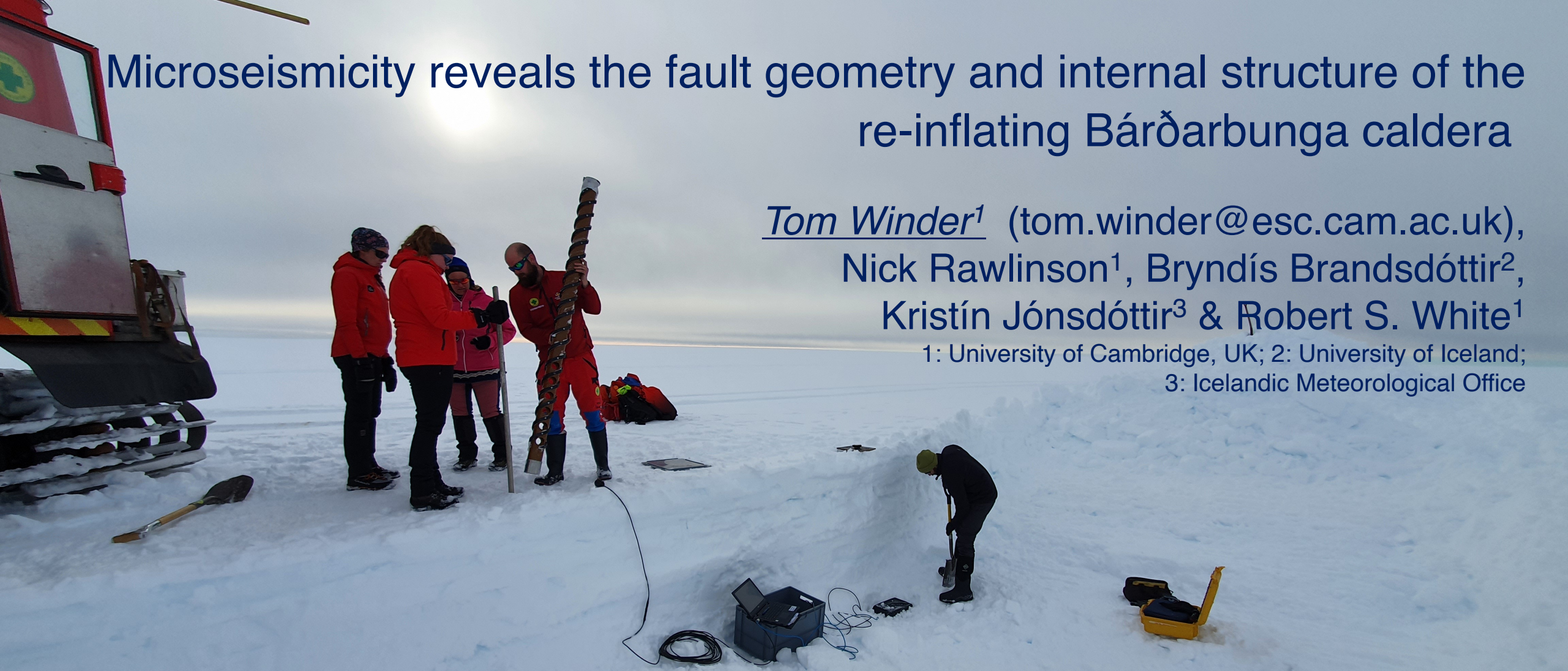
Microseismicity reveals the fault geometry and internal structure of the re-inflating Bárðarbunga caldera



Tom Winder[1] (tom.winder@esc.cam.ac.uk),
Nick Rawlinson[1], Bryndís Brandsdóttir[2],
Kristín Jónsdóttir[3] & Robert S. White[1]

1: University of Cambridge, UK; 2: University of Iceland;
3: Icelandic Meteorological Office

(with special thanks to Omry Volk, Hlynur Skagfjörð, Sveinbjörn Steinthórsson, Conor Bacon, Esme Glastonbury-Southern, and all members of the 2021 JORFÍ Spring Expedition!)

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Department of Earth Sciences

The Geological Society
The Andrew Croft Memorial Fund

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QuakeMigrate

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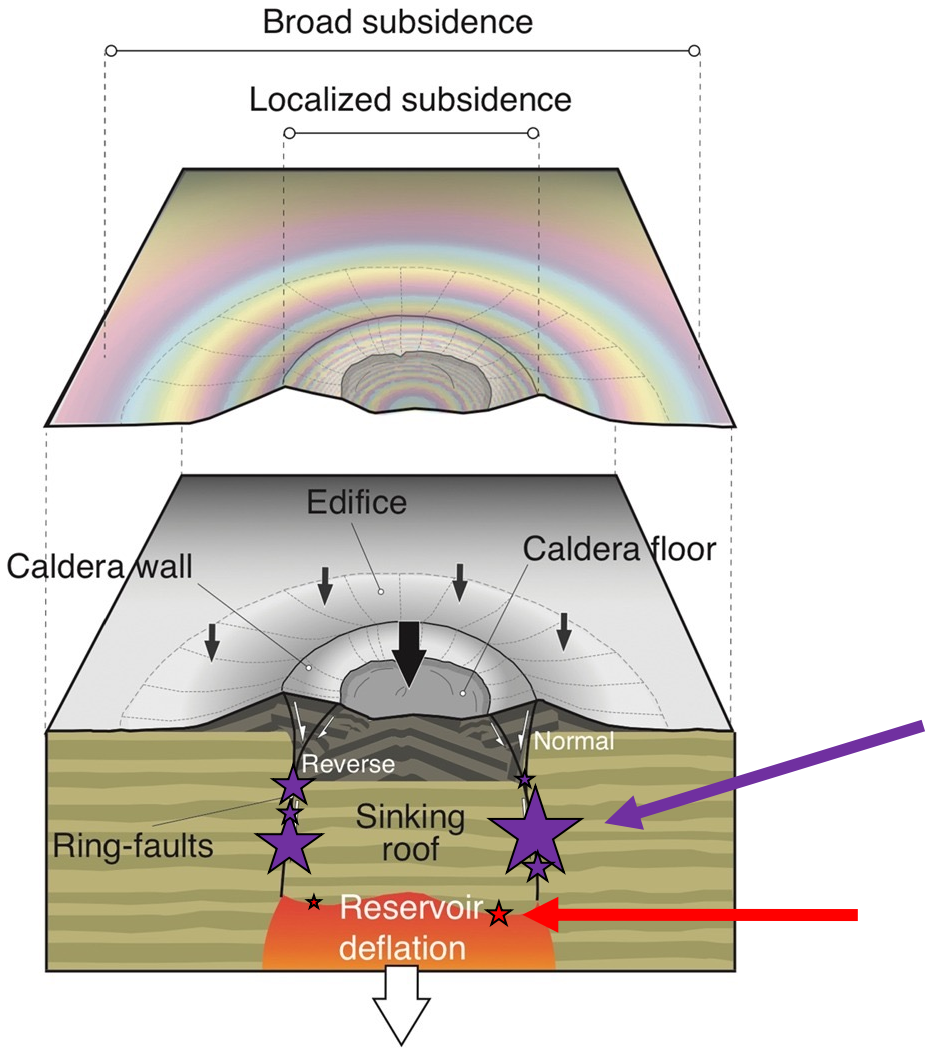

Liu et al. (2019) *EPSL*

- Seismicity provides direct information about fault slip along caldera ring faults
- Large earthquakes are complex, likely as a result of ring-fault curvature
- Microseismicity can provide a high resolution picture of the fault geometry and its motion

Using seismology to study actively-deforming calderas

Microseismicity reveals the fault geometry and internal structure of the re-inflating Bárðarbunga caldera

