EGU General Assembly 2022

3D Imaging of the Crust and Uppermost Mantle of the Northeast Atlantic, from Madeira and Canaries to the Atlas-Gibraltar Zone

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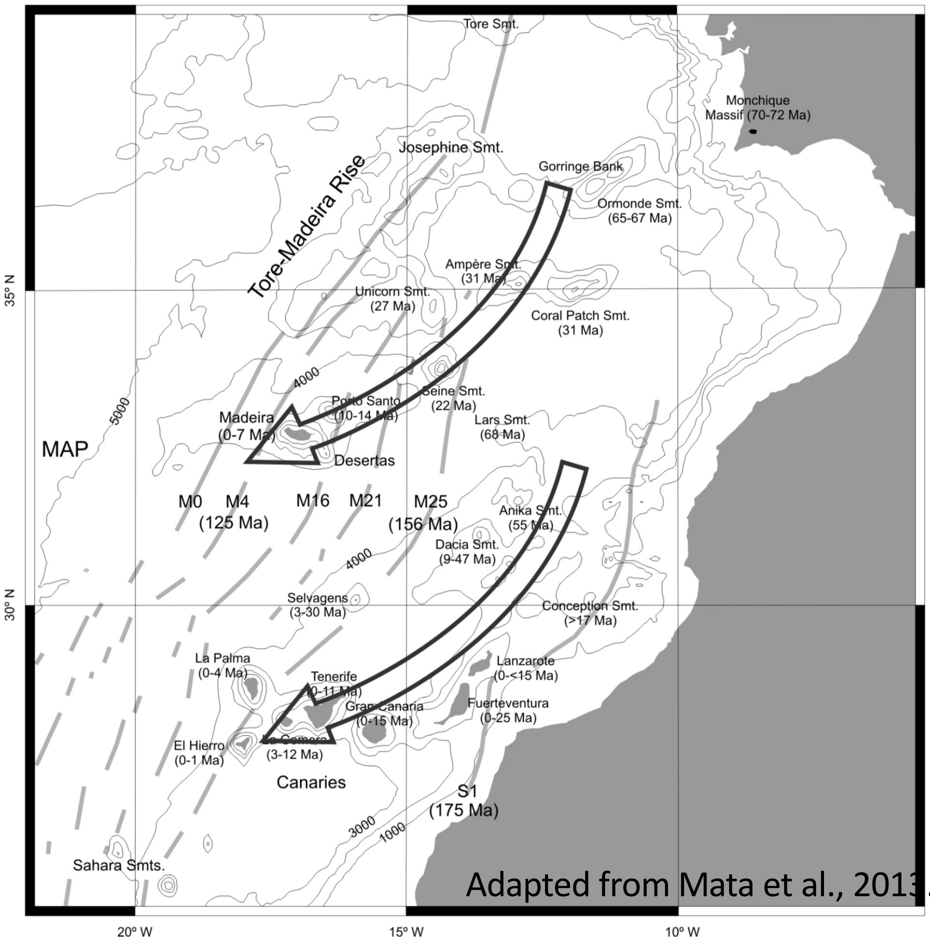
OBJECTIVE

Obtain a 3D model of the crust and uppermost mantle beneath Madeira, Canaries and surrounding areas.



Adapted from Mata et al., 2013.

