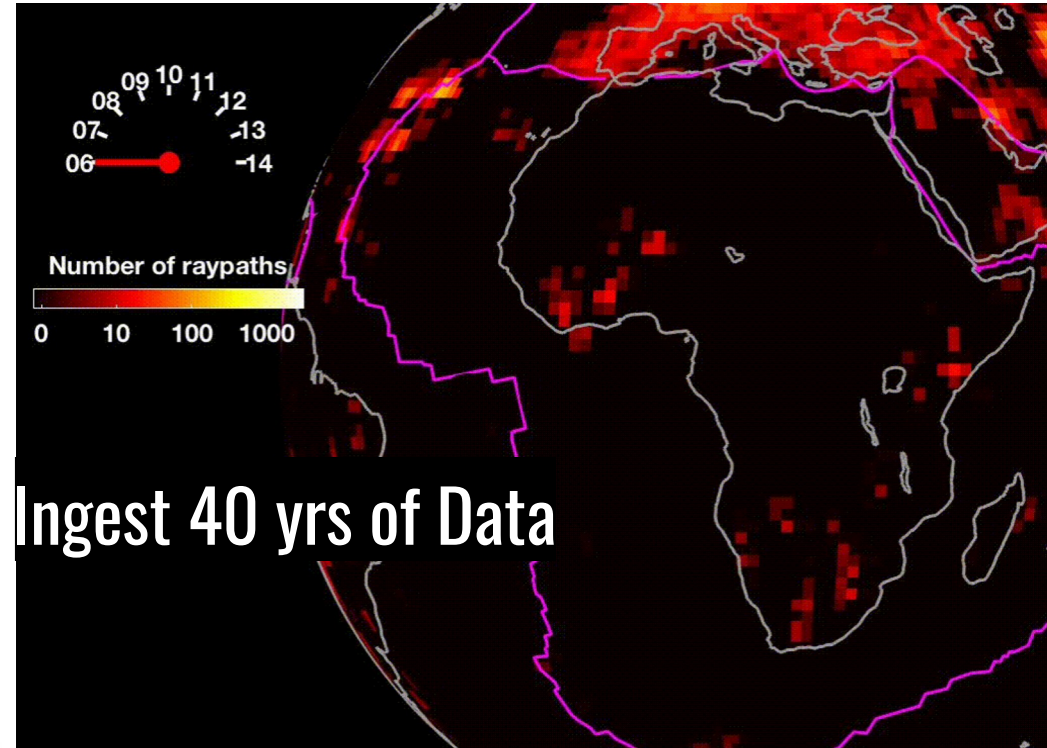
U Composition at $M_{85\%}$



Our Contribution: ADAMA

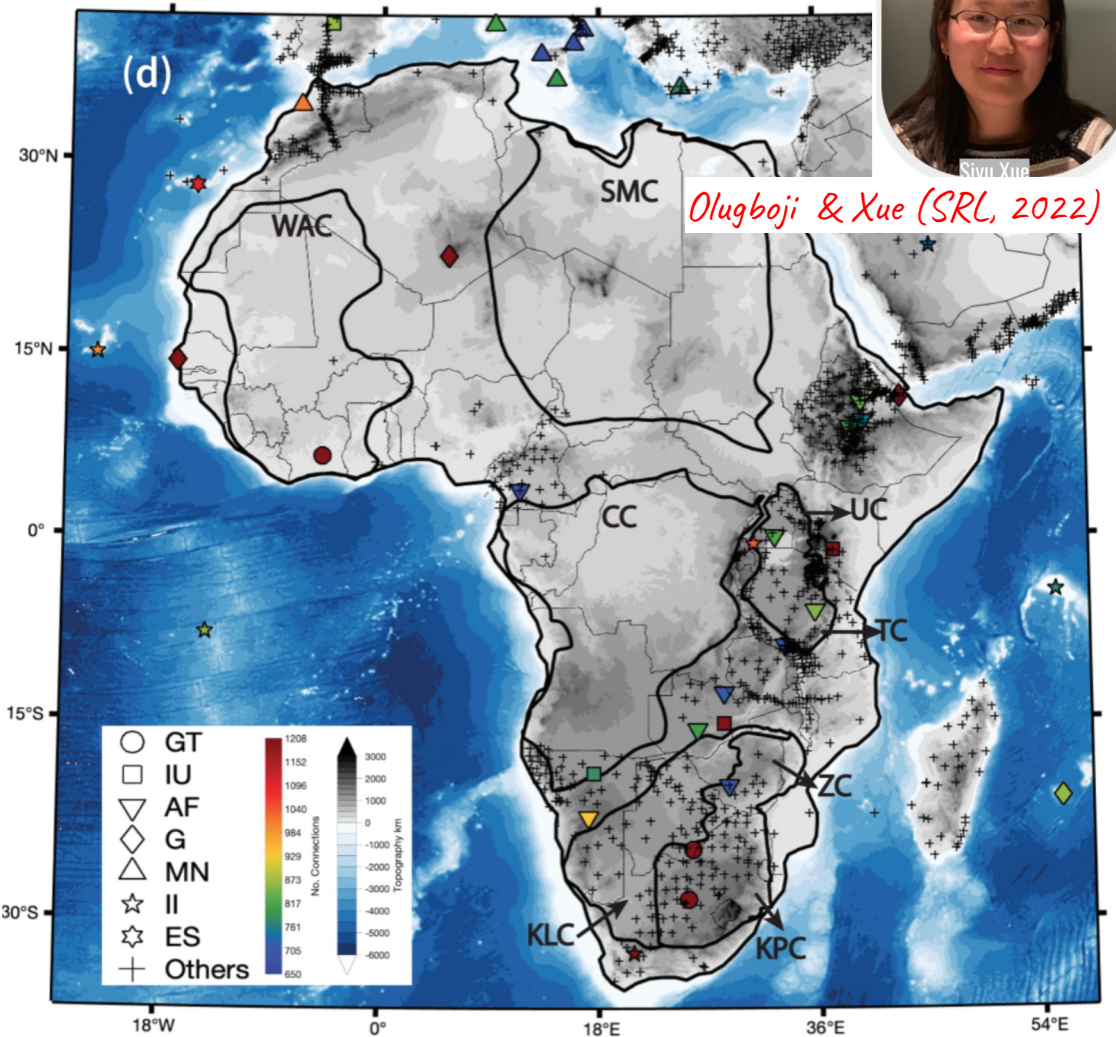
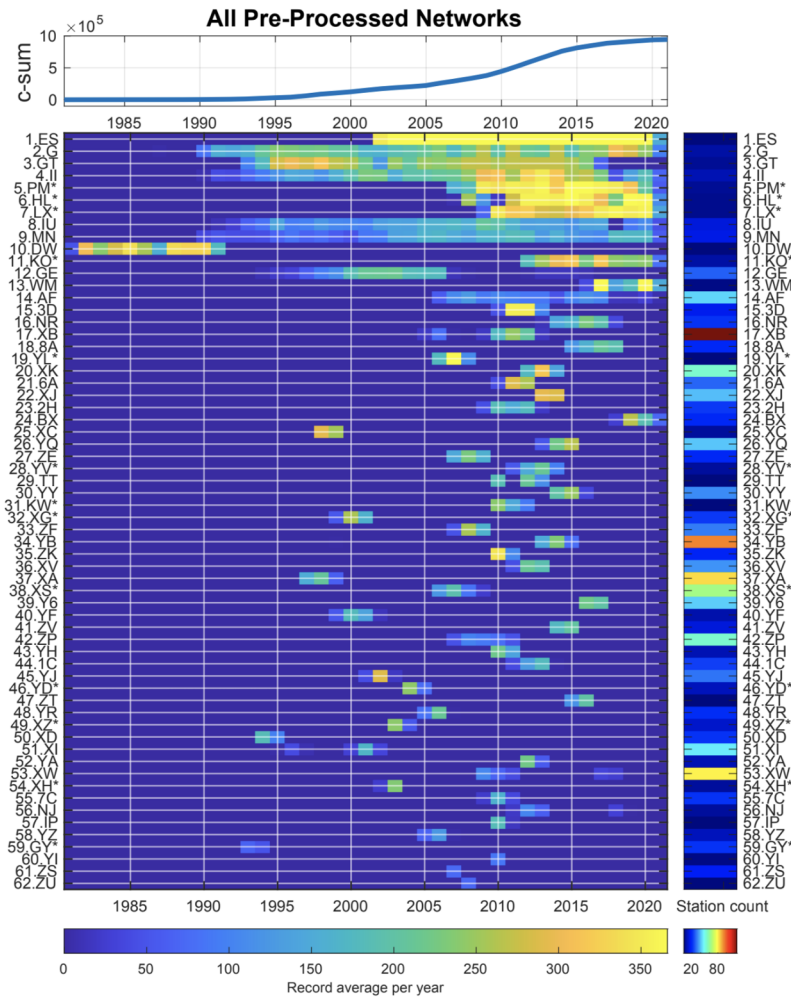


Olugboji & Xue (SRL, 2022)