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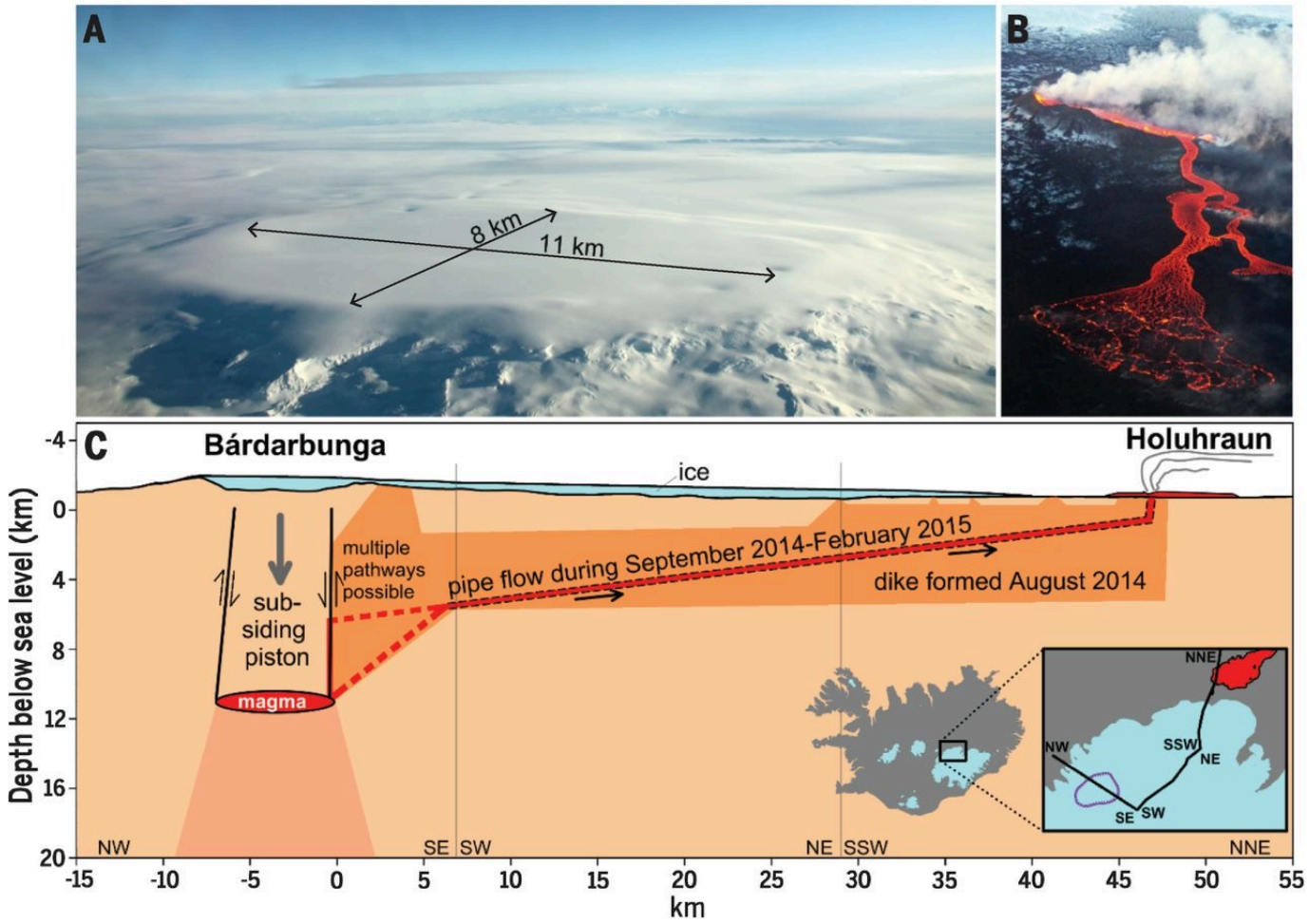

Gudmundsson et al. (2016) *Science*

- Large ice-filled caldera located beneath the Vatnajökull ice-cap, Iceland
- Dramatic & well-recorded eruption and caldera collapse in 2014-15
- Now re-inflating, with continued heightened microseismicity

Geological setting: Bárðarbunga volcano, Iceland

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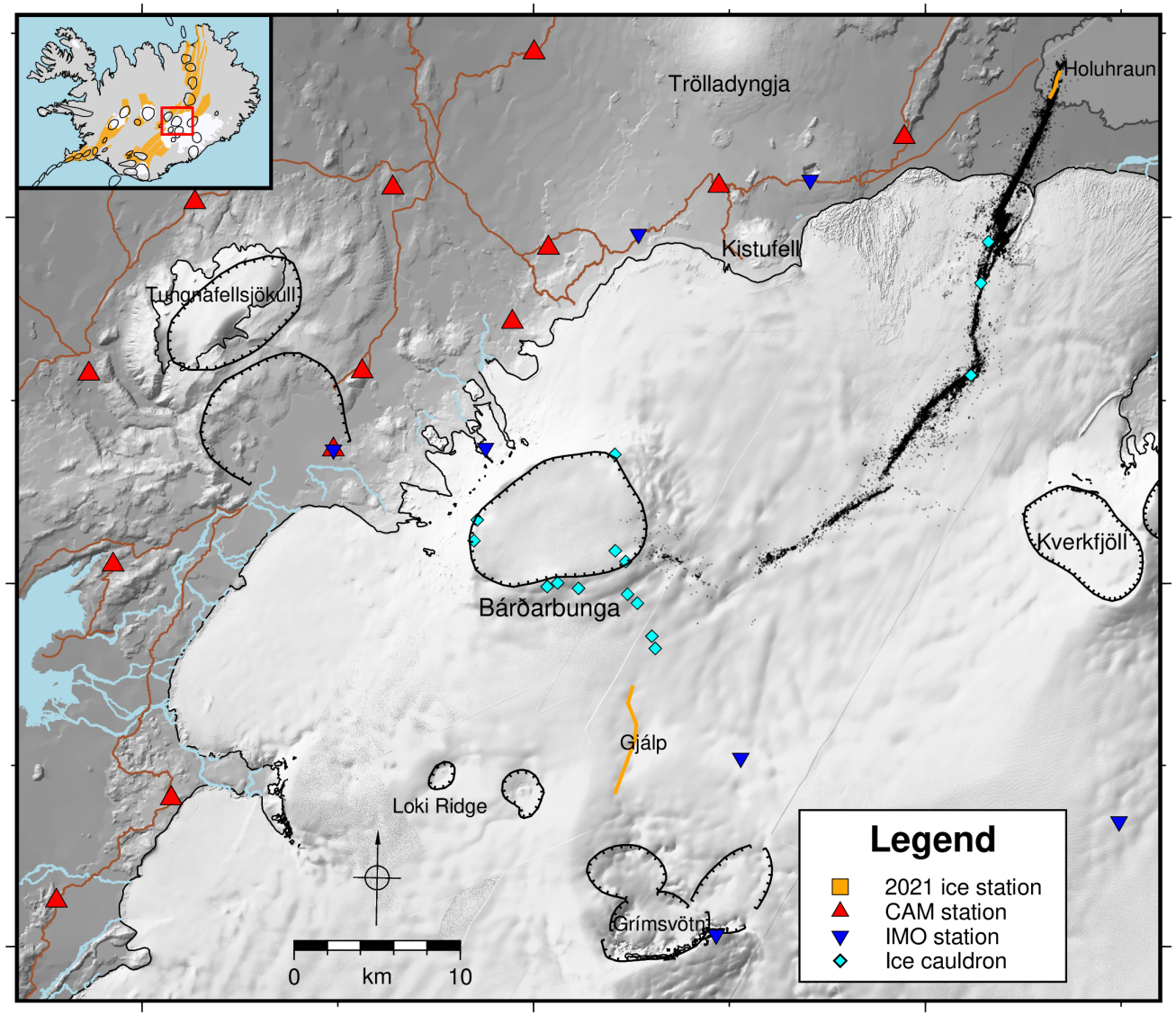

- Seismic network geometry determines detection threshold and accuracy of locations & focal mechanisms.

