



Imaging Aberdeen with Seismic Noise: Passive Methods for Geothermal Exploration

AGFP Project Team

geothermal@abdn.ac.uk

Dave Cornwell (Co-Lead)

d.cornwell@abdn.ac.uk



Why geothermal in Aberdeen?



Granite

The city sits above a distinctive crystalline geology worth testing.



Heat demand

Homes, hospitals, campuses and public buildings all need low-carbon heat.



Energy skills

Aberdeen has a workforce with deep subsurface and engineering expertise.



Heat networks

The city has opportunities where local heat sources could connect to demand.



Just transition

A geothermal pathway must be practical, fair and useful to local people.



Delivering the underpinning research to determine the geothermal potential of Aberdeen city and de-risk future investment to accelerate Aberdeen's transition to a sustainable energy future.

- £1 million NERC capital expenditure grant
- Awarded September 2026
- AGFP started 1st November 2026



Aberdeen Geothermal Feasibility Pilot

Phase 1: Subsurface – temperature, geology, hydrology

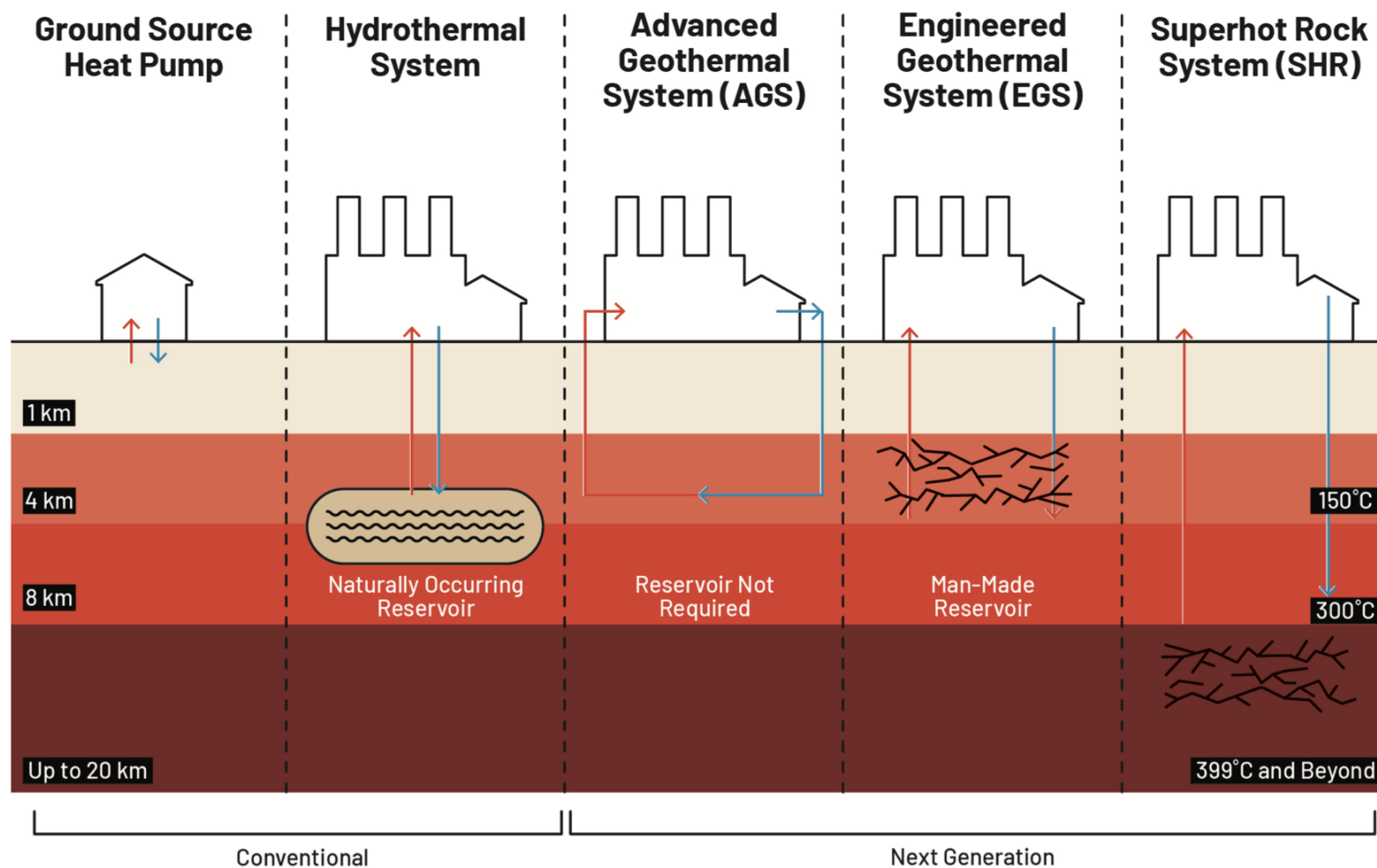
Phase 2: Social – fuel poverty assessment, community engagement, increased understanding

Phase 3: Skills – increased awareness, accessible geothermal education, workforce upskilling/transition

Phase 4: Scale – business case, delivery model, investment pathway, route to heat networks

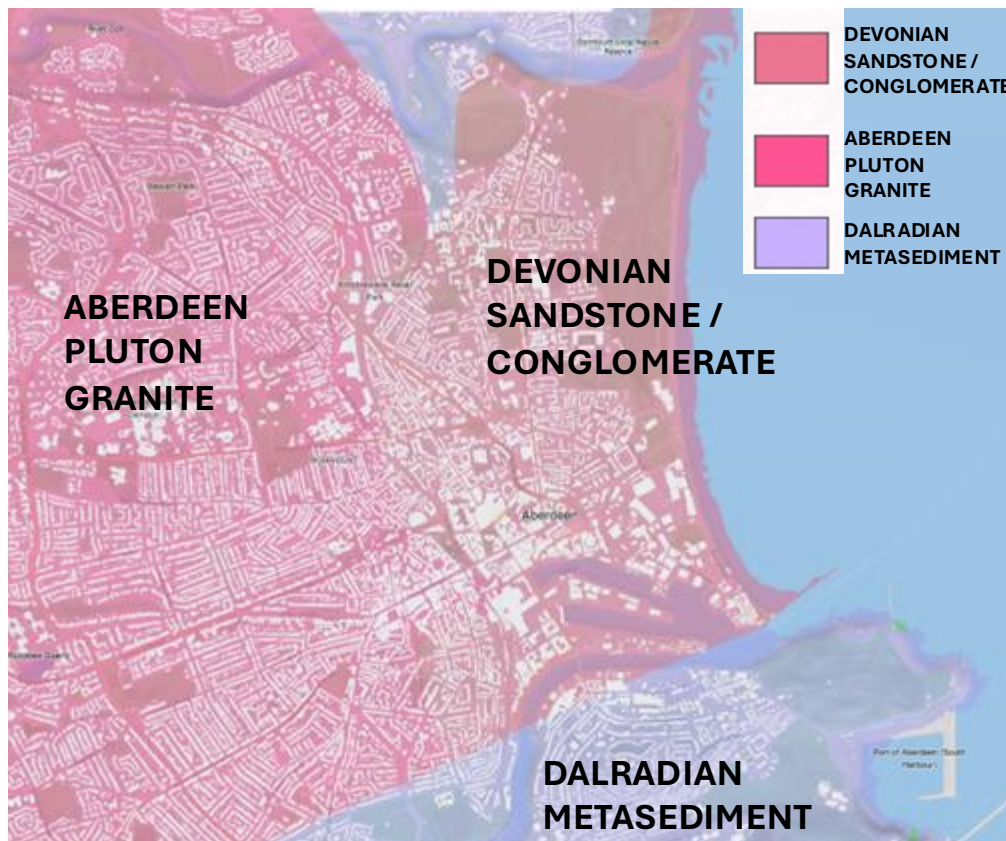
Funded Phase 1 Deliverables and Capital Outputs:

- Instrumented borehole (>500 m) on campus with thermal, geological, and hydrological analyses
- Cross-city 3-D subsurface model to 5 km depth (ambient noise tomography)
- Open-access borehole and subsurface datasets, reports, and maps
- Focal point for research, collaboration, dissemination, and de-risking future geothermal projects



Geothermal in the “Granite City”

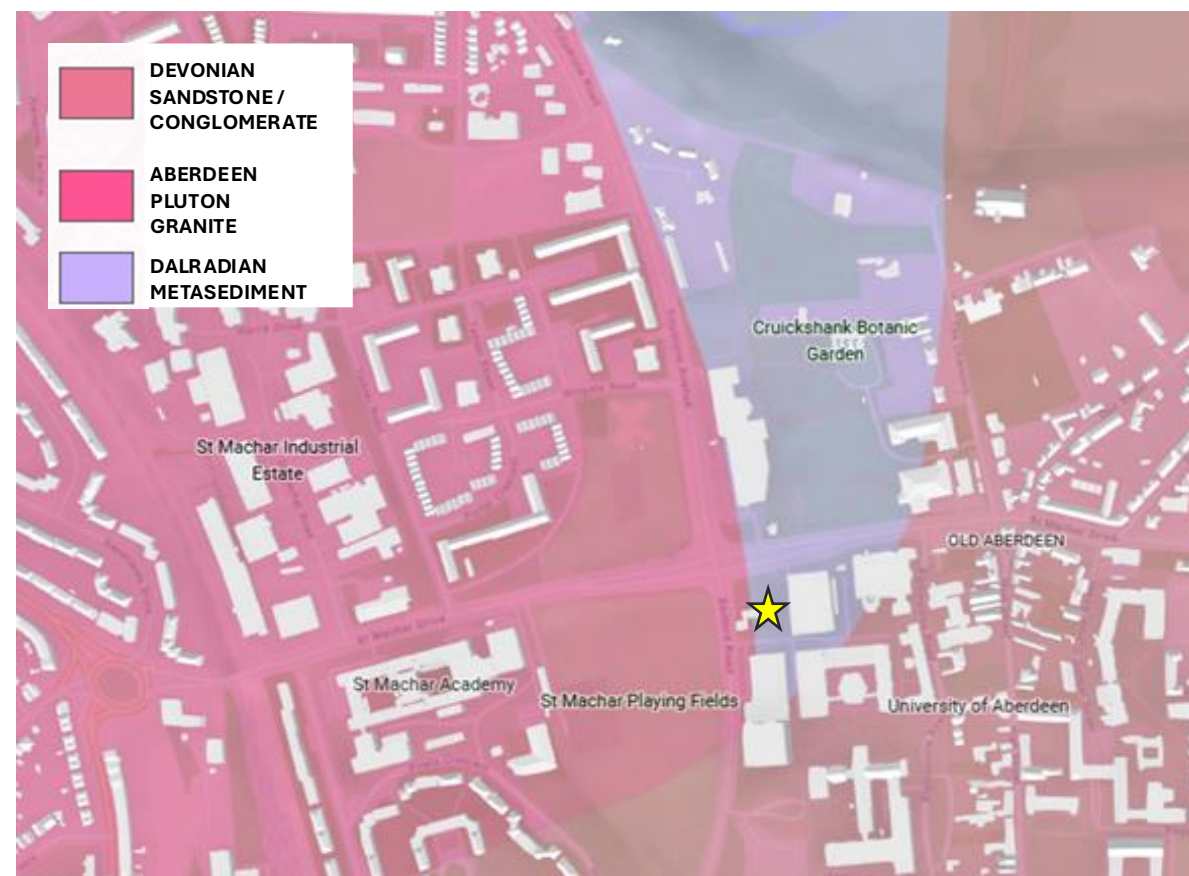
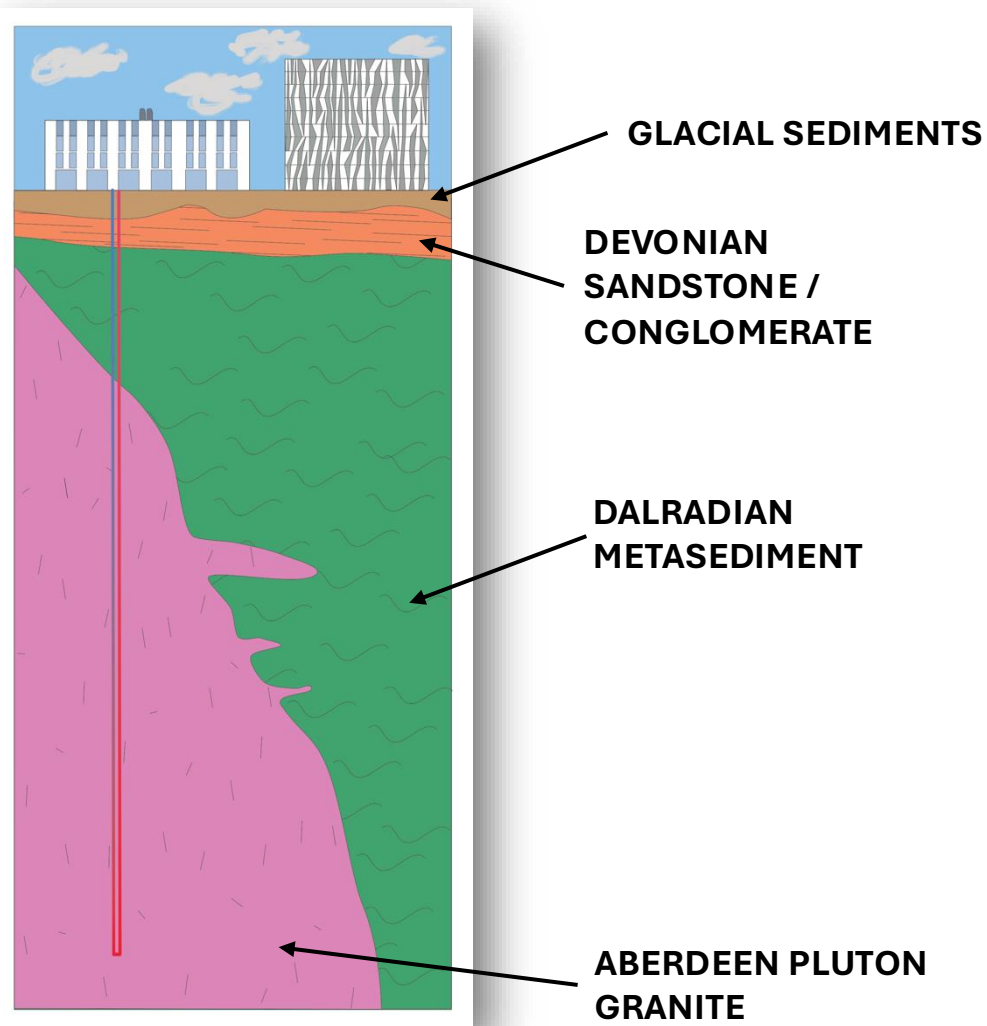
Aberdeen is not all granite and (surprisingly) we don't know our own rocks very well