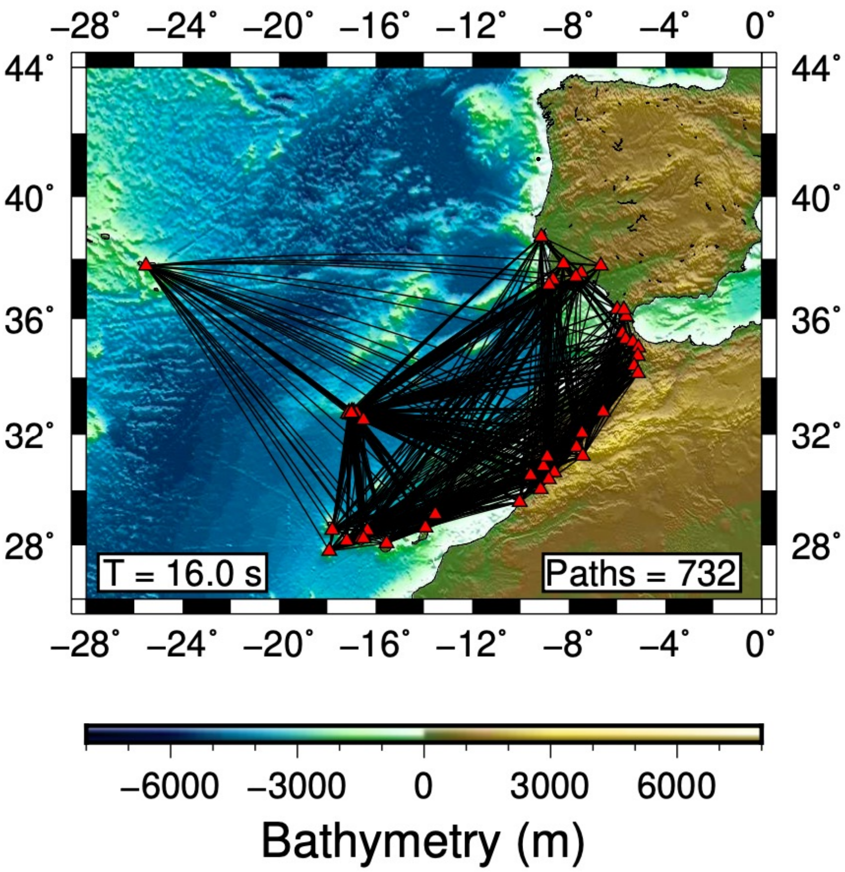
Framework

Project **SIGHT** - **SeI**smic and **G**eochemical constraints on the madeira **HoT**spot system

Also expects to bring some seismological constraints to the structure of the wider region, encompassing Madeira and Canaries to the Atlas- Gibraltar zone.

Madeira and Canary in the context of Eastern Central Atlantic. Magnetic anomalies after Verhoef et al., 1991. The arrows represent the Madeira and Canary hotspot tracks as proposed by Geldmacher et al. (2005), suggesting the intervention of mantle plumes on the origin of those archipelagos. The ages are from the same authors.