Seismic network geometry

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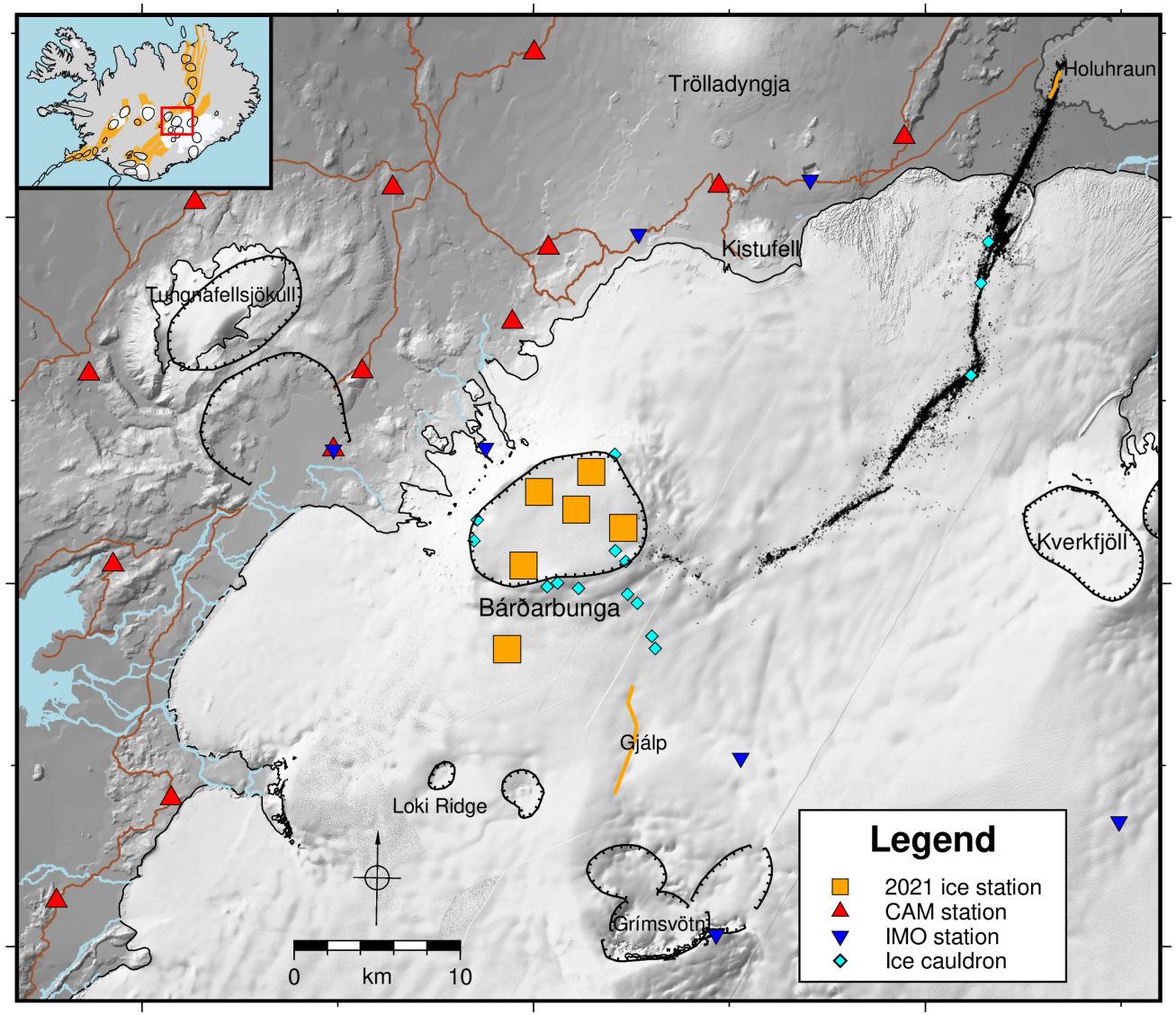

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- 6 stations deployed on the glacier between June-August 2021

Seismic network geometry – summer 2021 glacier stations

Microseismicity reveals the fault geometry and internal structure of the re-inflating Bárðarbunga caldera

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Deployment!

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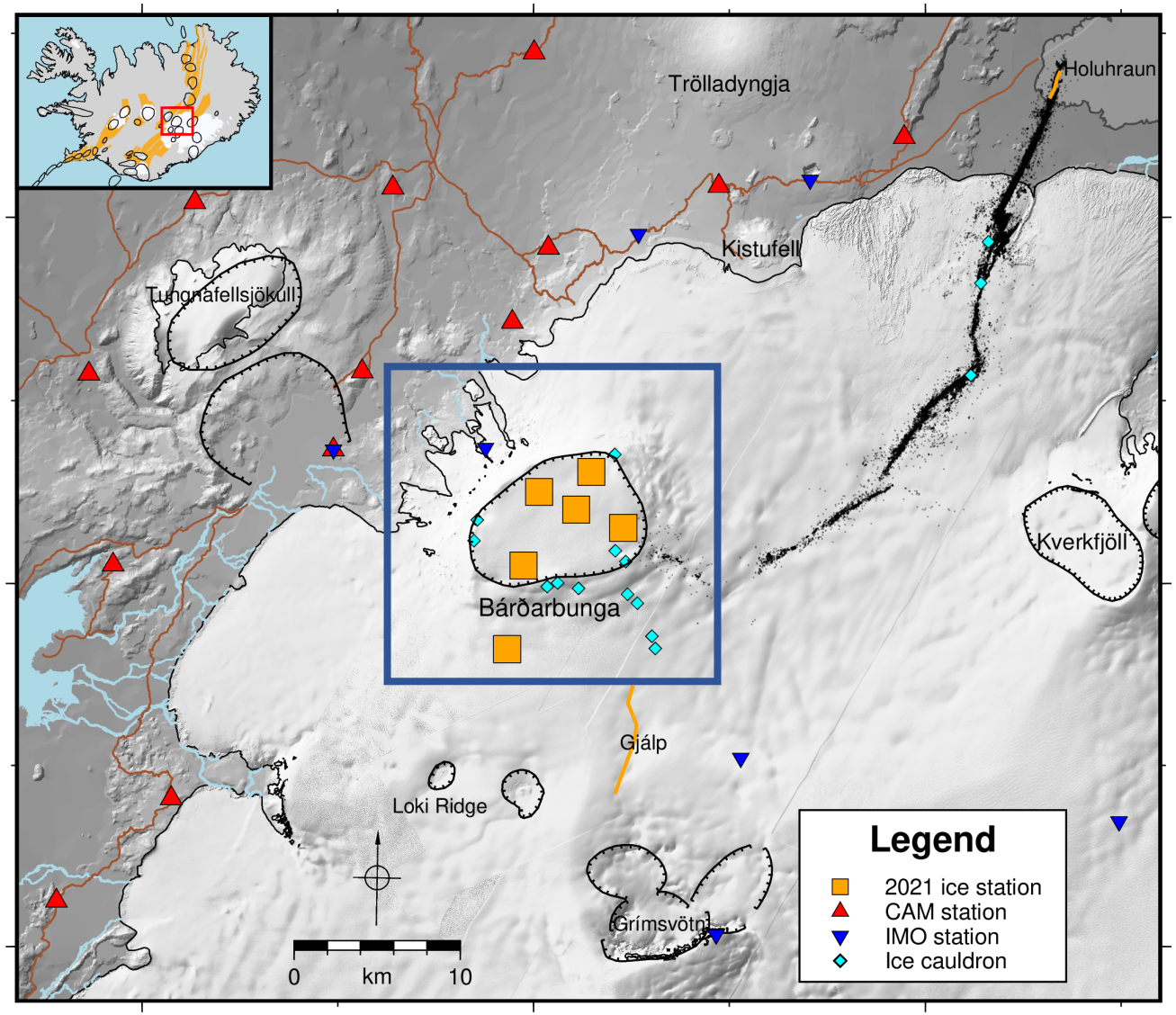

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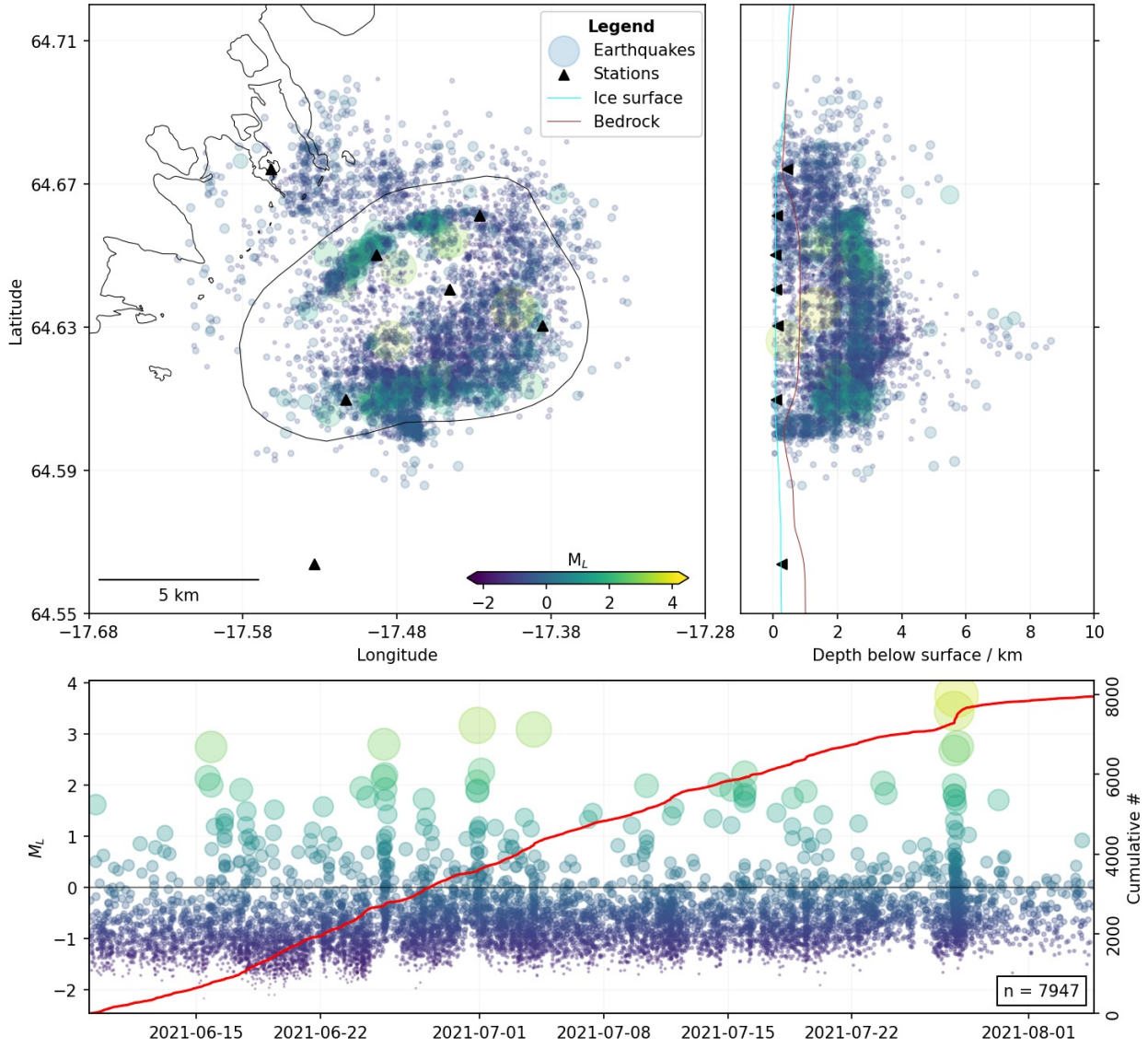