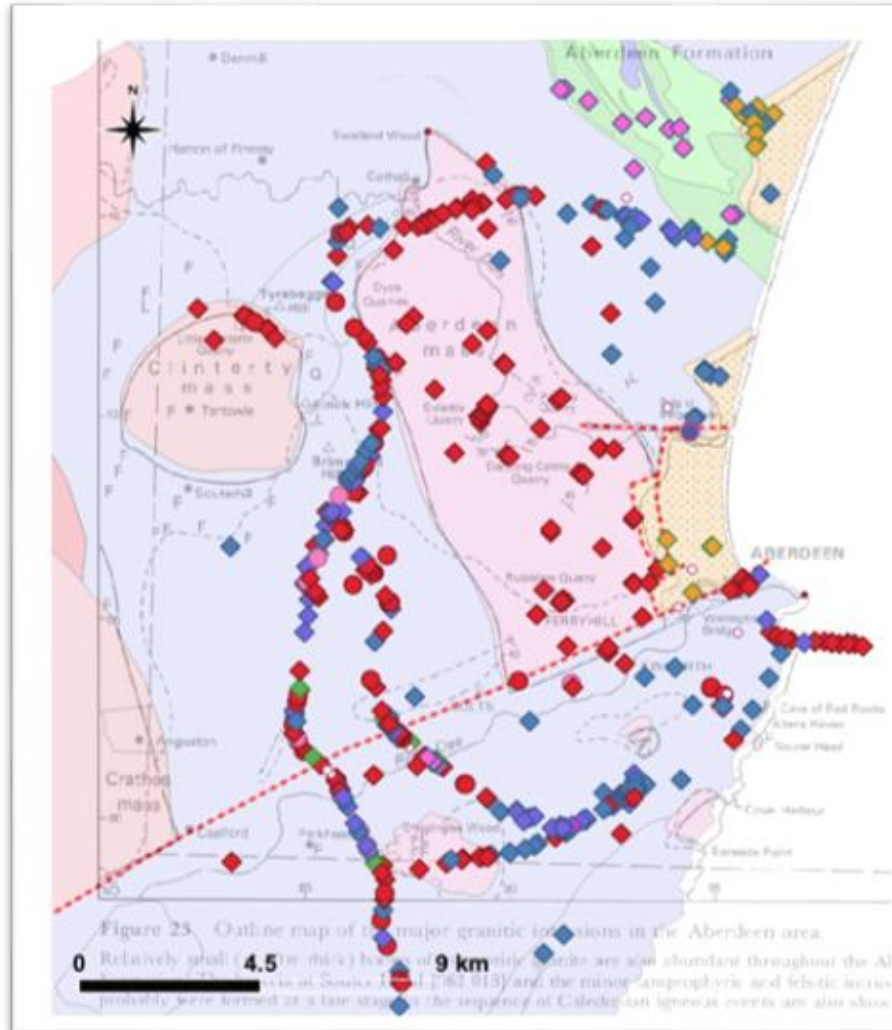
(British Geological Survey)

- ~470 Ma granite pluton with metamorphosed and sedimentary neighbouring rocks
- Geological boundaries unclear at depth
- Glacial sediments (0-40 m)
- Temperature uncertain: 60-65 °C at ~2 km depth (granite) / ~31 °C at ~1.4 km depth (schists)
- ~200 m deep borehole into Devonian sediments – no temperature data.
- Rising fuel poverty in Aberdeen in both the civil and public sectors.
- Aberdeen's energy transition is fair and inclusive for its workforce and communities.

500 m Borehole on University Campus



Re-Analysis of City Boreholes



- Borehole lithology
- Basement lithology
- Depth to basement

Seismic node deployments

City-wide passive seismic survey: 3-D subsurface model to ~5 km

- 32 x Smartsolo 3-component seismic nodes deployed across **UoA campus** for ~30 days (Dec '25-Jan '26)
- 102 x nodes deployed across **city** for 60-90 days (Feb-Apr '26)
- Nodes to be re-deployed around Aberdeen Royal Infirmary & Robert Gordon University (Nov '26)