← Improve Data Coverage

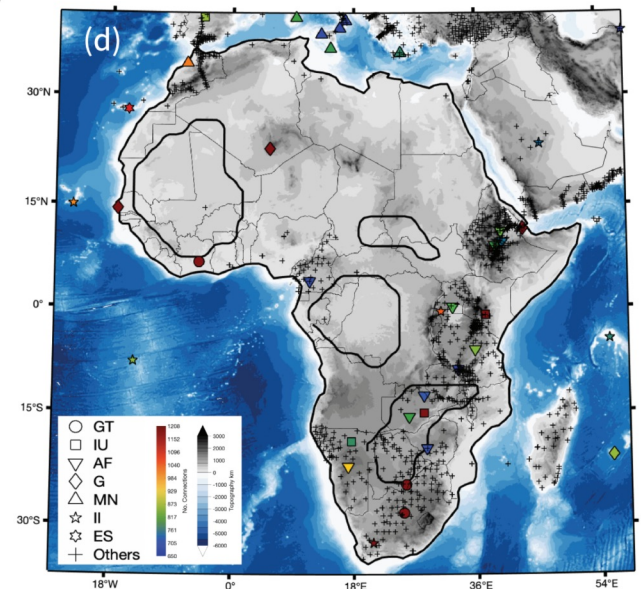
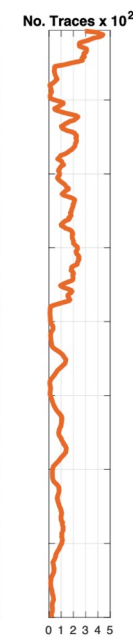
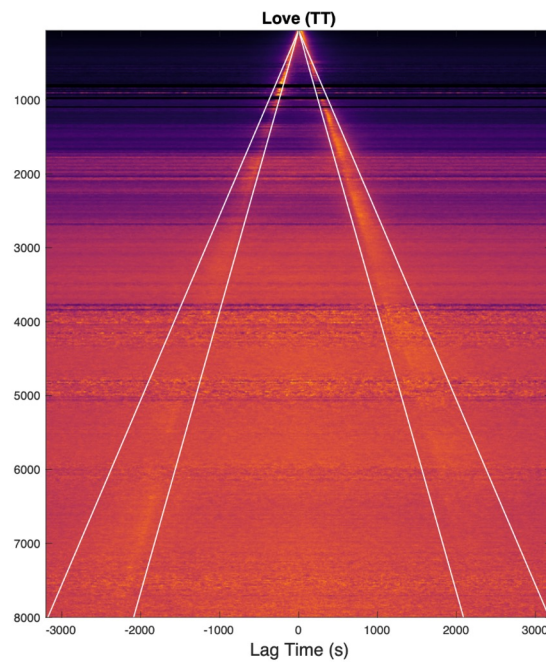
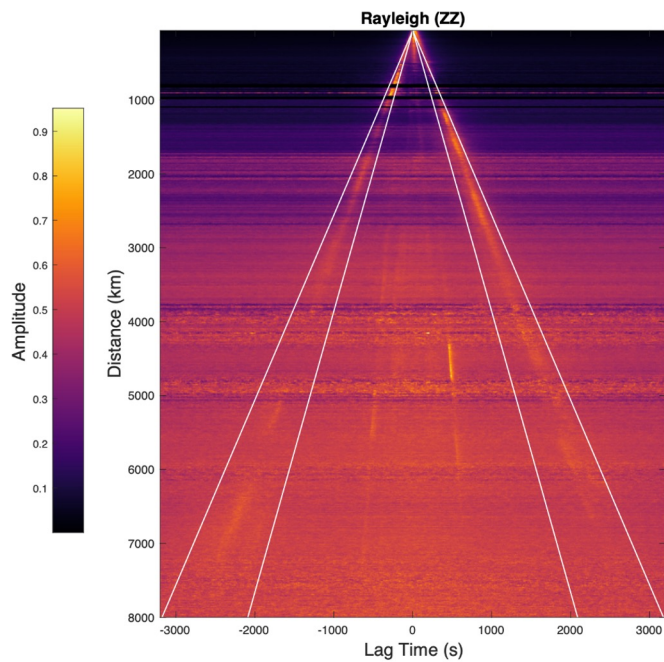
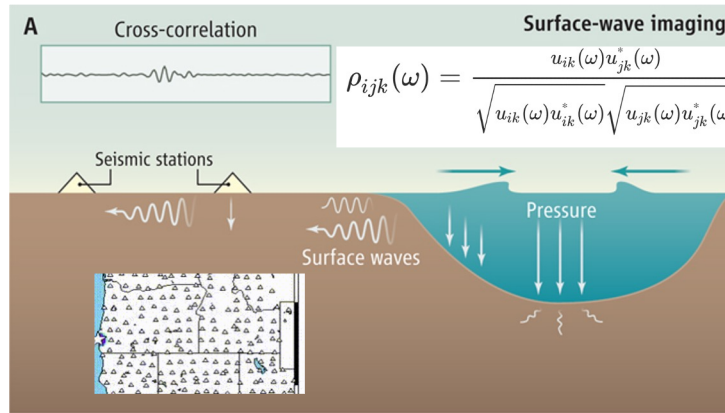
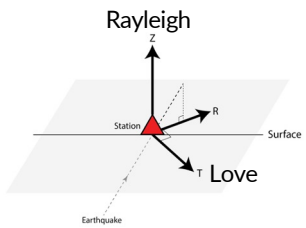
Waveform Catalog: 1 Million Daily Records



Olugboji & Xue (SRL, 2022)

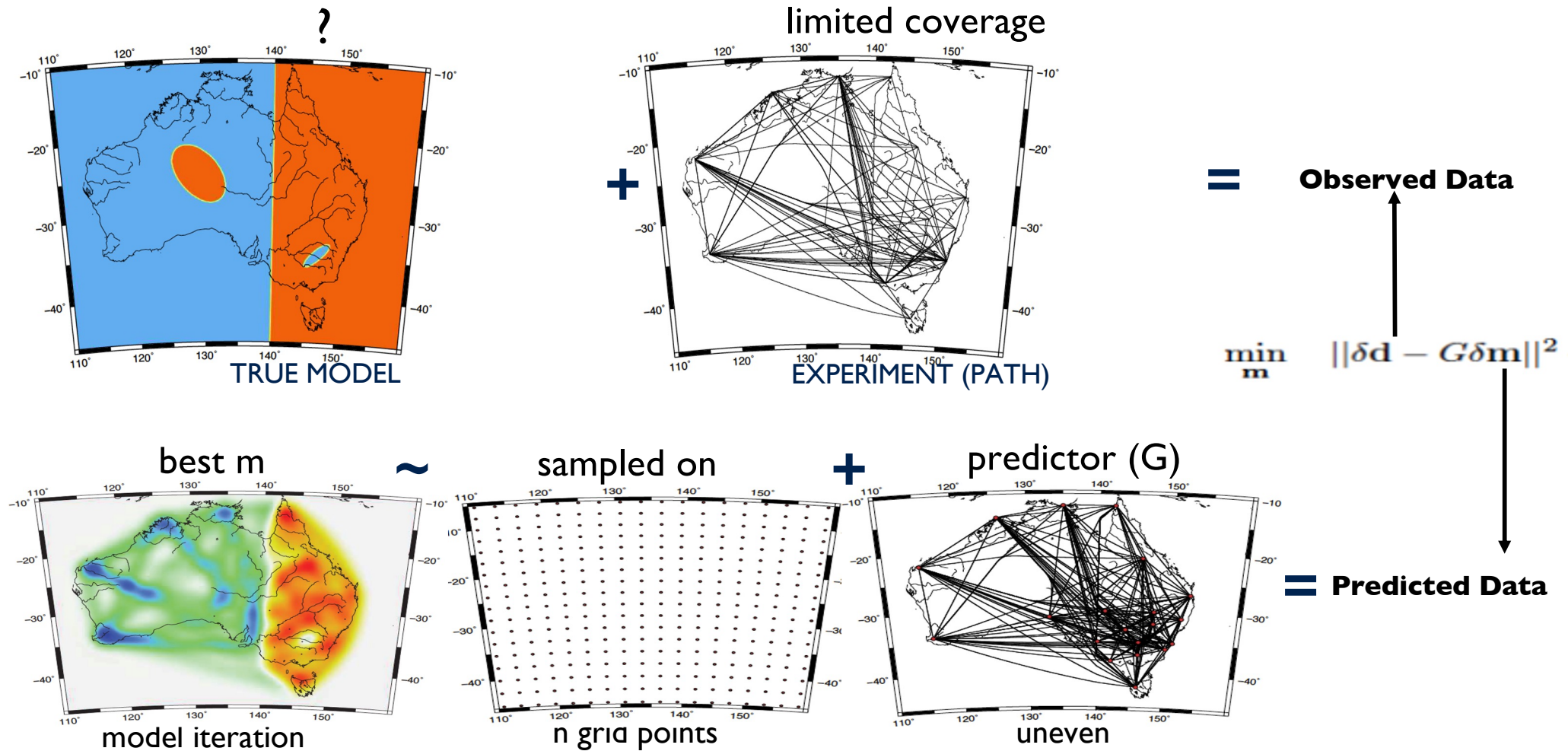
Waves from Noise

Rayleigh + Love Surface Waves



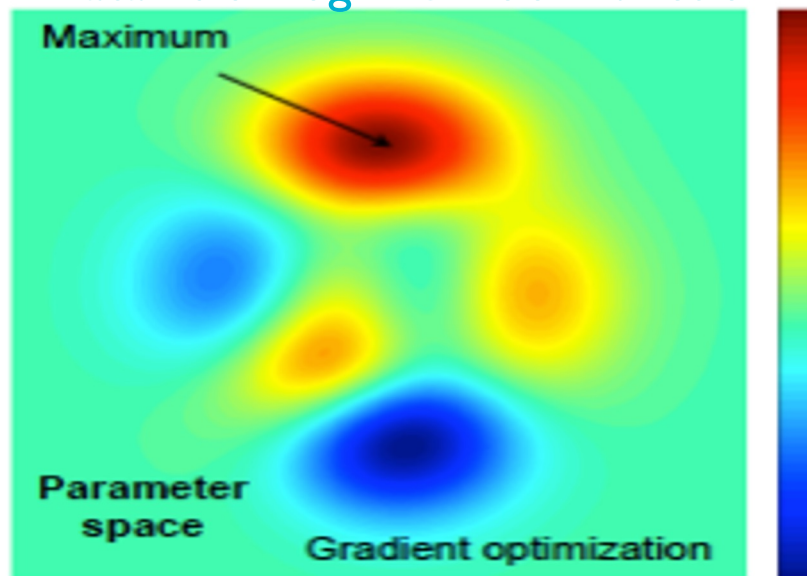
Methodology

Tomography 101: Solving for an Earth Model (Velocity Maps)