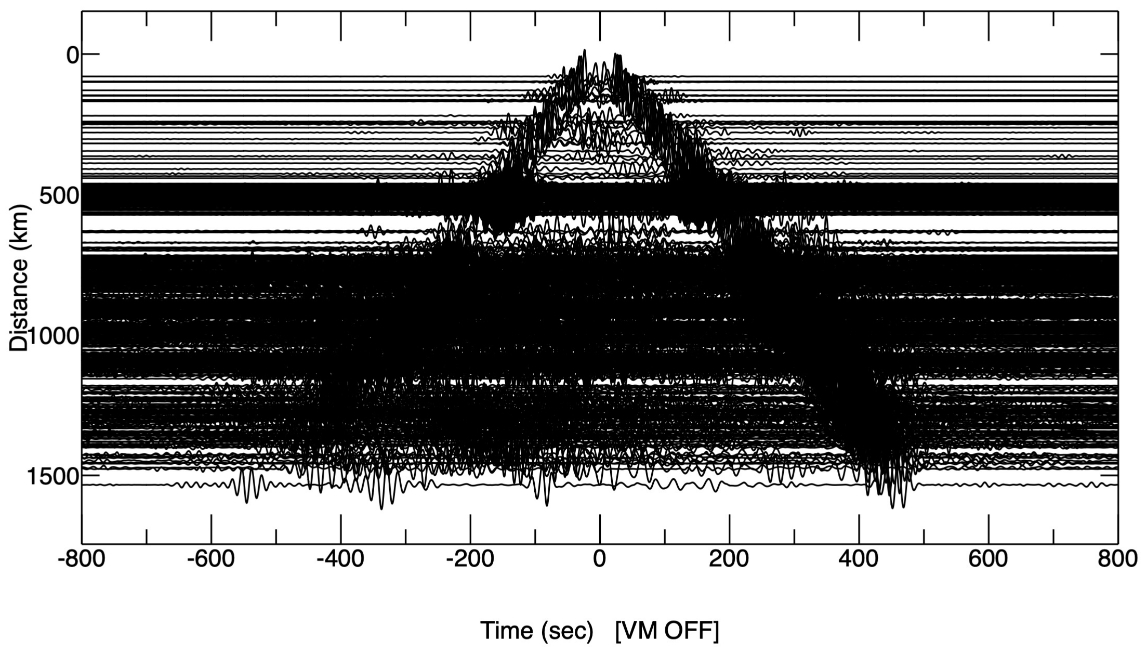
DATA ANALYSIS



50 Broadband Seismic stations
2011 – 2012
IPMA, IGN, DOCTAR, WM

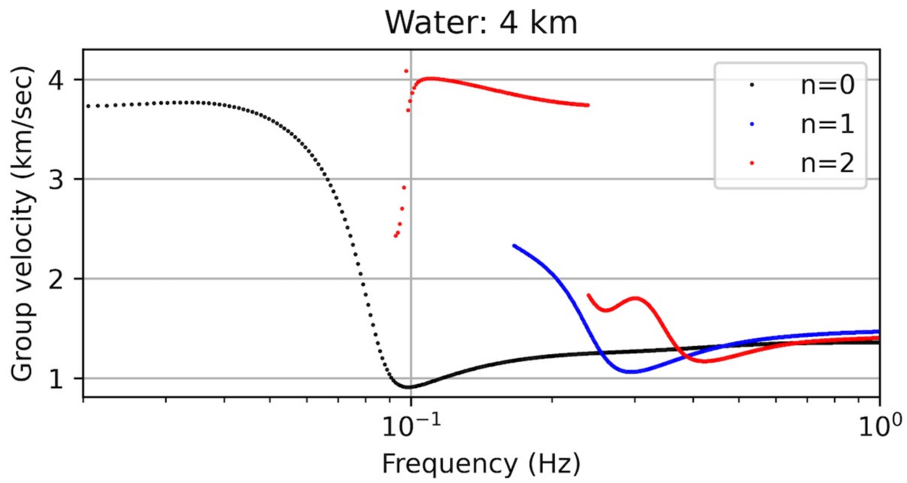
Empirical Green Functions

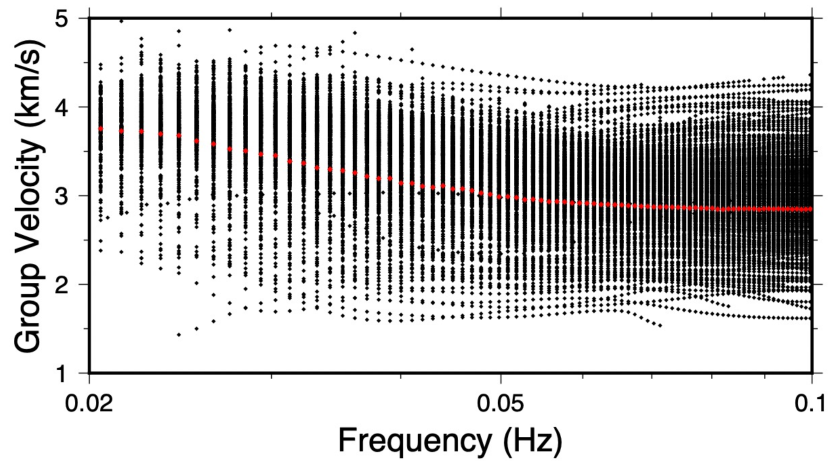
Phase cross-correlation
+
Time-frequency phase weighted stack
(Schimmel et al. 2011)