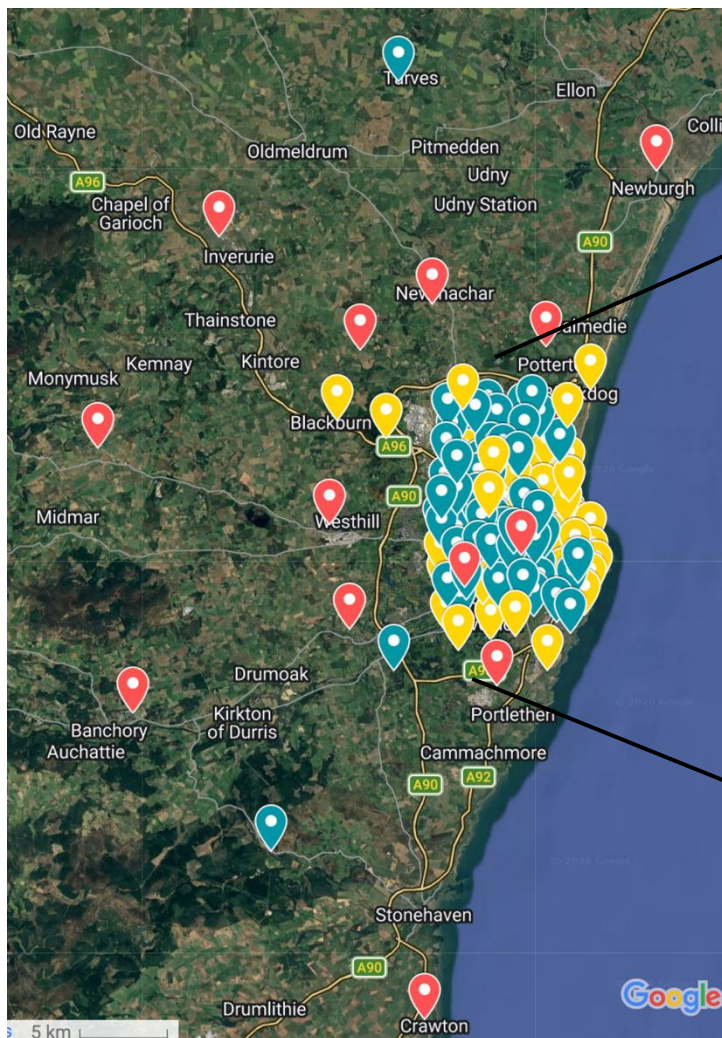
City-wide node deployment

- Public call to “Adopt a node” (online form) - 82 responses
- NHS, universities, city council, private gardens, golf courses, park rangers, AFC, businesses, staff, students, etc.
- Main city ~12 x 20 km ‘rectangle’ plus two ‘arcs’ further afield
- 88 x nodes deployed across city in 3 days (Feb 11-13), battery swap, & collected in 2 days (Apr 15-16)
- 5 x teams of 2-3 people, ~100 miles driven per team
- Safety and planning meetings daily
- AGFP information sheets