QuakeMigrate catalogue: ~ 8,000 events

- QuakeMigrate software used to produce an automatic earthquake catalogue from continuous waveform data
- ~ 8,000 earthquakes detected during the two-month deployment, with M_c ~ -1
- Earthquakes concentrated in top 4 km of the ring-fault system

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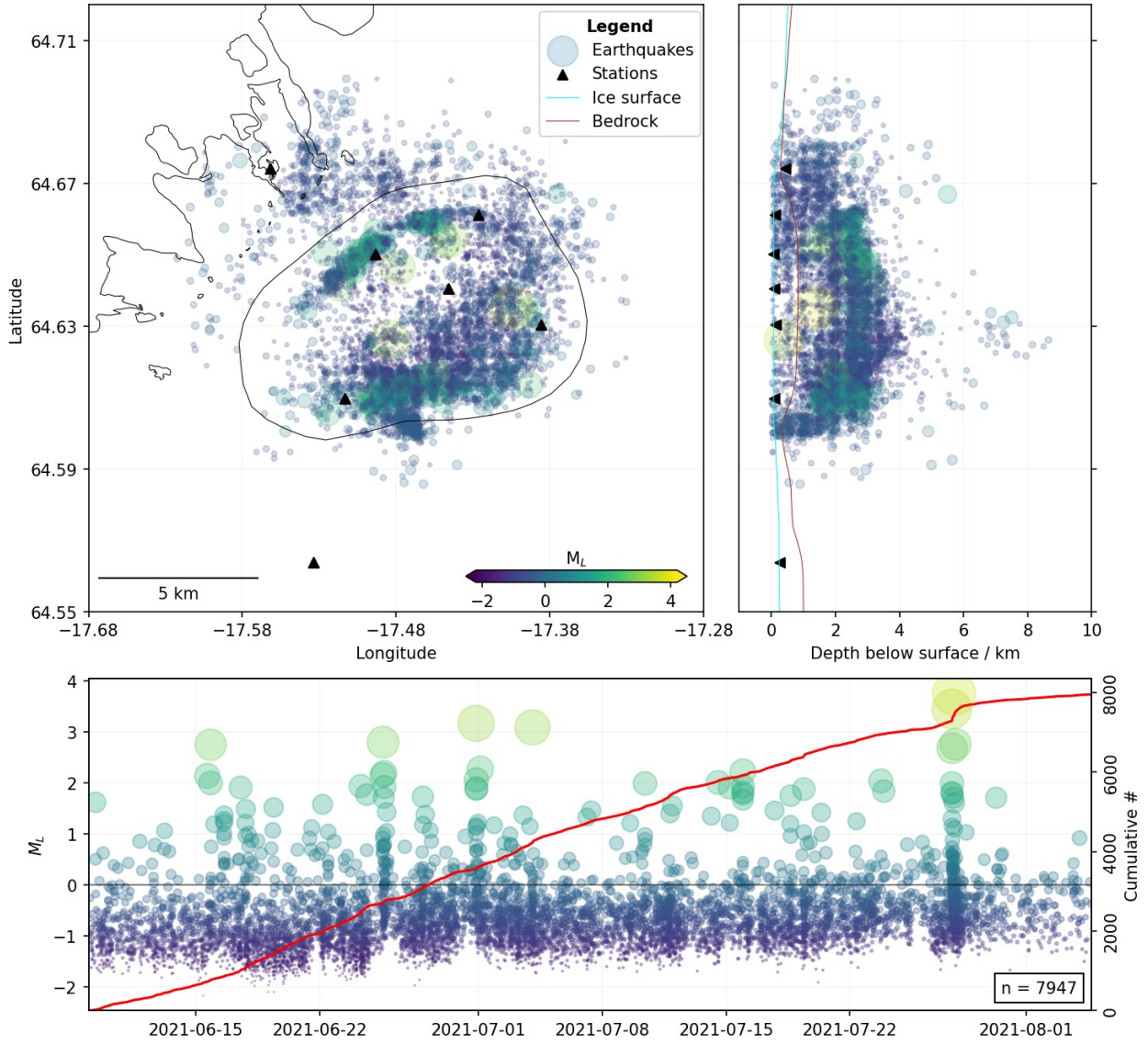

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- QuakeMigrate short-course SC5.16 - Friday 13:20-14:50!

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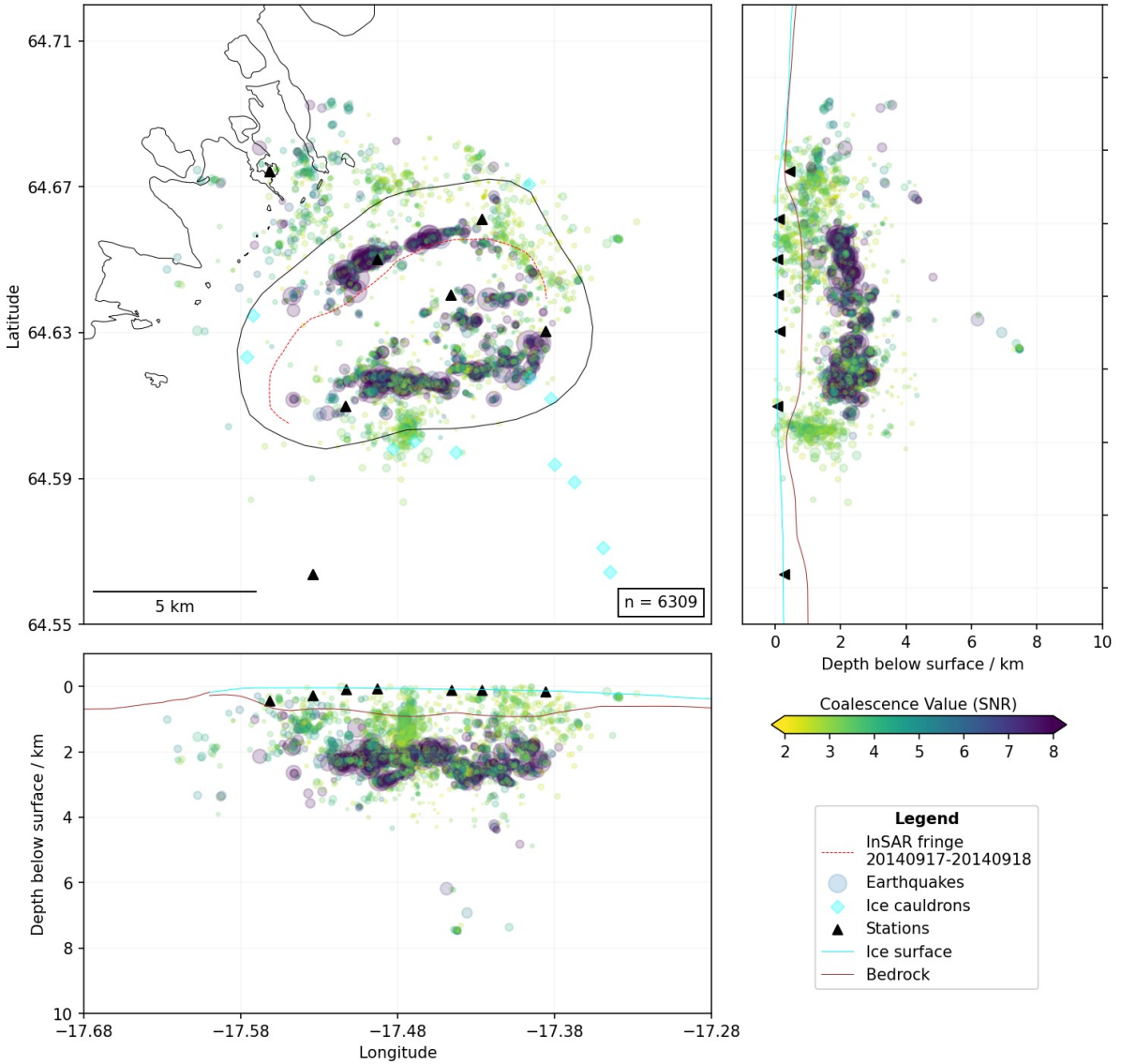