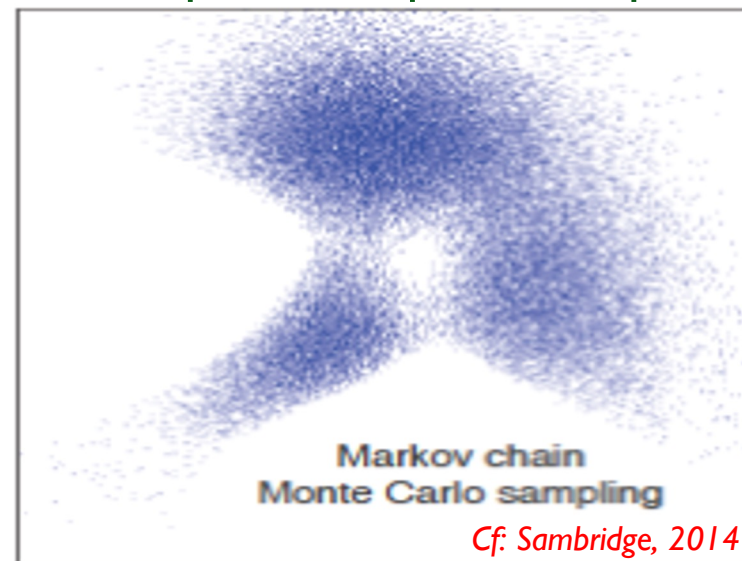
Optimization vs Probability

Data fit or log likelihood function



$$\phi(\mathbf{m}) = \|\mathbf{d} - \mathbf{g}(\mathbf{m})\|$$

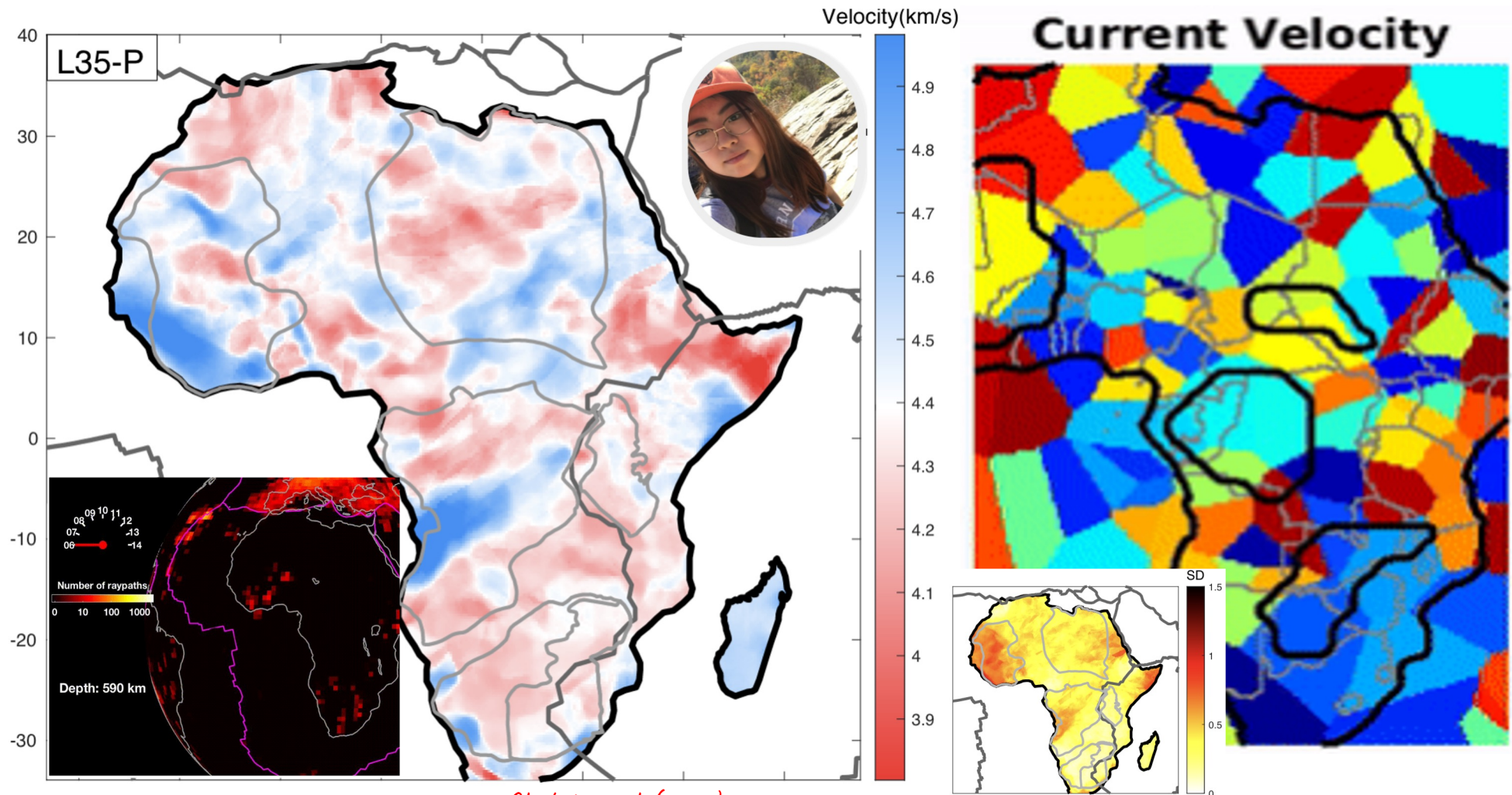
Samples from posterior pdf



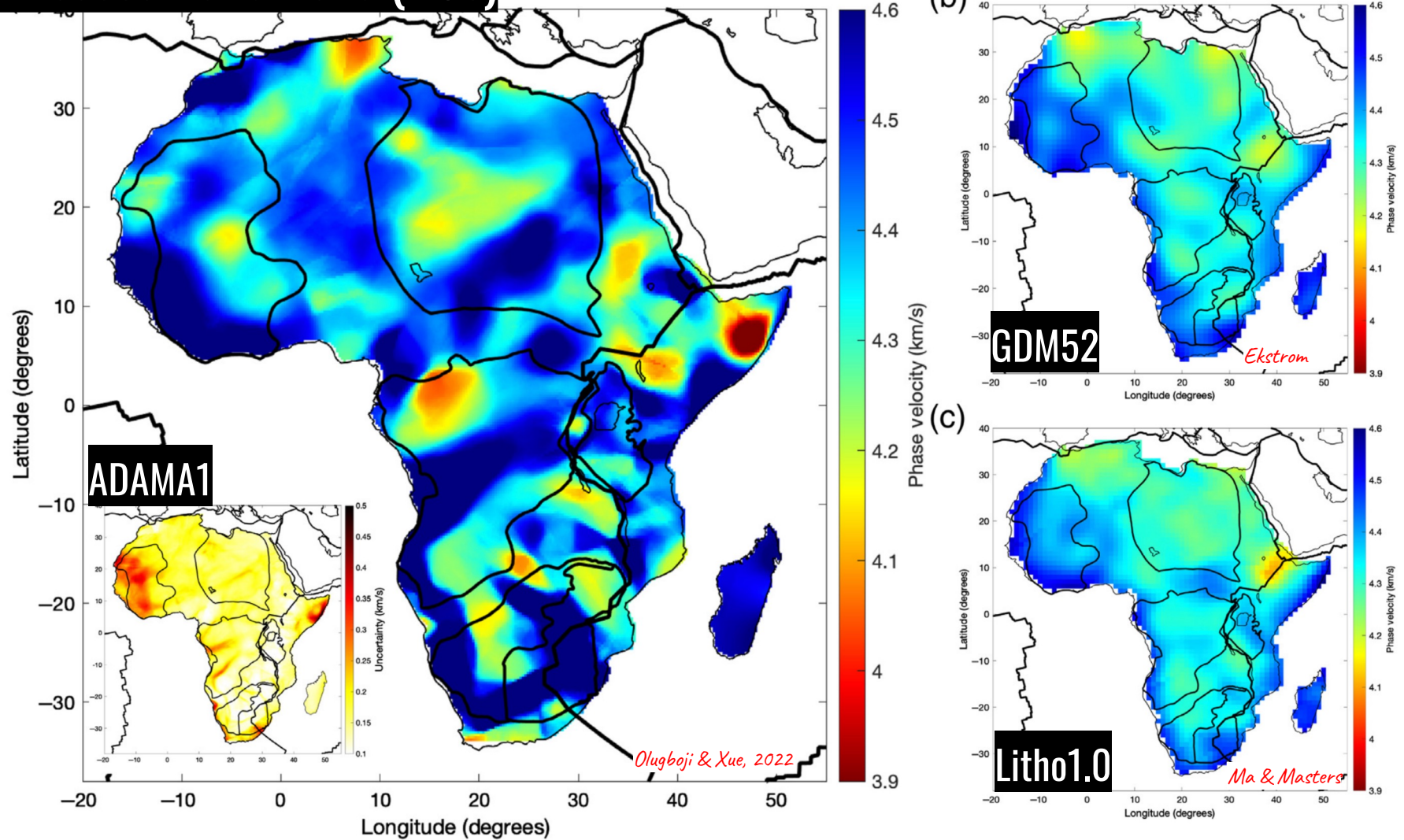
Cf. Sambridge, 2014