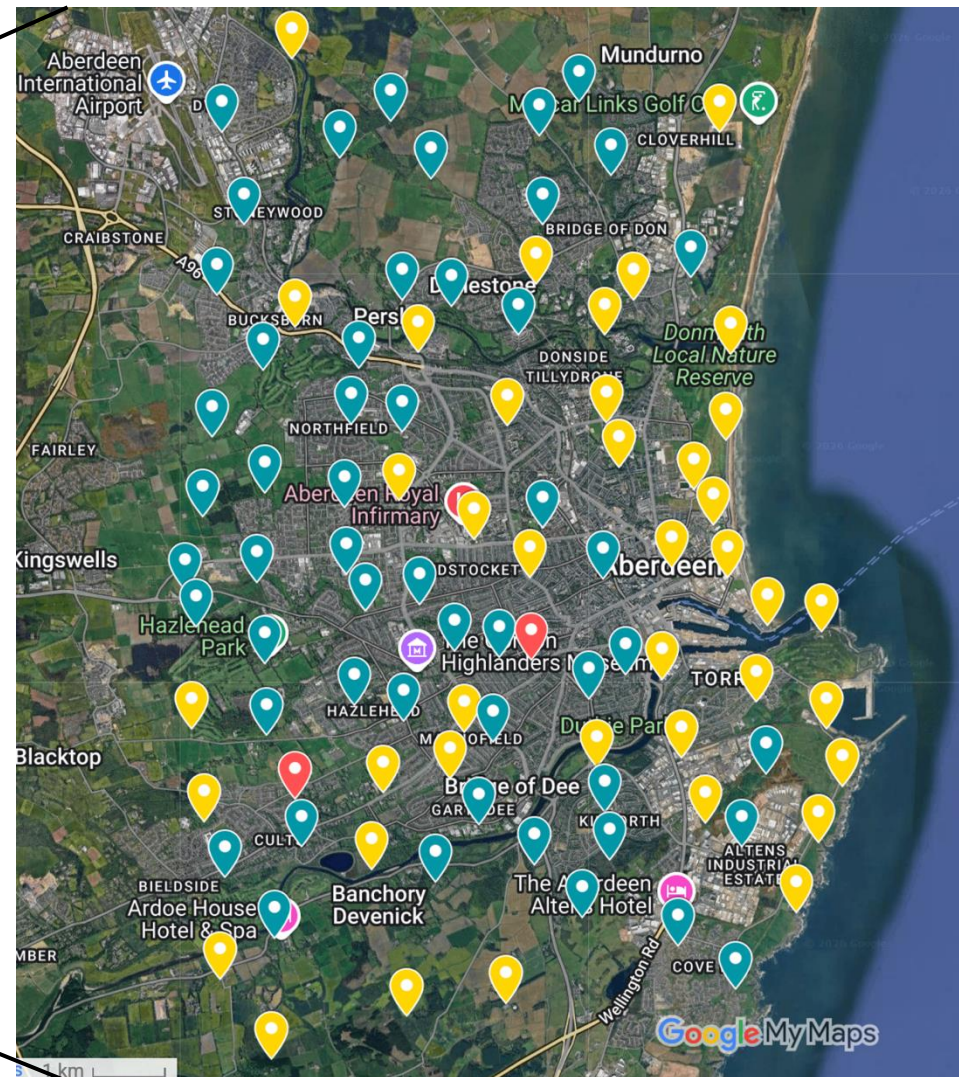
Campus & City Node Deployment



City-wide node deployment

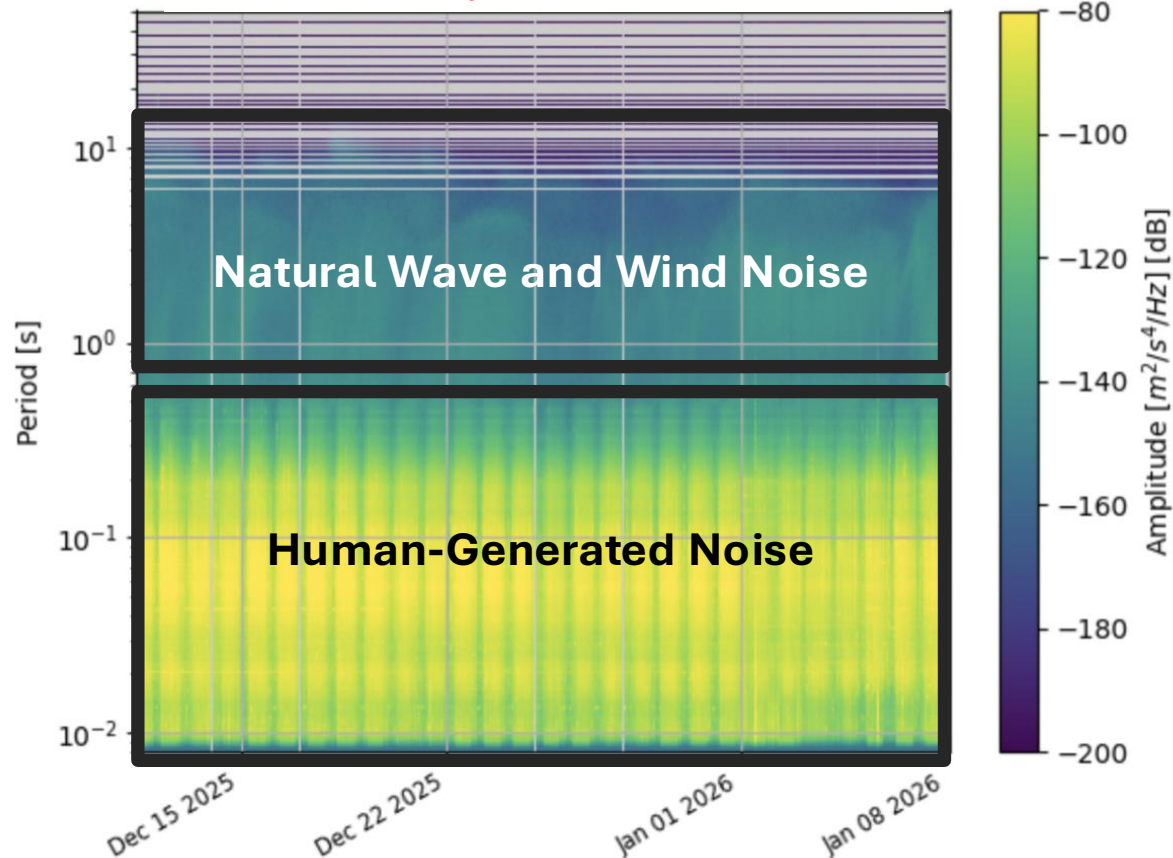


- “Adopt a node”
- ~2 months natural vibrations
- SmartSolo 3C nodes

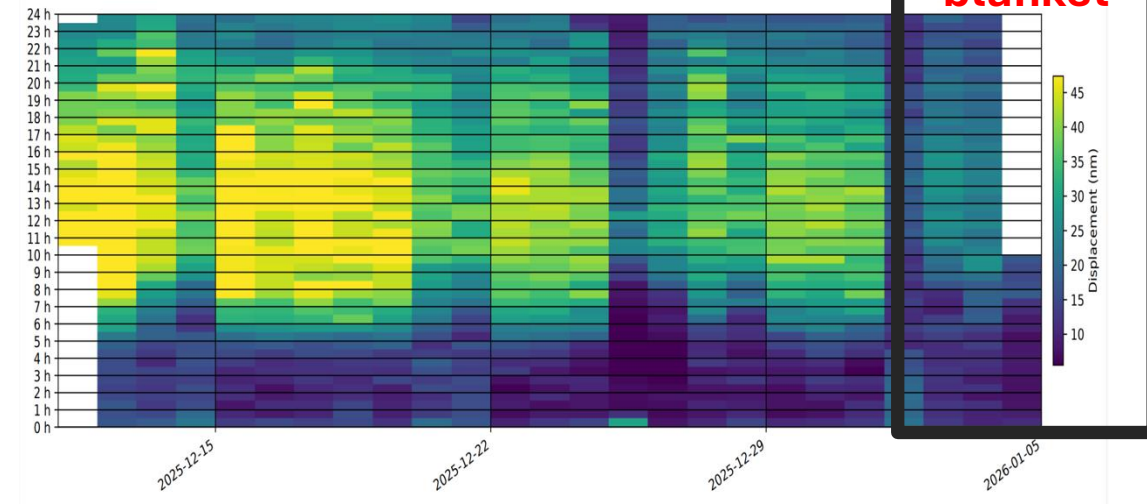


University campus test data

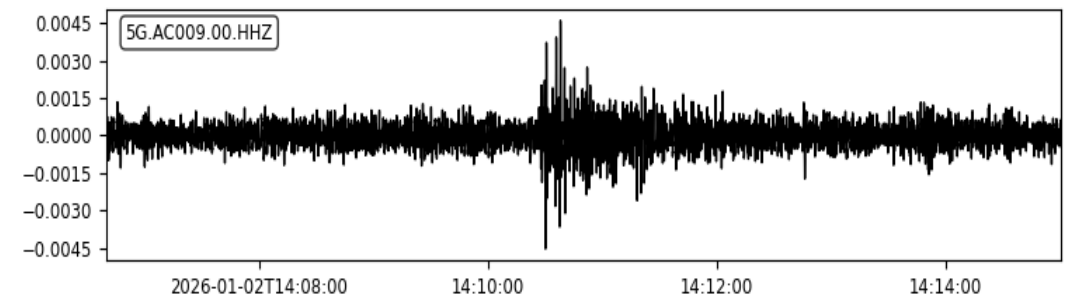
Noise period vs. date



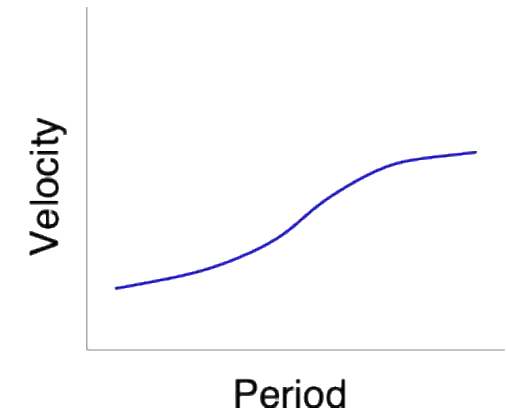
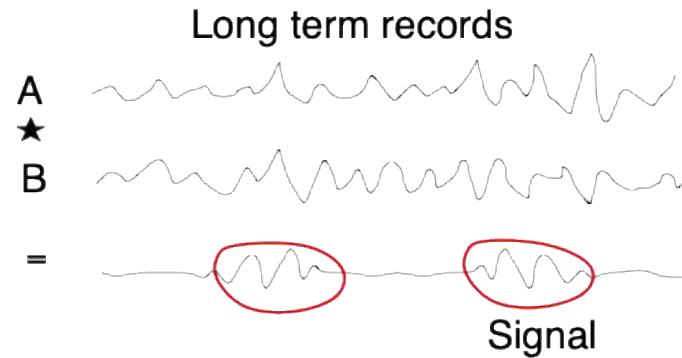
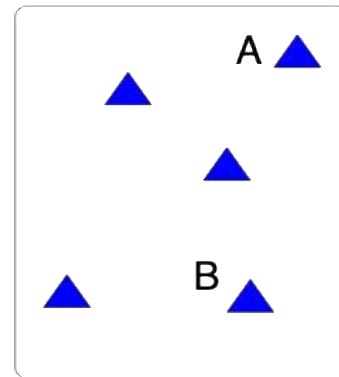
Noise time of day vs. date