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Relocated microseismicity delineates the caldera ring fault

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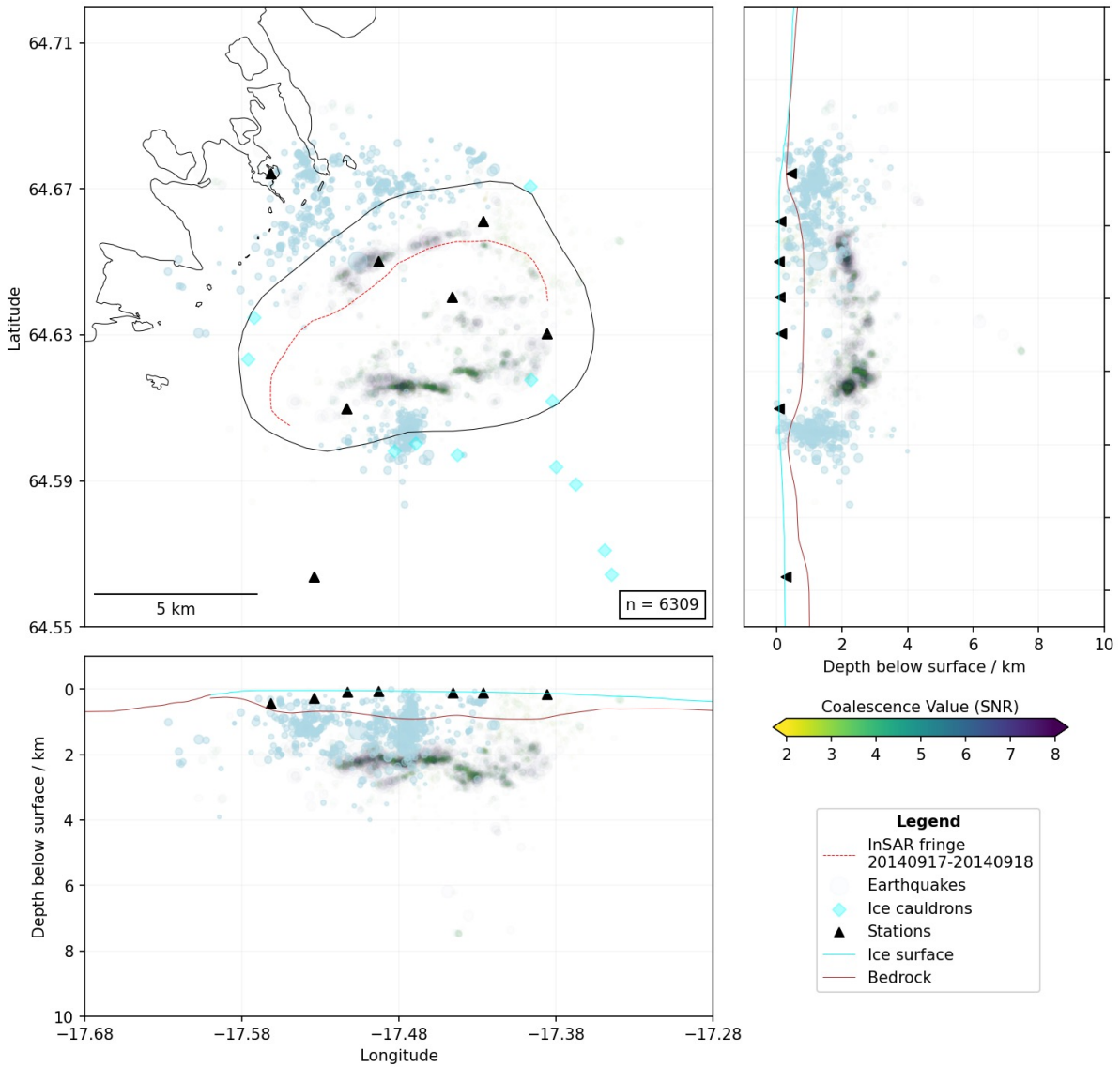

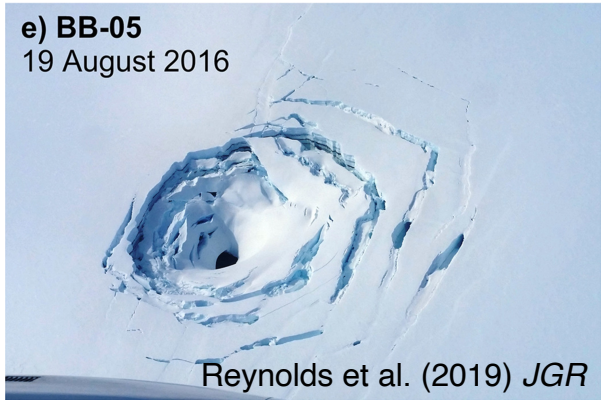

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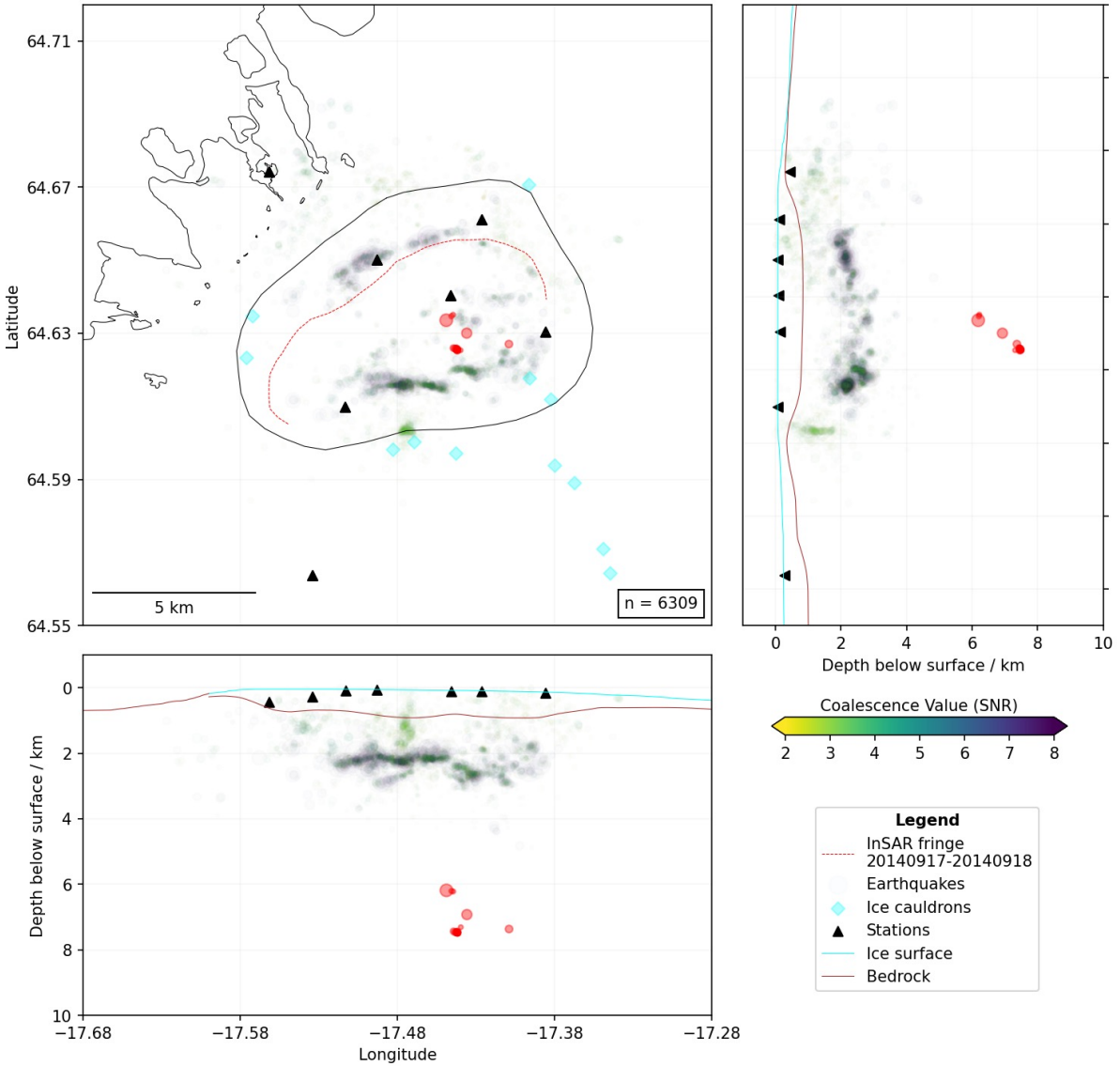