$$p(\mathbf{m}|\mathbf{d}) = C \times p(\mathbf{d}|\mathbf{m}) p(\mathbf{m})$$

Bayesian Adaptive Tomography

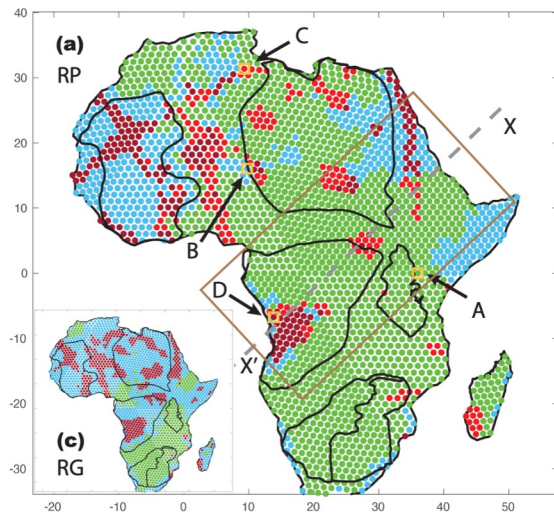


Model Assessment: Love (40s)



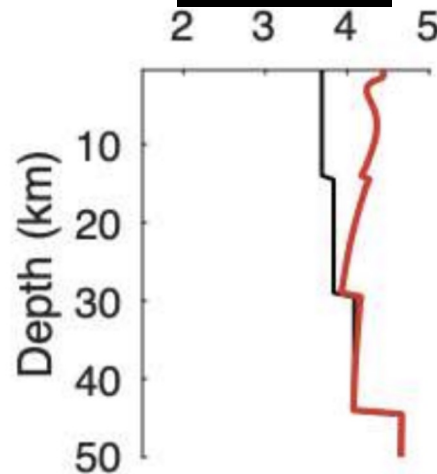
Is there Information in ADAMA?

Each Pixel is a 1D model



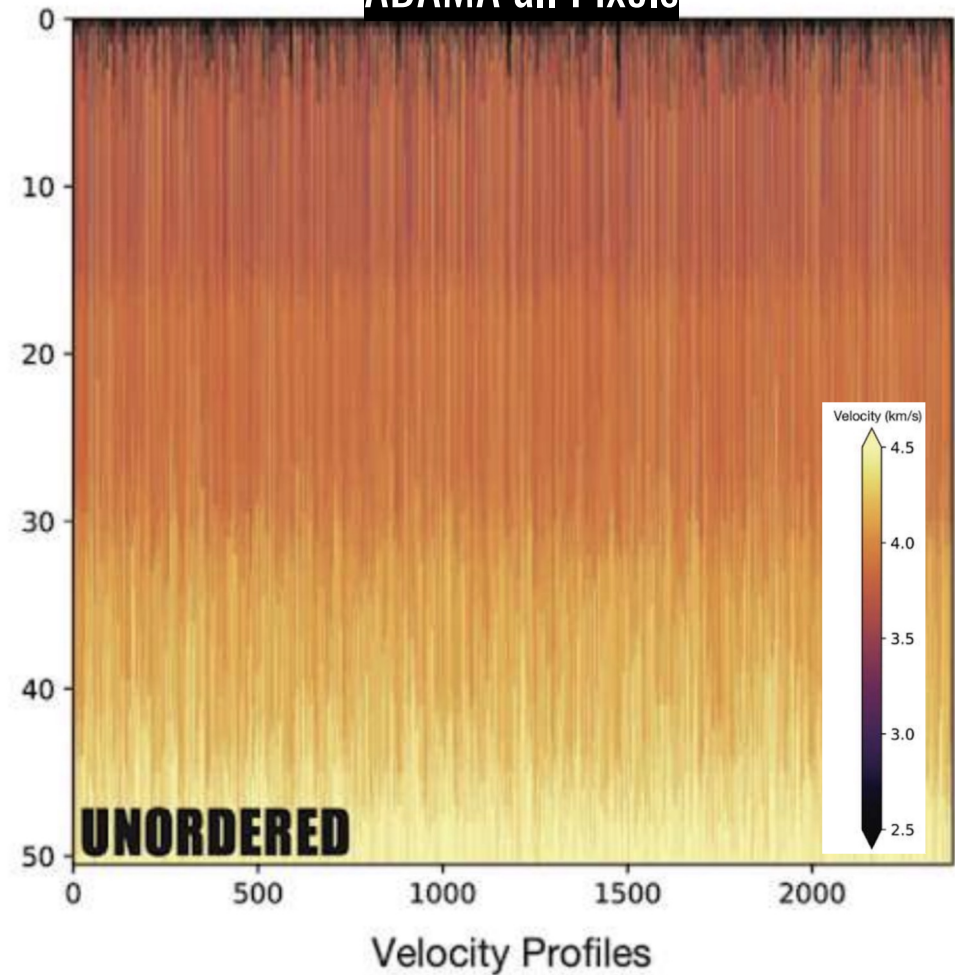
Olugboji et al. (Gcubed, 2024)

@ Point 'D'