2 Jan 2026 M6.1 Mexico earthquake



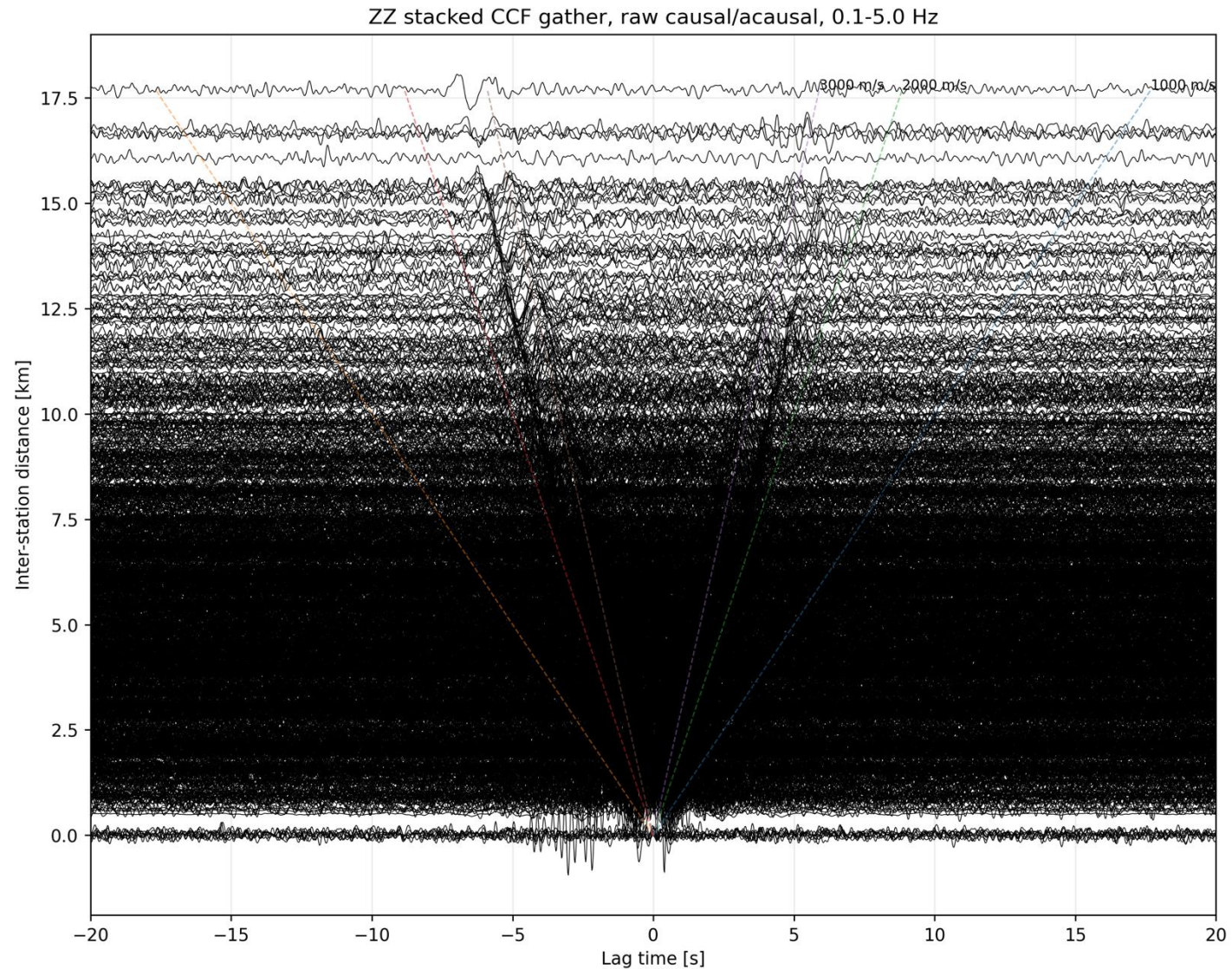
Ambient noise tomography



- noise → node vibrations → correlation → time/distance = rock speed
- then repeat for different signal frequencies (periods) → lower = deeper