METHODOLOGY

Rayleigh waves → mode contamination in the short frequency range, that depends on the water layer thickness;



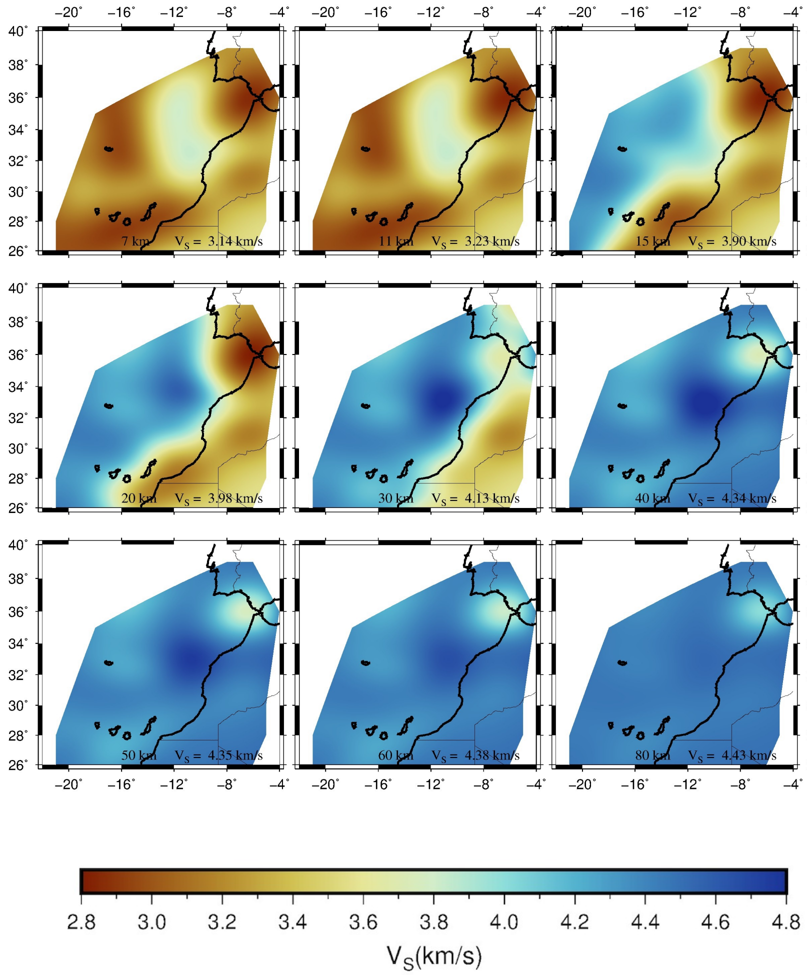


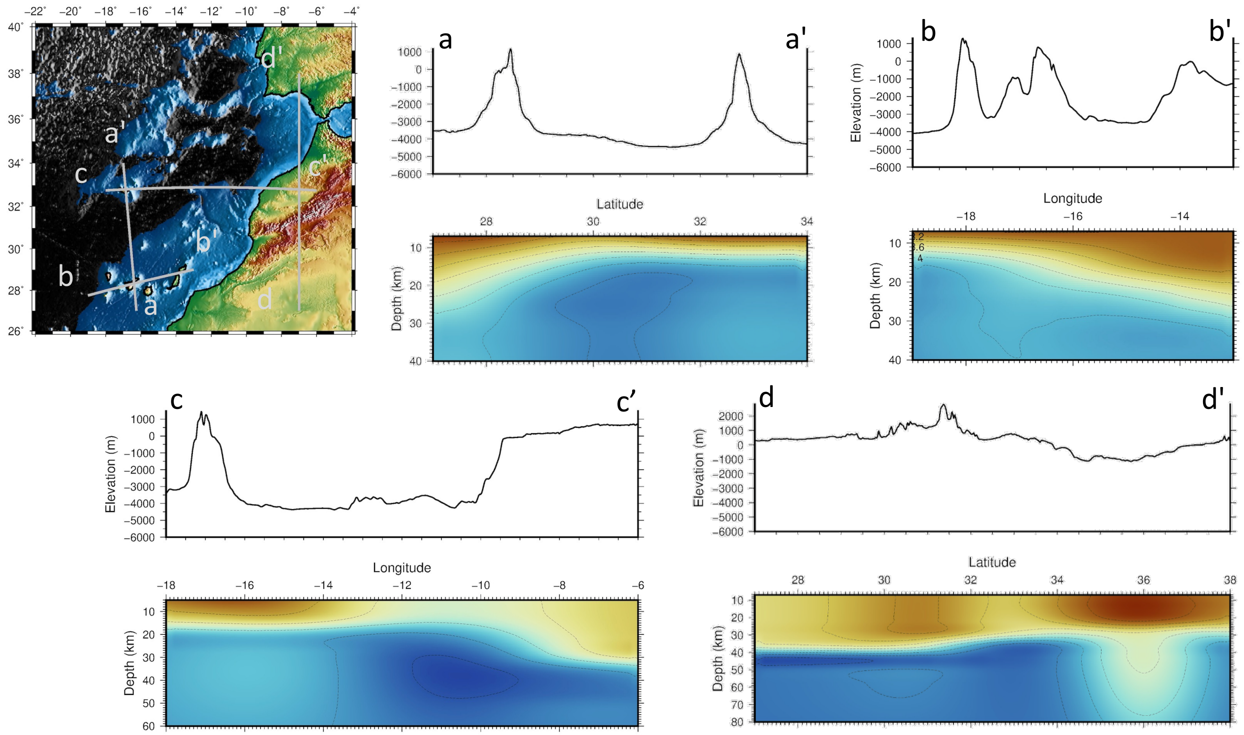
Rayleigh wave group velocity dispersion curves using a random sampling and subset stacking strategy (Schimmel et al., 2017).

Tomographic inversion in 2 steps:

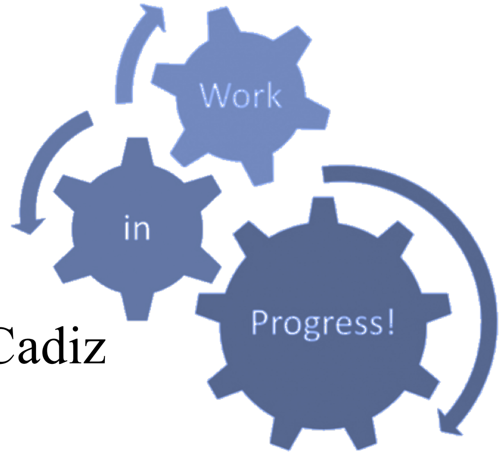
(1) regionalization to obtain group velocity lateral variations for each period (Rawlinson et al., 2005);
(2) inversion at each grid point to obtain the 3D shear wave velocity model (Silveira et al., 2022).

3D SHEAR-WAVE VELOCITY MODEL (preliminar)





- Lower velocities beneath Madeira and Canary Islands, still visible at mantle depths;
- Crust beneath the Canaries thicker crust than beneath Madeira;
- Lowest velocities beneath the Gulf of Cadiz region persists to 80 km depth;
- Lower velocities beneath the High Atlas.



Improve the azimuthal coverage and fill some "voids" by:

→ using previous dispersion measurements from an OBS array in the Cadiz Gulf (Corela et al., 2017);
→ including other stations in the Azores (western group), Northwestern Africa, and Southwestern Iberia;

Madeira Island → Constrain the shear wave models with Rayleigh wave ellipticity and autocorrelations.

Cross-correlate the horizontal components to obtain Love waves and compute polarization anisotropy → joint analysis with local S splitting (Schlaphorst et. al., 2022).