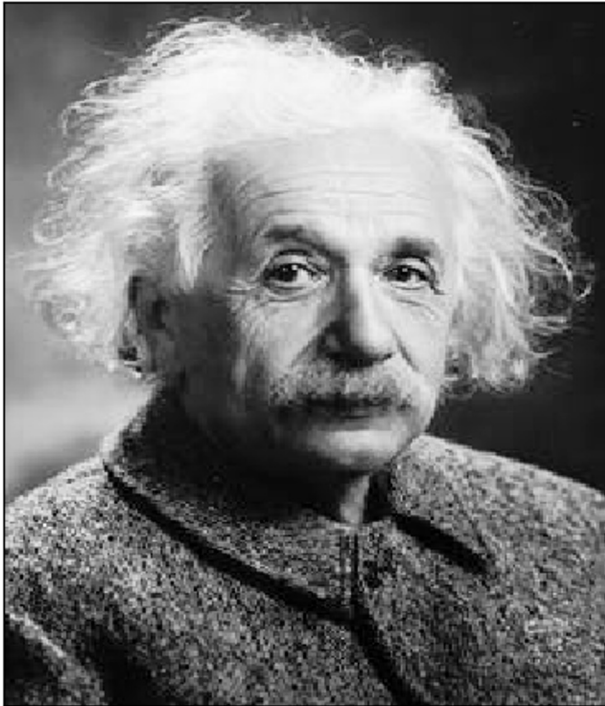
ADAMA update

ADAMA all Pixels

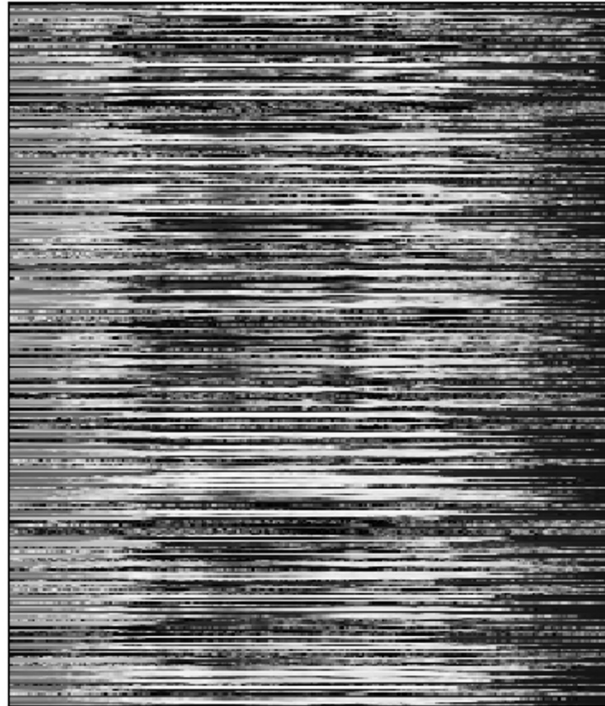


The Sequencer: Finding Patterns

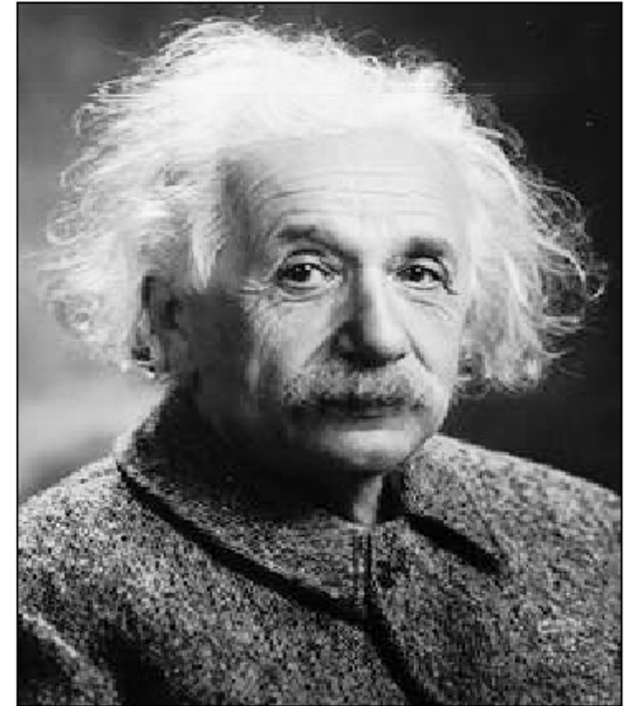
original image



input dataset



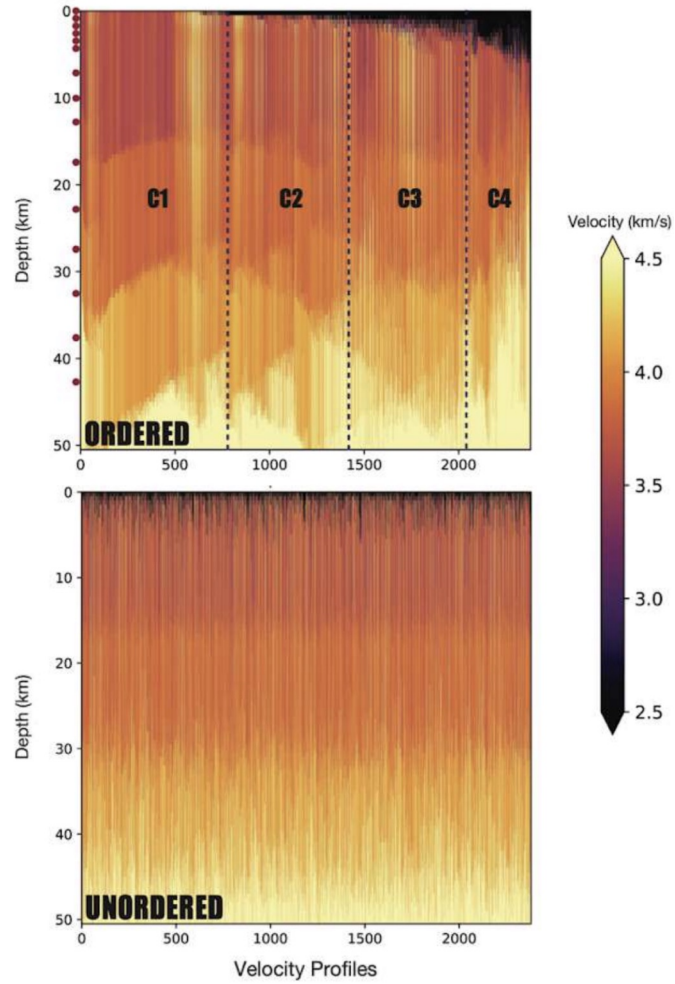
reordered dataset



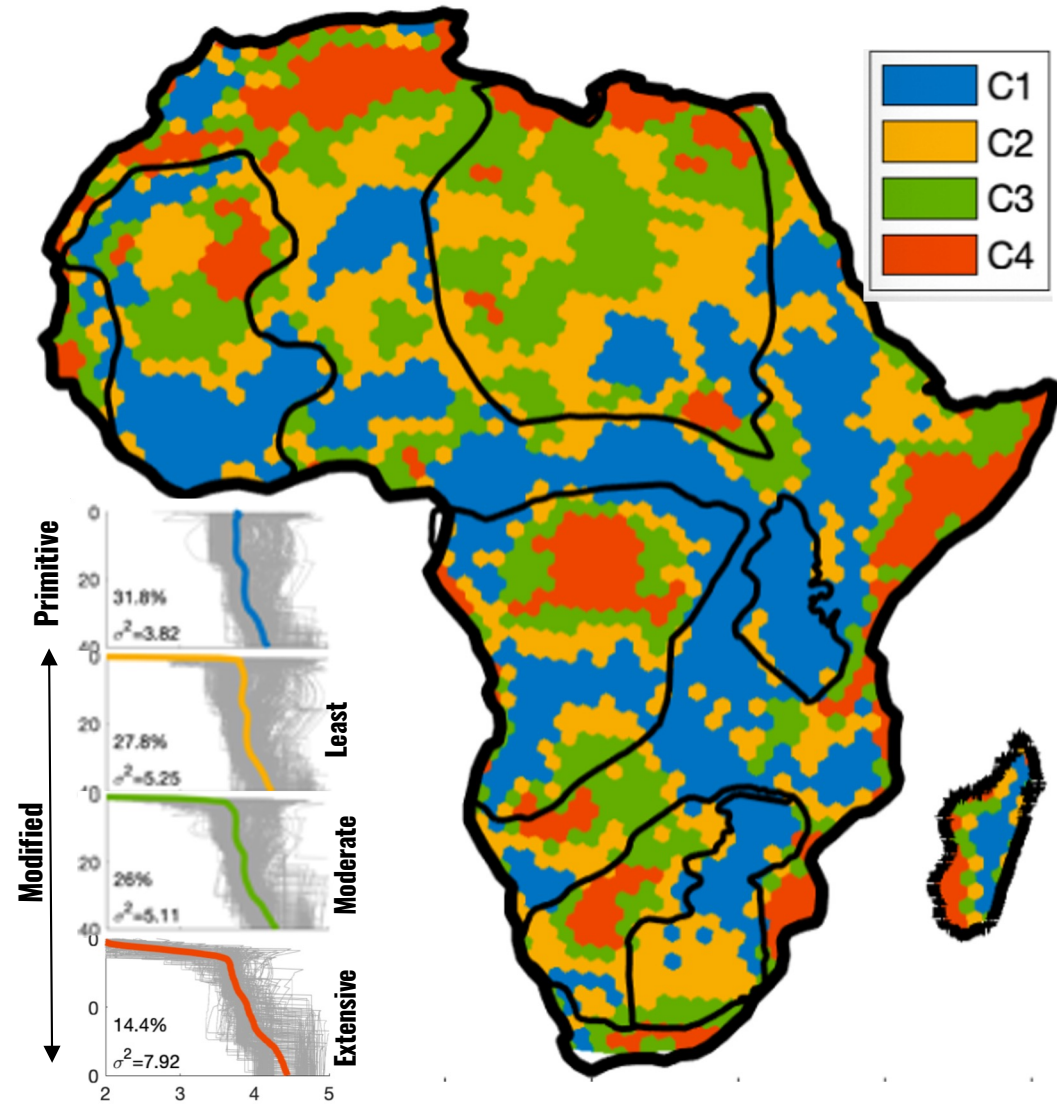
Baron and Menard (2021)

An unsupervised Machine Learning Approach

Sequencer+ADAMA = Taxonomy



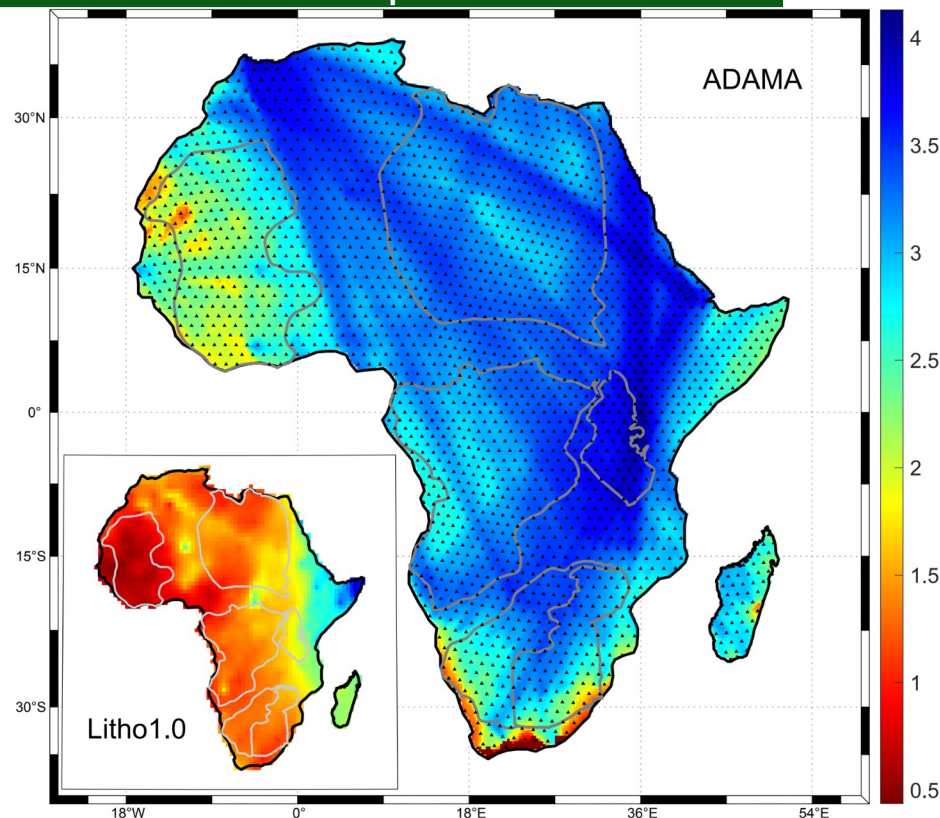
Olugboji et al. (Gcubed, 2024)