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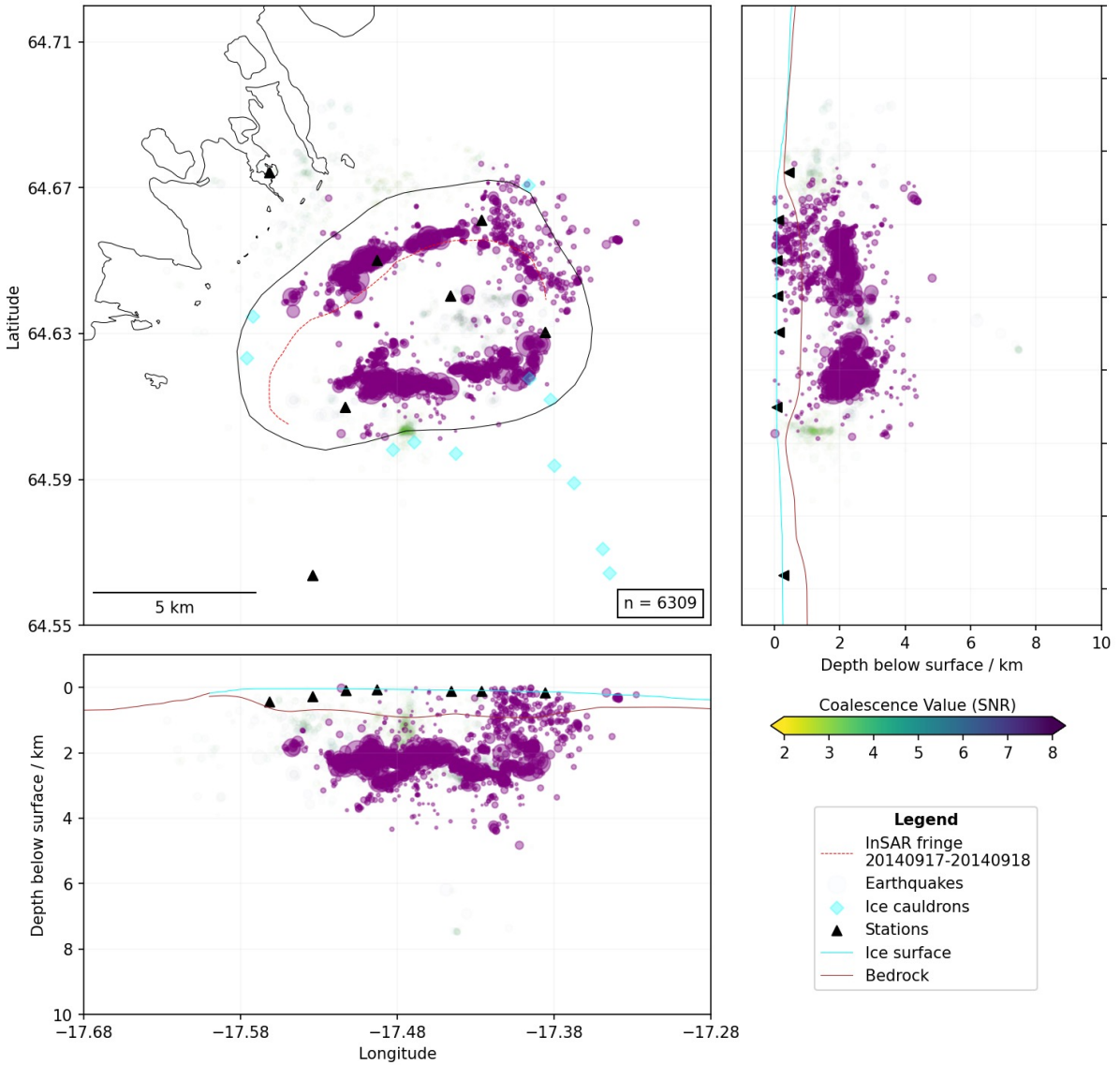

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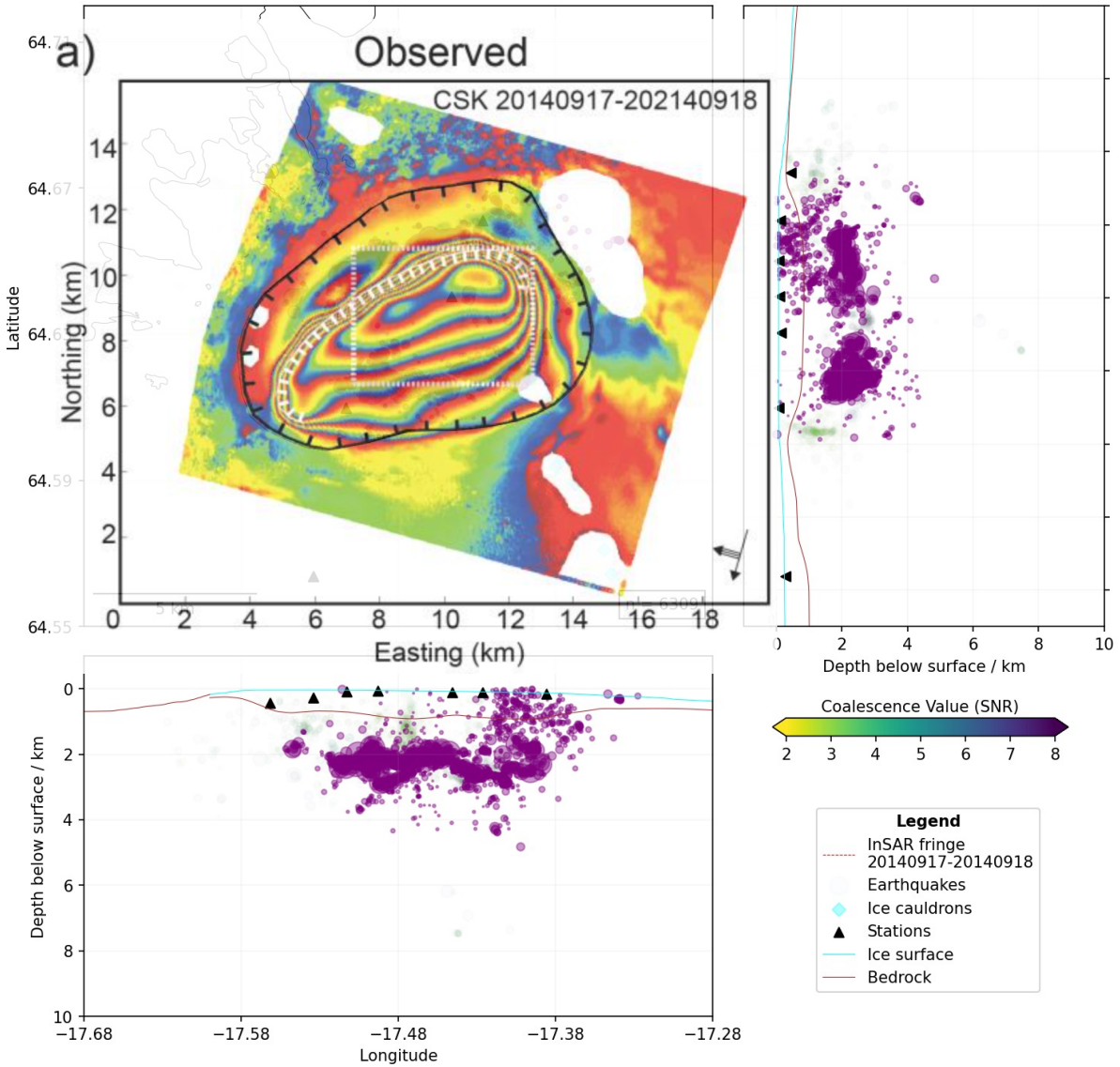

