

Relatively-relocated seismicity during the 2021 Fagradalsfjall dyke intrusion, Reykjanes Peninsula, Iceland:

Detailed evolution of a lateral dyke, and comparison to Bárðarbunga-Holuhraun



Esme Glastonbury-Southern¹, Tim Greenfield¹, Tom Winder¹, Þorbjörg Ágústsdóttir², Bryndís Brandsdóttir³, Tomas Fischer⁴, Jana Doubravová⁵, Nick Rawlinson¹, Robert White¹, Egill Árni Gudnason², Gylfi Páll Hersir², Pavla Hrubcova⁵, Conor Bacon¹, Eva P. S. Eibl⁶

¹University of Cambridge, ²Iceland GeoSurvey, Reykjavík, ³University of Iceland, ⁴Charles University, ⁵Institute of Geophysics, Prague, ⁶University of Potsdam

The Team - Cambridge + NASPMON



The following people from the following institutions have contributed in the form of data, analysis, and/or fieldwork:

University of Cambridge

Esme Glastonbury-Southern, Tim Greenfield, Tom Winder, Nick Rawlinson, Robert White, Conor Bacon

Háskóli Islands

Bryndís Brandsdóttir

ÍSOR

Þorbjörg Ágústsdóttir, Egill Árni Gudnason, Gylfi Páll Hersir

Charles University

Tomas Fischer

Institute of Geophysics, Prague

Jana Doubravová, Pavla Hrubcova

University of Potsdam

Eva P. S. Eibl

NASPMON

- Introducing the seismic network
- Seismicity during the dyke intrusion
- Comparing Fagradalsfjall to the Bárðarbunga-Holuhraun dyke intrusion