Legacy: CRUST1 → Litho1

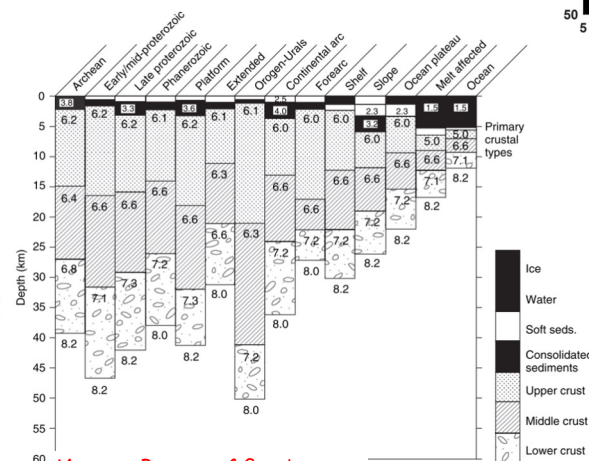
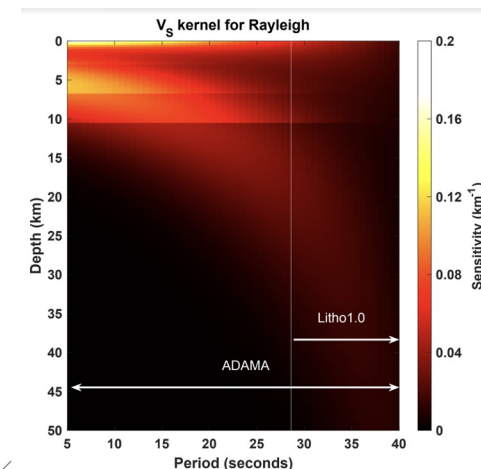
Data: Incomplete

ADAMA: Ambient Noise + Equakes + Receiver functions



New Directions

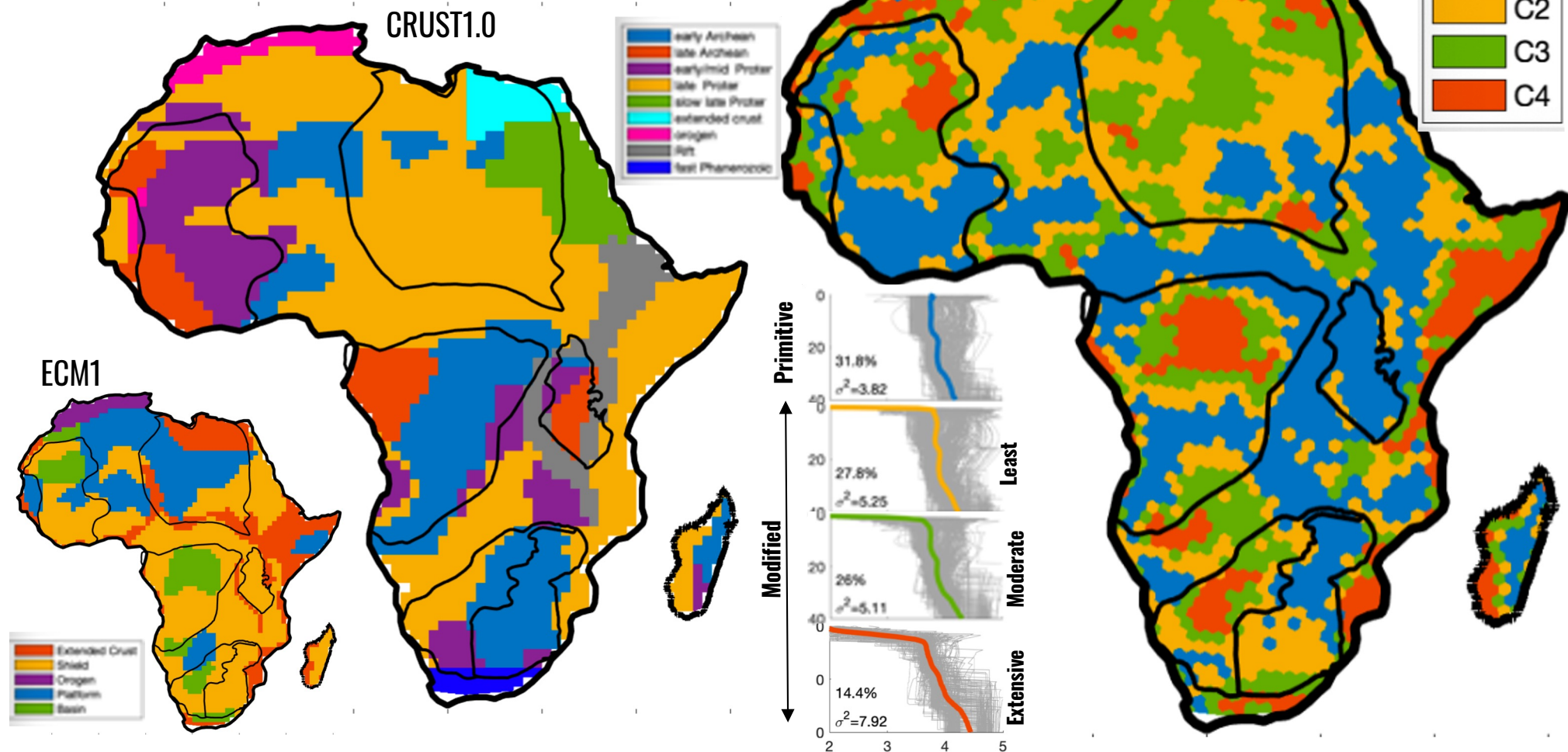
- * New Data Types, e.g. Ambient Noise →
- * Include Information on Uncertainty
- ↓ Test the Assumption of Crustal Types



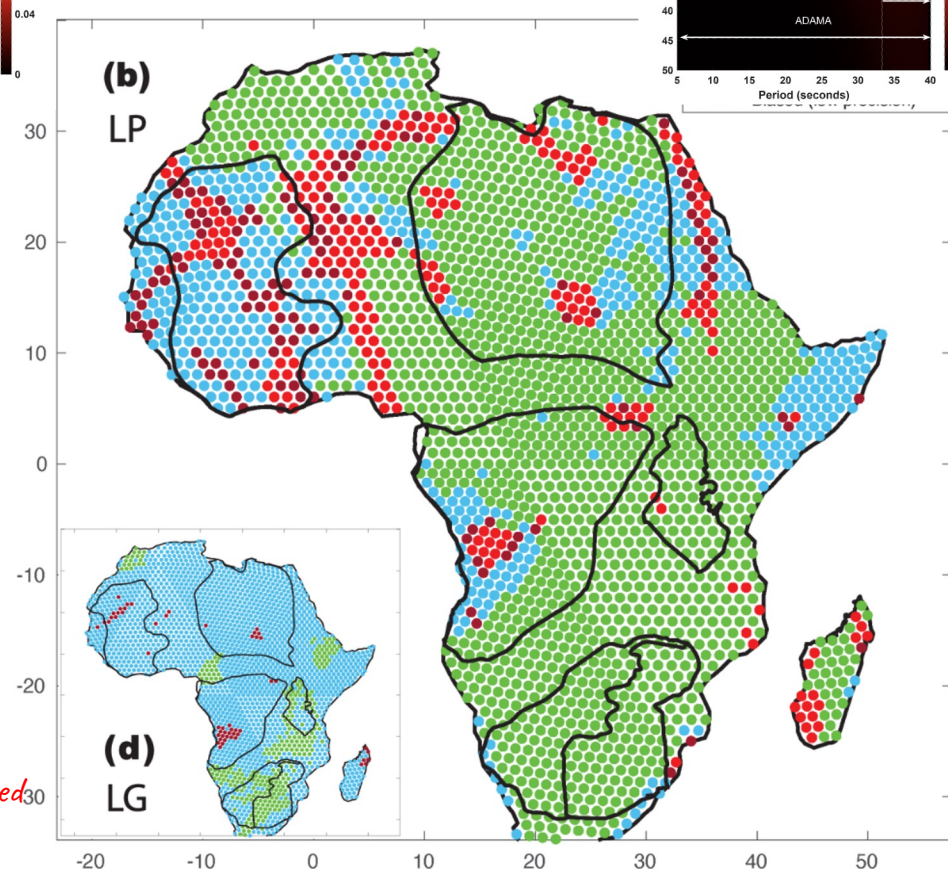
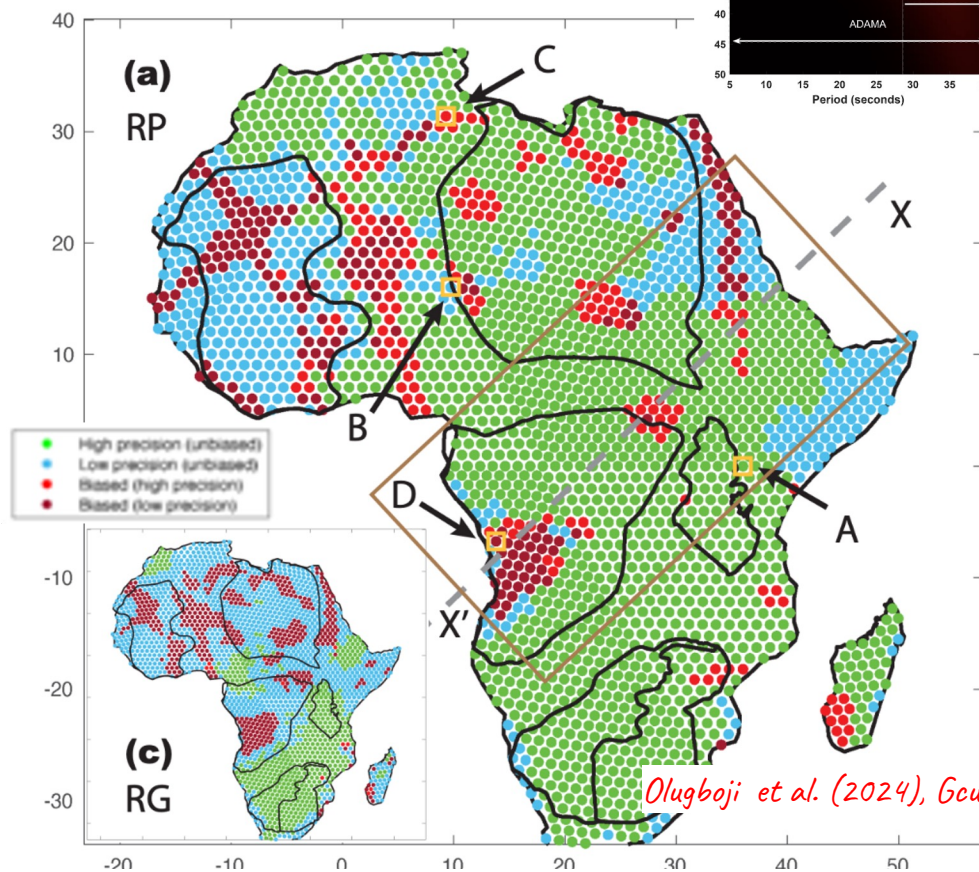
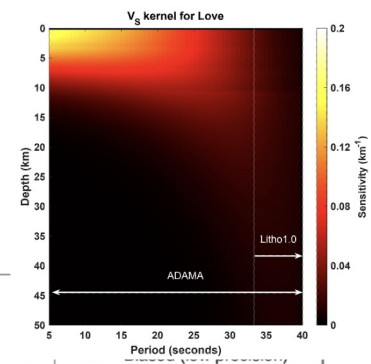
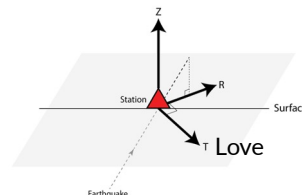
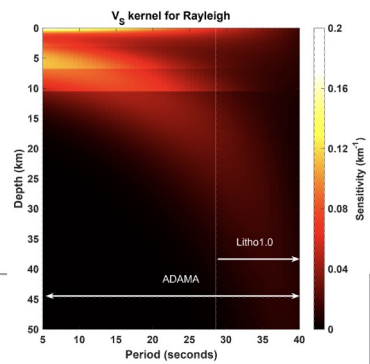
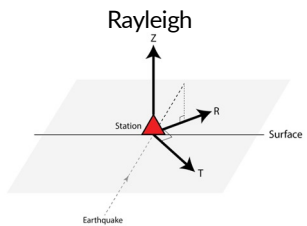
Mooney, Reviews of Geophy, 2007