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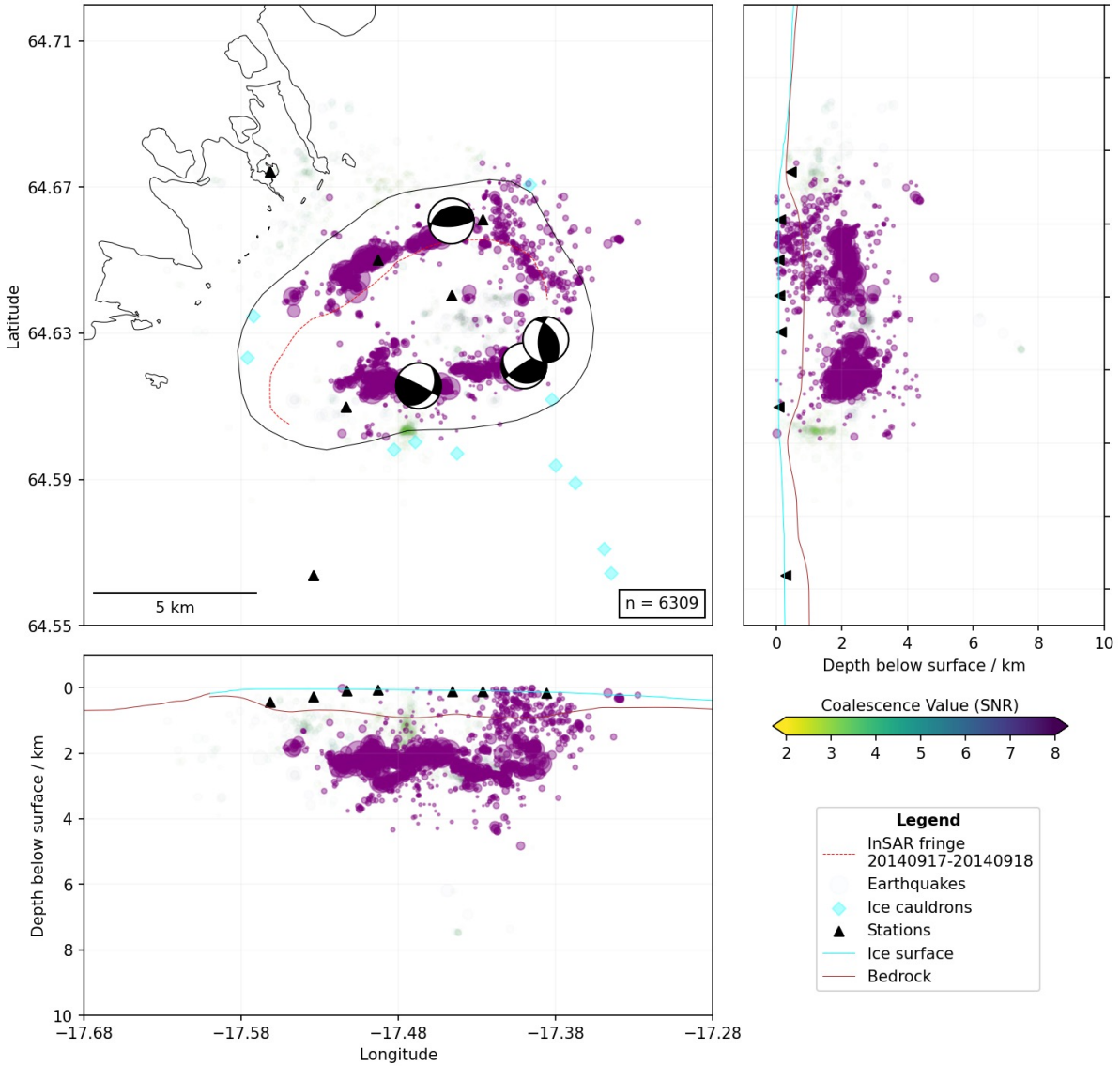

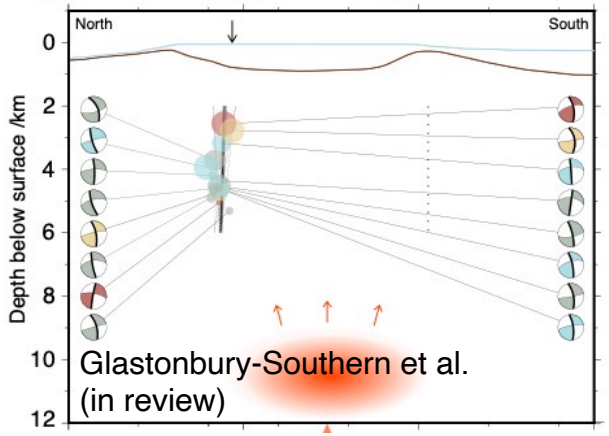

- Seismicity divided into 3 main types:
  - Shallow events likely related to ice movement & hydrothermal activity
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  - Ring fault seismicity
- Seismicity precisely delineates the curved shape of the active ring fault

Relocated microseismicity delineates the caldera ring fault

Microseismicity reveals the fault geometry and internal structure of the re-inflating Bárðarbunga caldera

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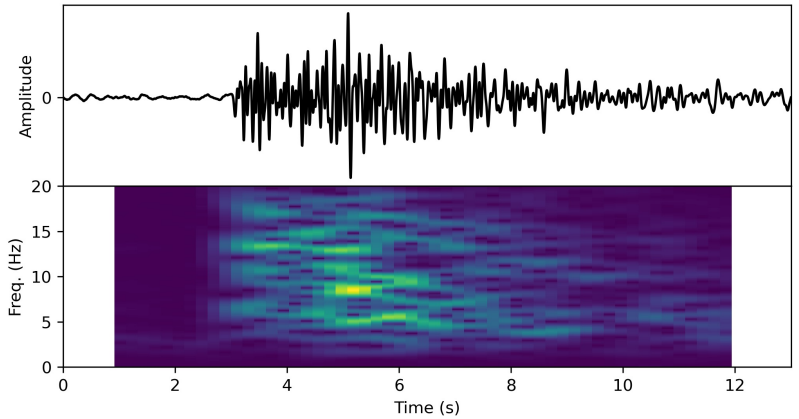

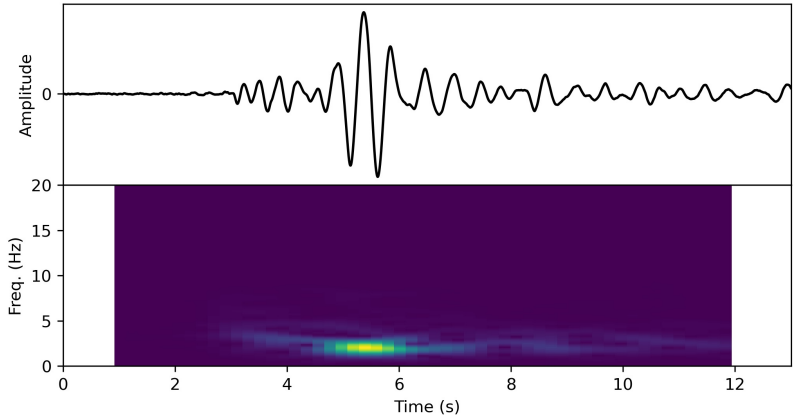

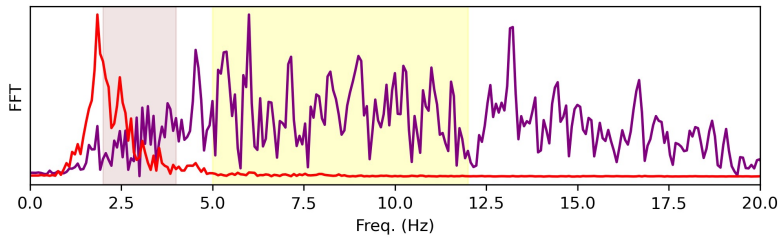

- Deep events have very different frequency content to similar magnitude shallow (ring fault) events
- Swarm-like occurrence also indicates a likely association with fluid processes
- An indication of where magma is moving currently?

Deep earthquakes are dominated by low frequencies

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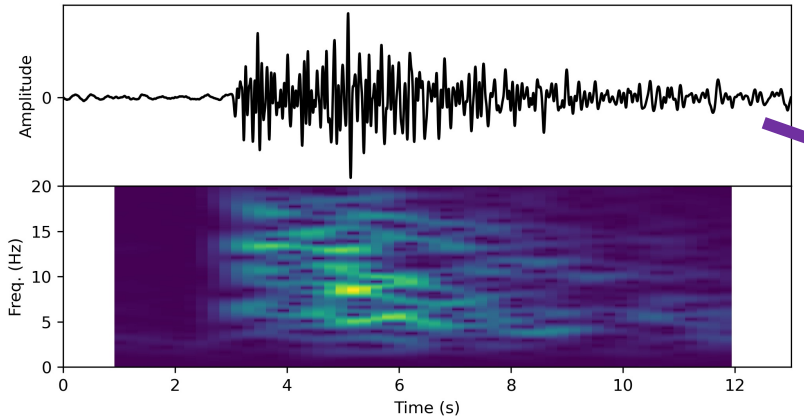