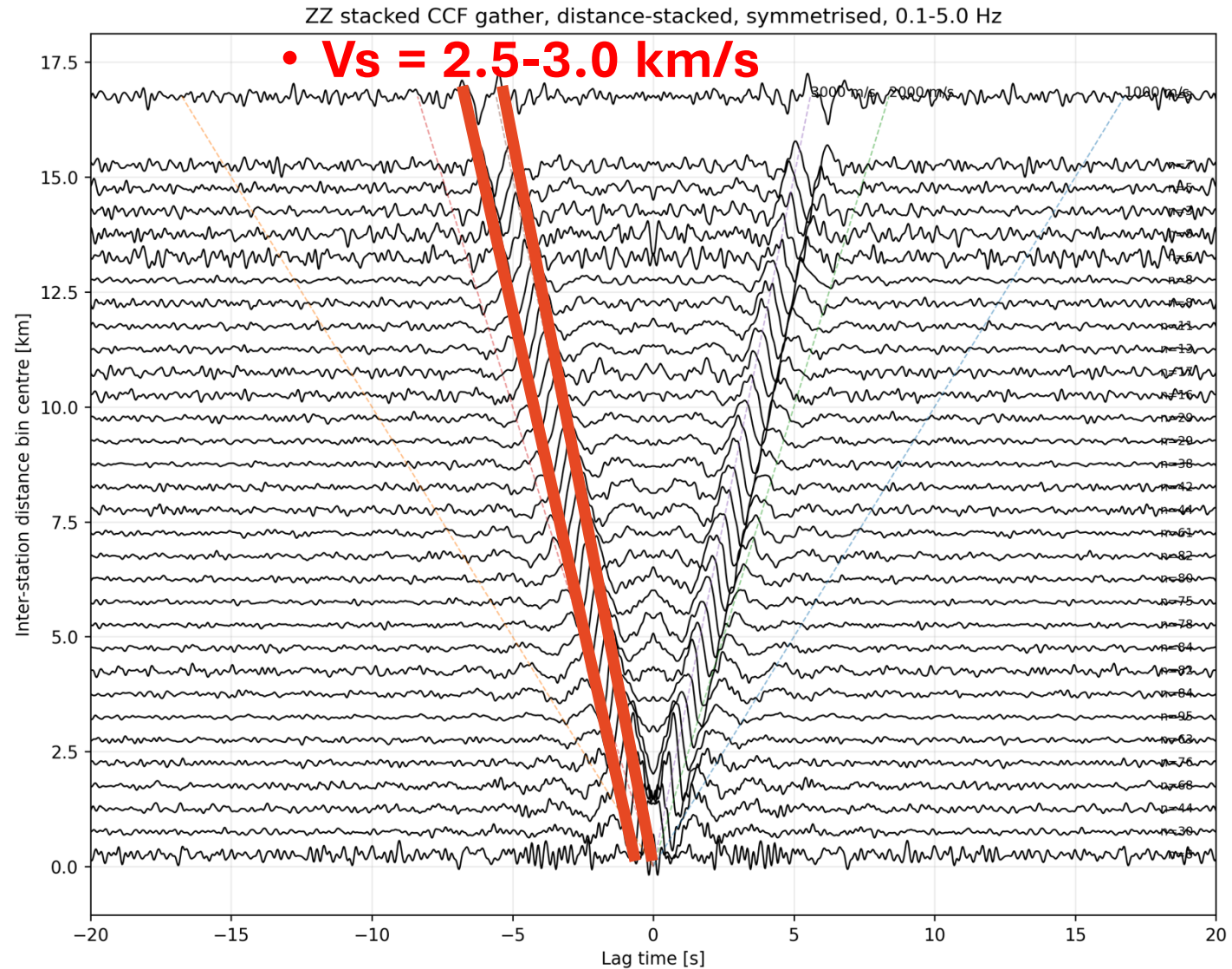
City Node Data – ZZ CCFs

0.1-5 Hz

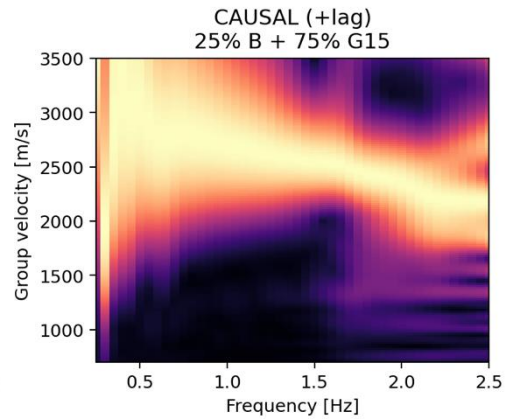
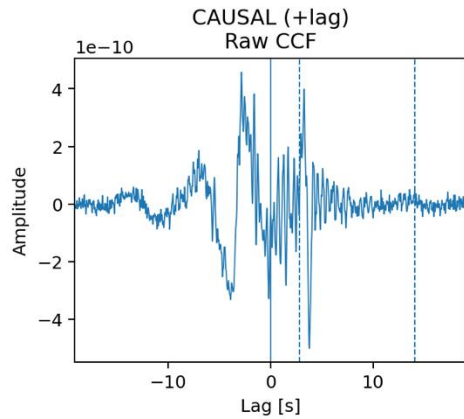