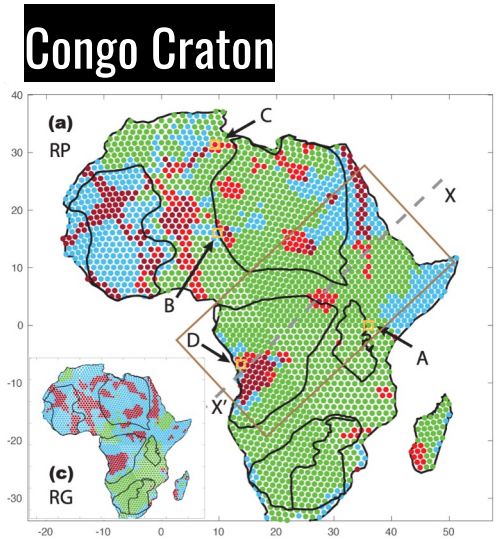
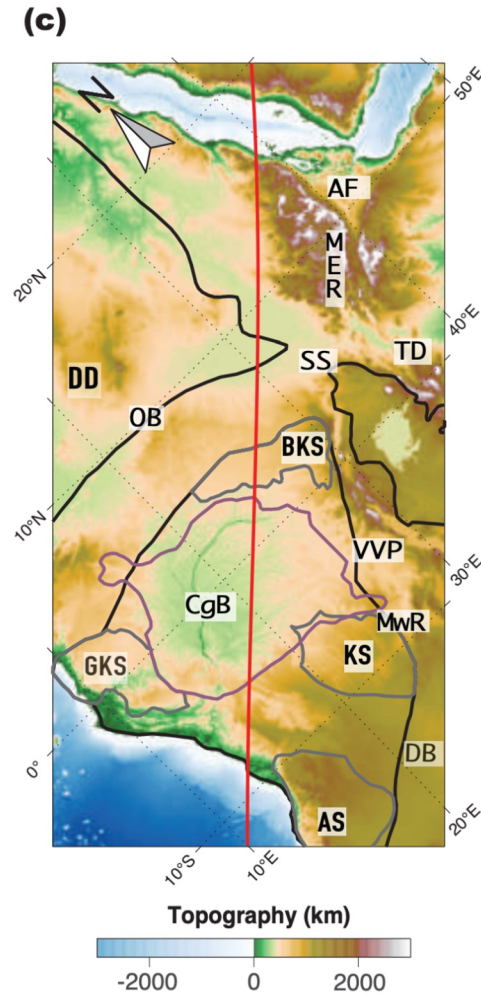
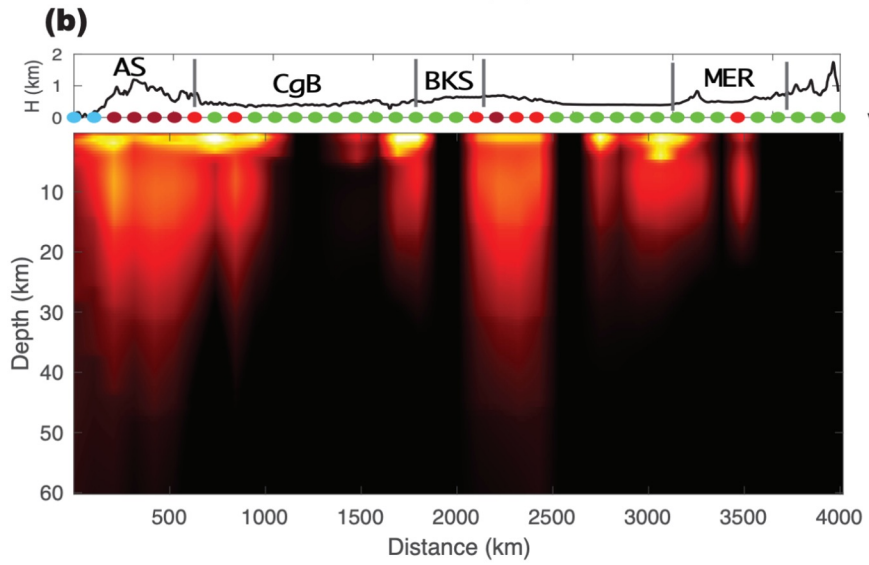
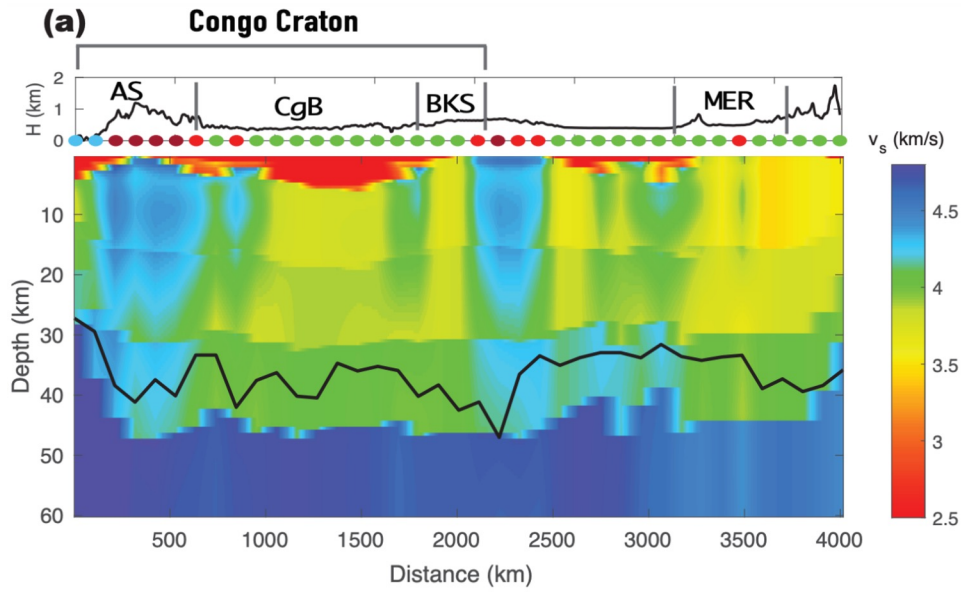
Start: Crust Types (Bias)
No a-priori model parameterization