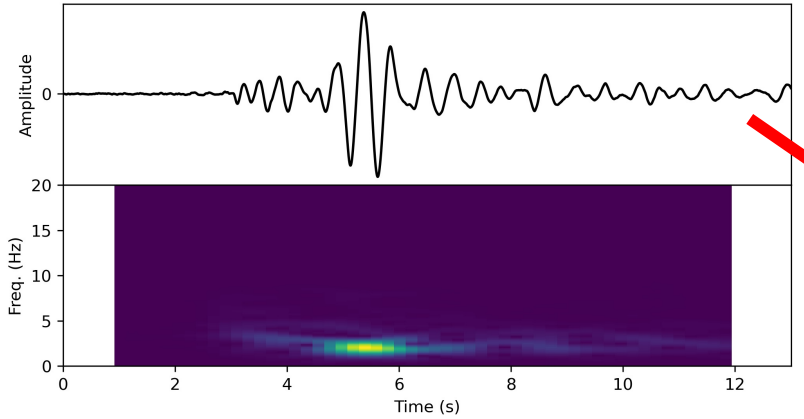

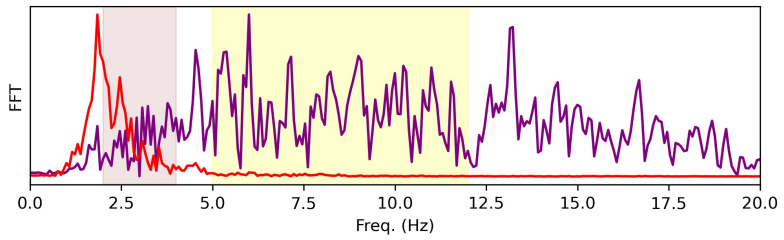

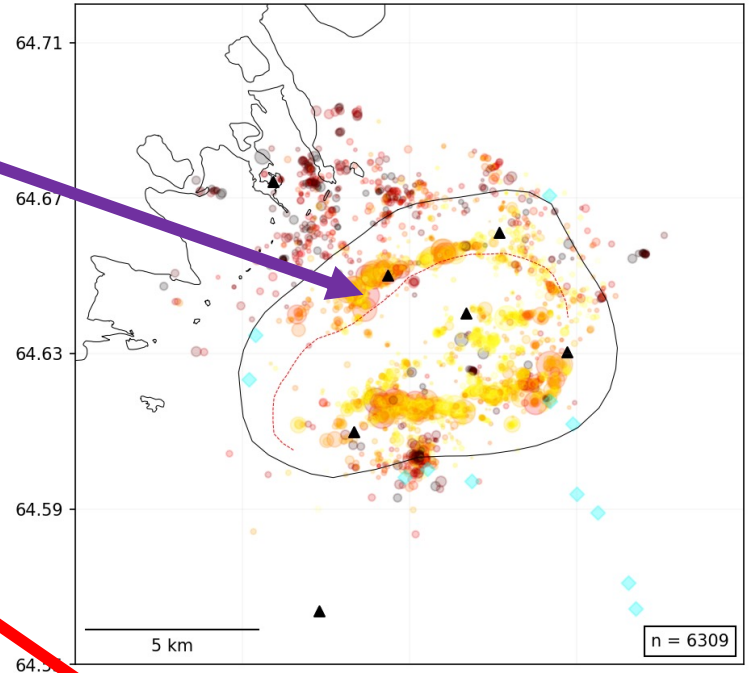

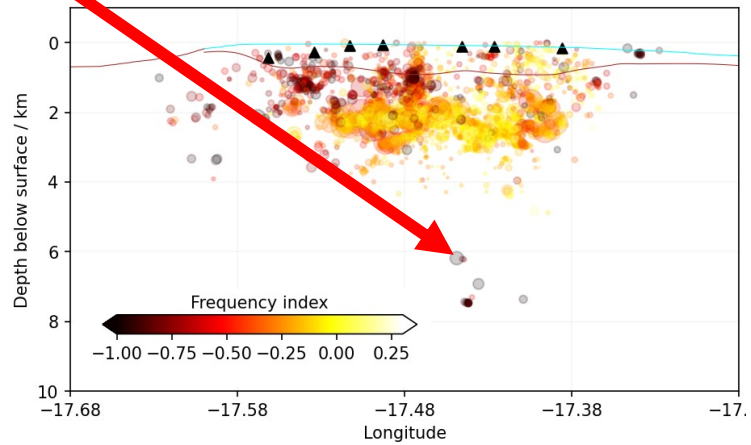

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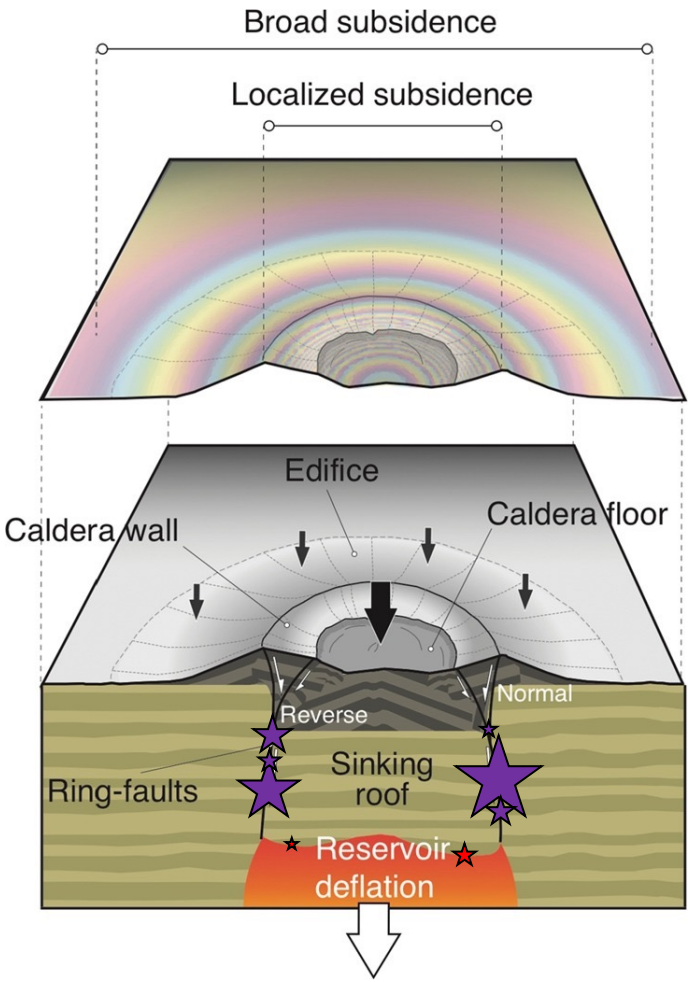
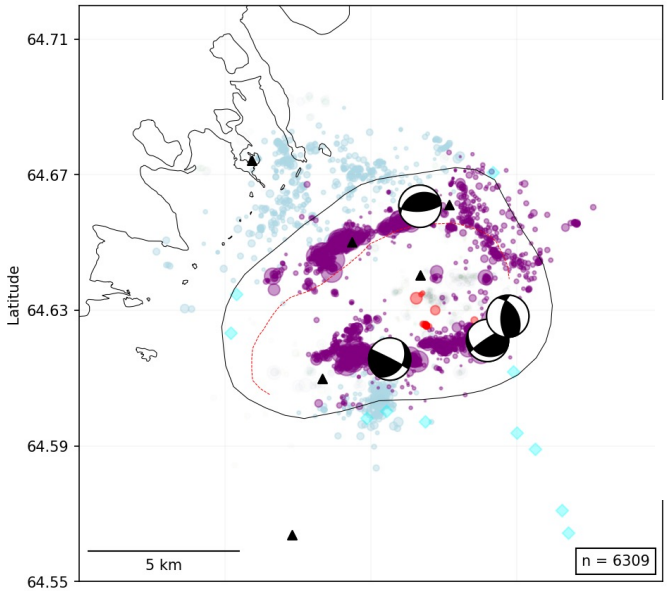
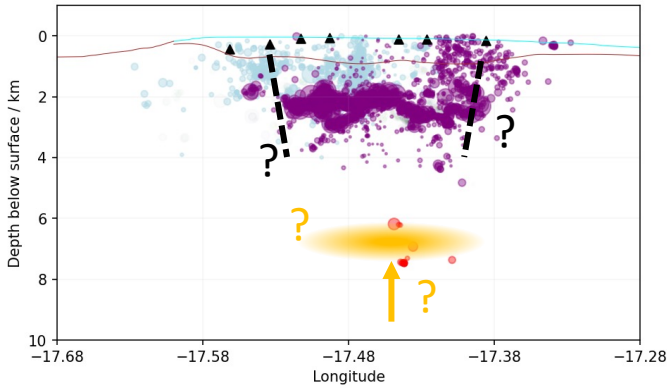


Liu et al. (2019) *EPSL*





Summary: a new picture of the internal structure of Bárðarbunga?

Microseismicity reveals the fault geometry and internal structure of the re-inflating Bárðarbunga caldera

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Software

Read more about QuakeMigrate in our 2020 AGU poster:
(full publication coming soon!)


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QuakeMigrate: a Modular, Open-Source Python Package for Automatic Earthquake Detection and Location

You can download QuakeMigrate on GitHub:

https://github.com/QuakeMigrate/QuakeMigrate

Access the documentation on readthedocs:

https://quakemigrate.readthedocs.io/en/latest/

And follow updates on Twitter!

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