City Node Data – ZZ CCFs

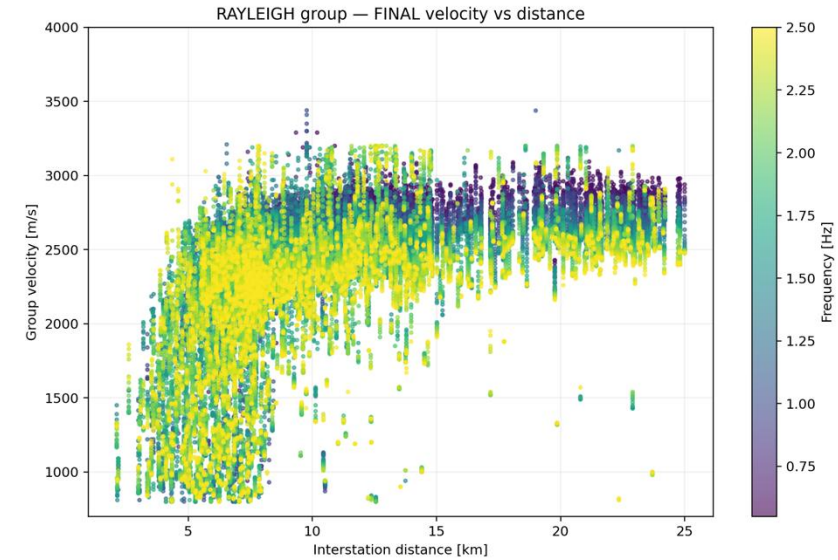
0.1-5 Hz



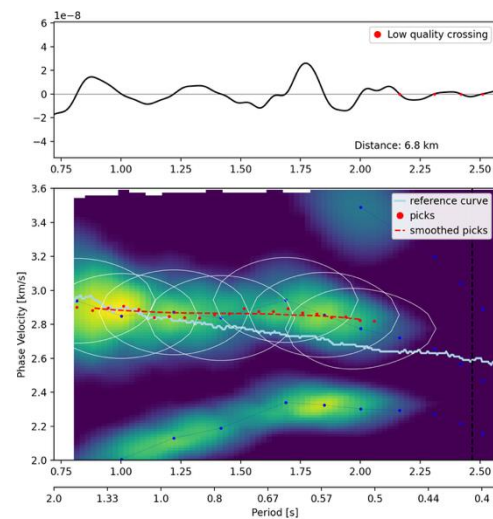
Rayleigh Wave Group + Phase Picks



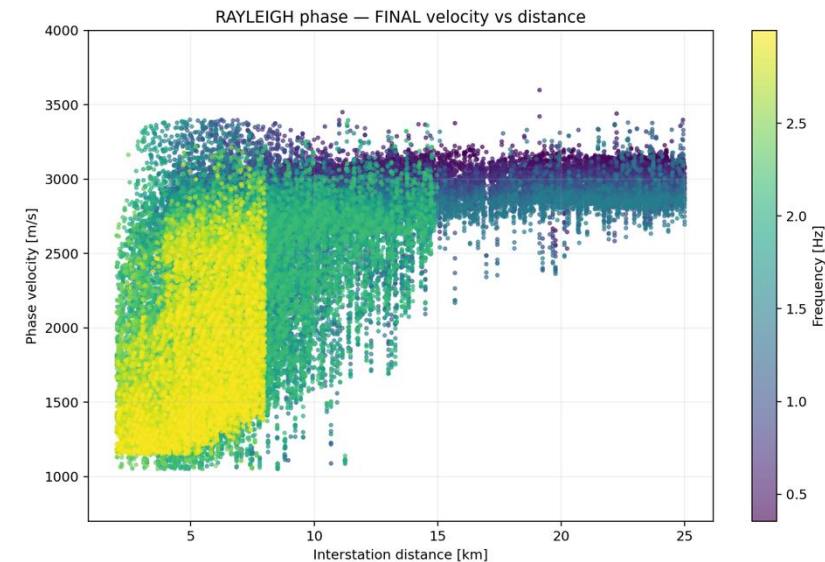
FTAN



46,850
GROUP
PICKS



SEISLIB
+ CC-FJ



78,928
PHASE
PICKS

GeoPVI Joint Group/Phase Inversion

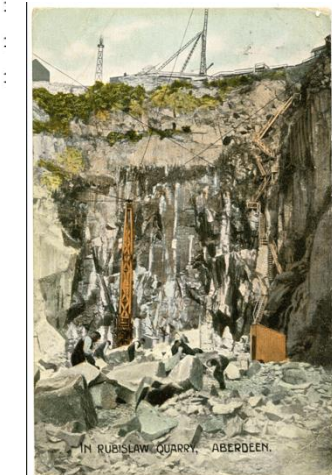
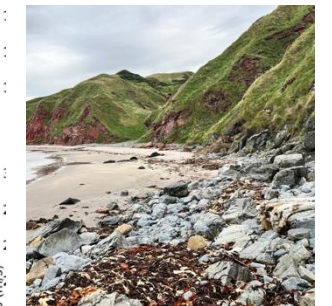
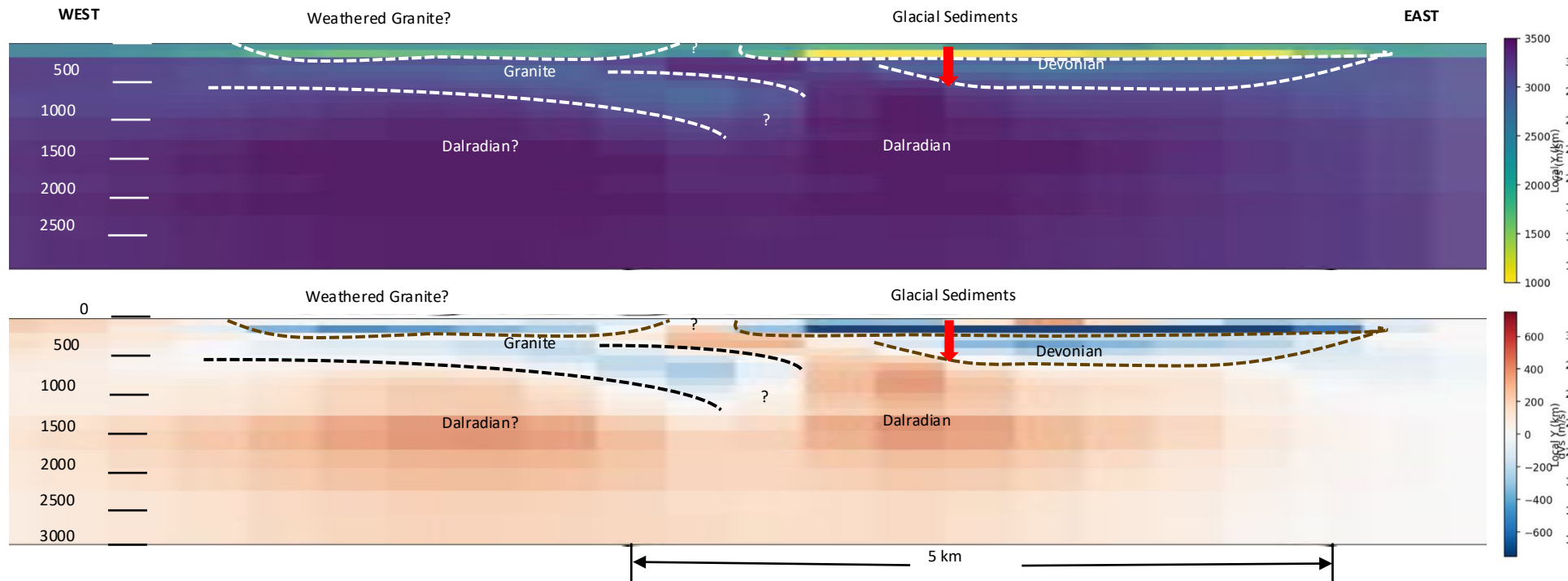
Direct 3-D joint inversion → S-wave velocity-depth:

- Group and phase Rayleigh wave picks
- Can add Love wave / density / other models to joint inversion later

Seismic velocity is not temperature:

- Shear-wave velocity (V_s) maps the physical structure of the subsurface, e.g. contrasts between sediments and basement, weathered, fractured or structurally complex areas
- Interpretation requires geological and borehole information as well as the seismic model.

Initial Geological Interpretation



Passive Methods for Geothermal Exploration

- **Mapping geological structure:**
 - Where heat can be accessed
 - How groundwater may move through the subsurface
- **Geothermal heating but also for heat storage / cooling**
 - Integrated 'smart-city' energy delivery
- **Low-cost subsurface screening**
 - Ambient seismic methods are quick and low-cost
 - First-pass 3-D subsurface model for geothermal feasibility / de-risking drilling

Ways To Engage

- Ideas for collaboration welcome!
- All datasets will be publicly available.
- Available to discuss geothermal / come to your city in the future 😊
- Loan our Smartsolo 3C nodes!
- Website: <https://www.abdn.ac.uk/geothermal/>
- LinkedIn Page: <https://www.linkedin.com/company/aberdeen-geothermal-feasibility-pilot-agfp/>
- Email ideas/meeting requests/contacts/other to geothermal@abdn.ac.uk



Imaging Aberdeen with Seismic Noise: Passive Methods for Geothermal Exploration

AGFP Project Team

geothermal@abdn.ac.uk

Dave Cornwell (Co-Lead)

d.cornwell@abdn.ac.uk

GeoPVI Joint Group/Phase Inversion

Rayleigh FINAL-v3 GRID500 — depth = 0.100 km