New Taxonomy ≠ Old



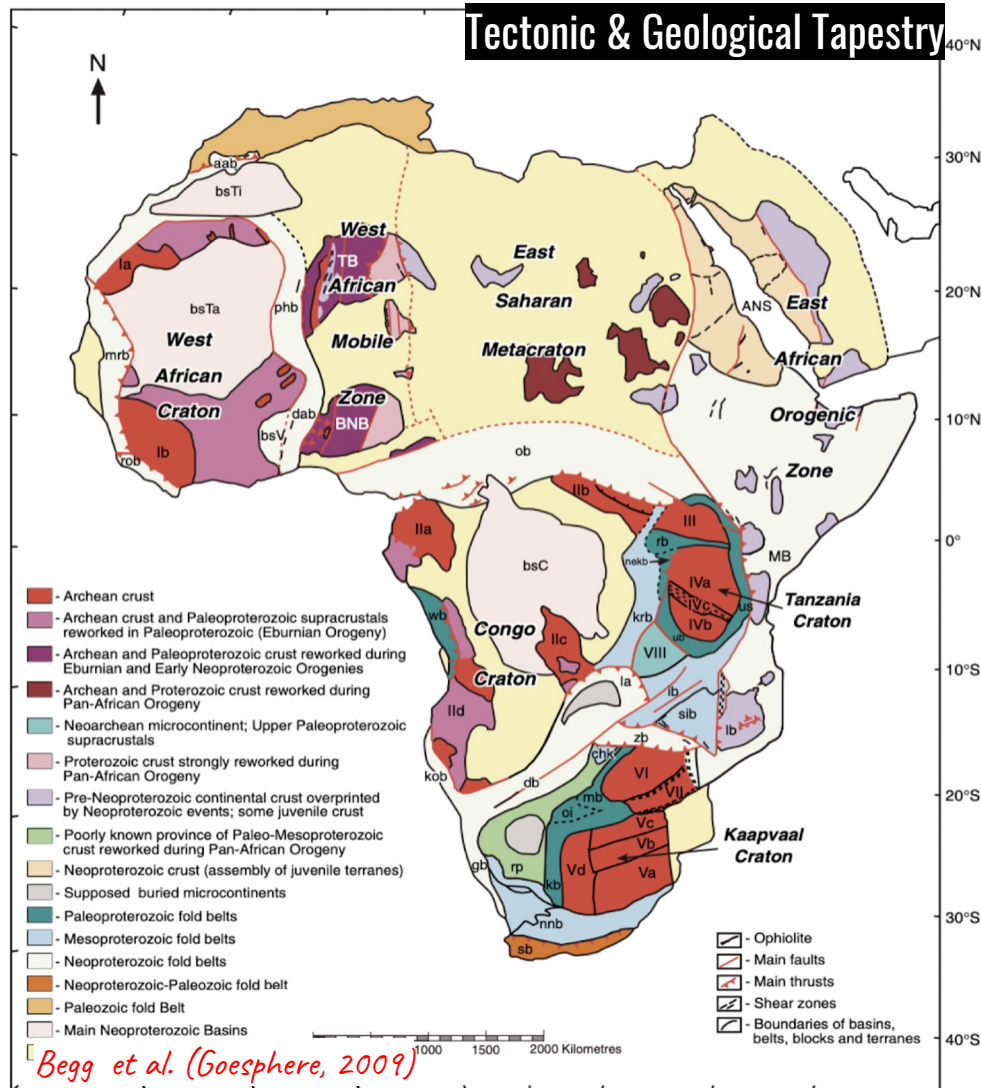
Olugboji et al. (2023), Gcubed, in press



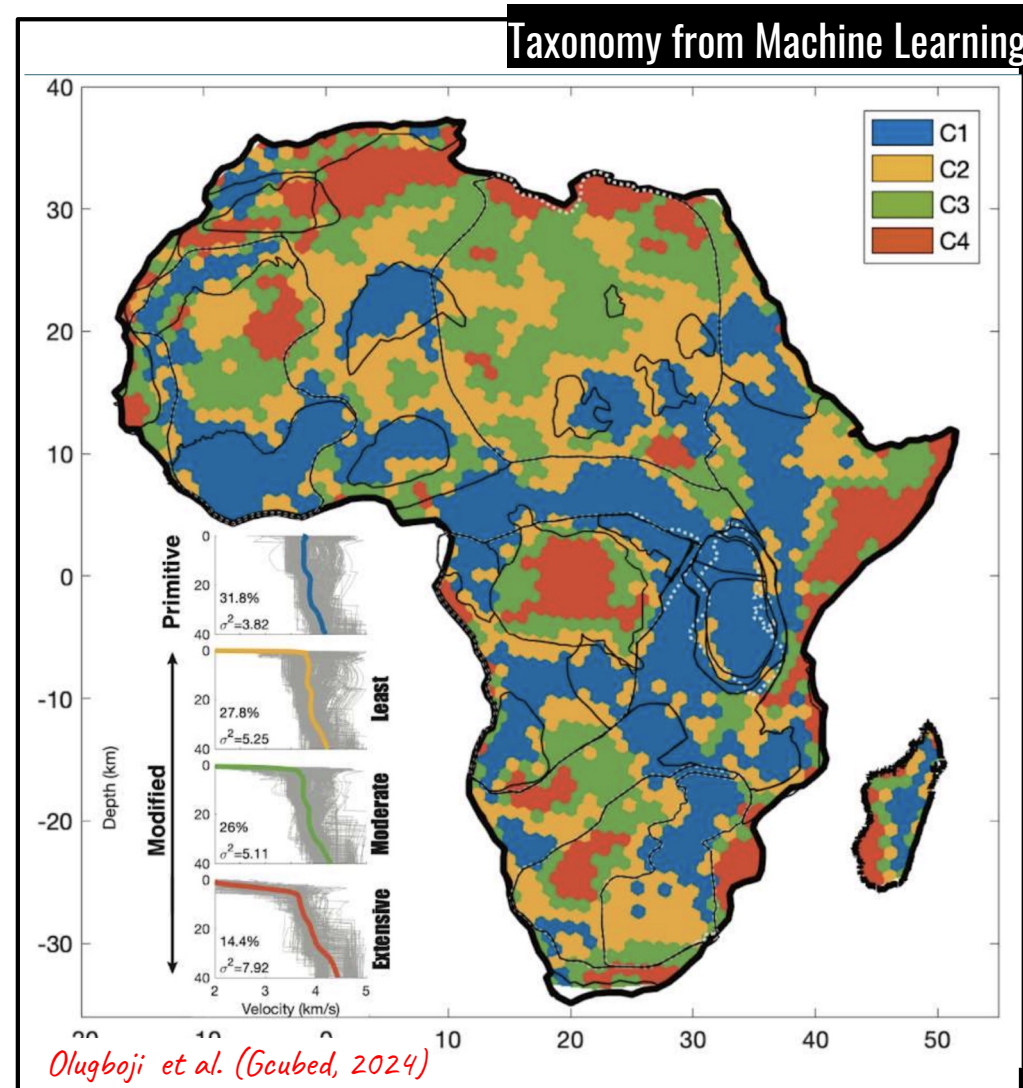


Olugboji et al. (2023)

Tectonic & Geological Tapestry



Taxonomy from Machine Learning

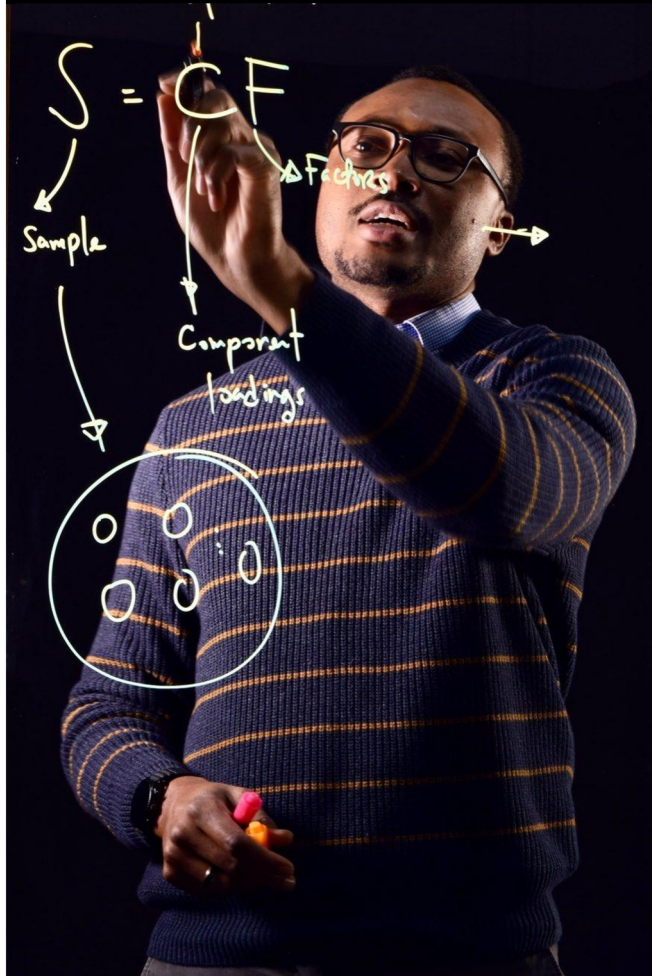


Part III: Outreach

And Opportunities

Take:

Courses



Create & Share

New Knowledge



Inspire:

Broader Impacts



Planetary Imaging & Earth Hazards (Circa 2026)

Seismology and
Computational Geophysics
<http://ees.rochester.edu/urseimo>
Tolulope Olugboji



Dr. O (PI)



Tushar Mittal



D. Sarah Stamps



Aubrey Adams



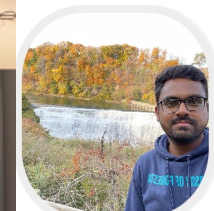
Zachary Sudholz



Ziqi (Evan) Zhang



Jung-Hun Song



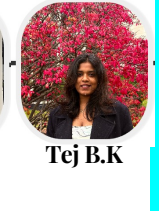
Sayan Swar



Margaret Maenner



Chris P-G



Tej B.K.



Baowei Liu

Pls + Funding

P-Doc Collab

PhD/RAs

Support

Other Ques?

Thanks