Introduction

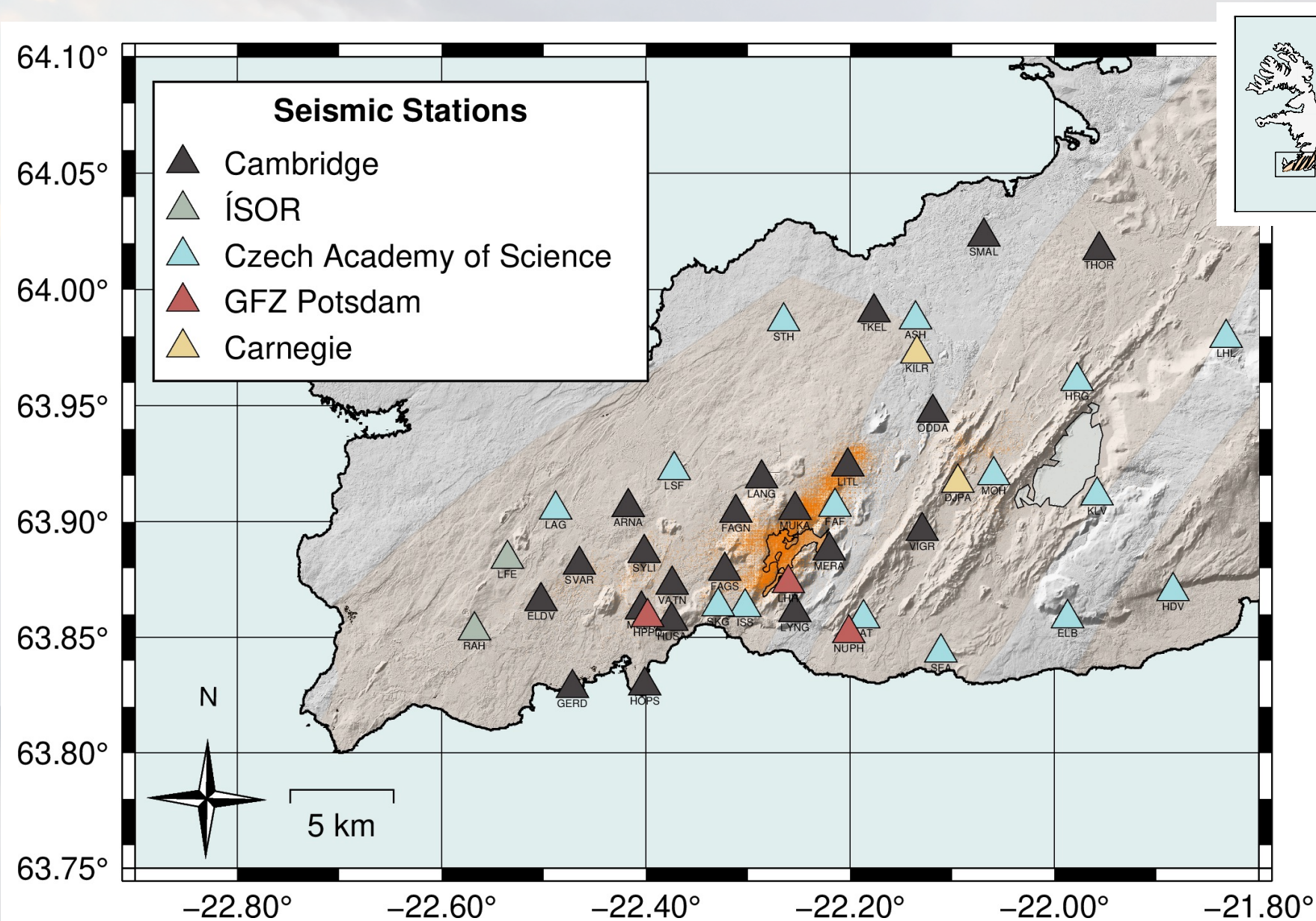
Data

Seismicity

Discussion

Esme Glastonbury-Southern
eos24@cam.ac.uk
Abstract: EGU22-8804

The Reykjanes network



Introduction

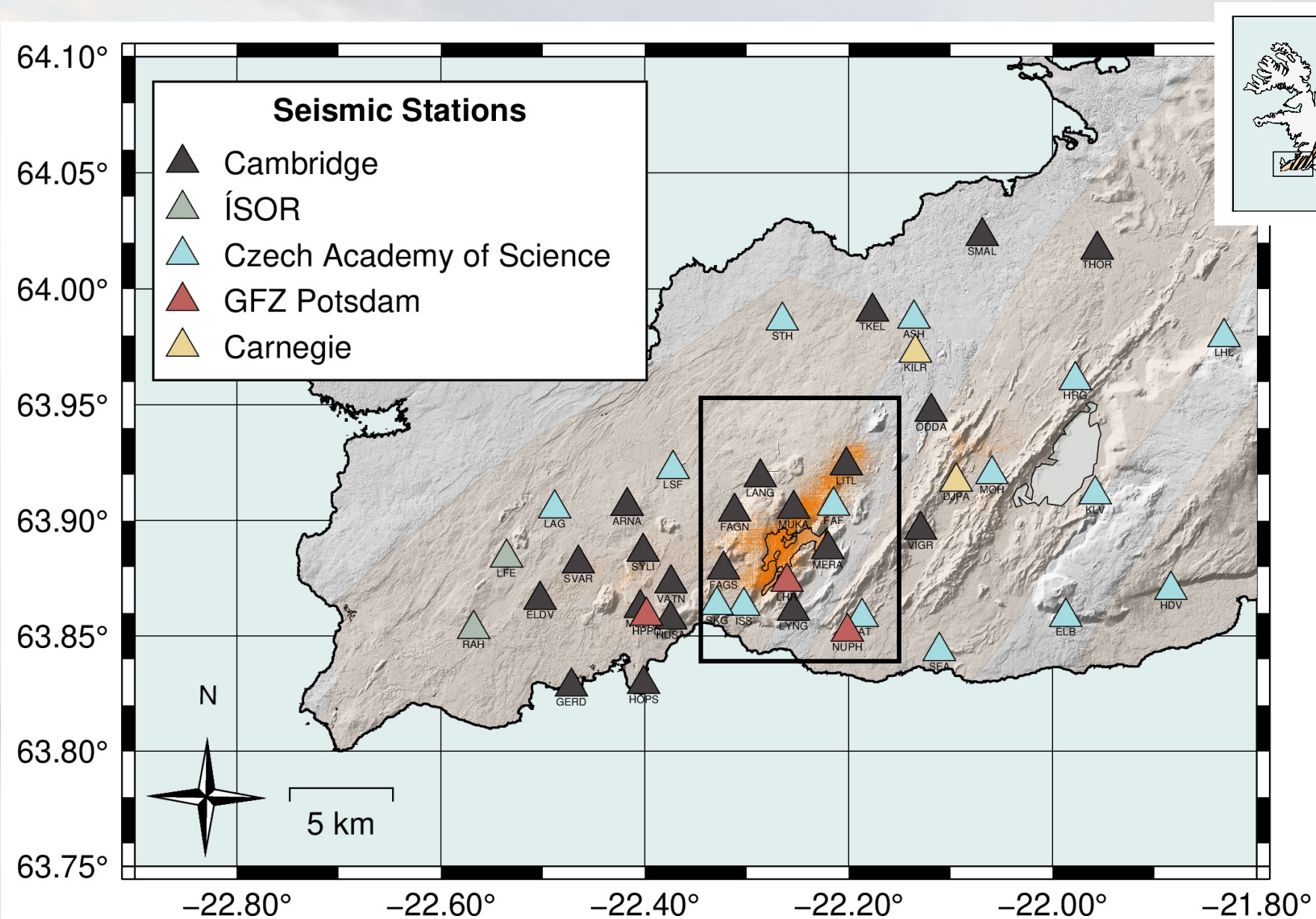
Data

Seismicity

Discussion

Esme Glastonbury-Southern
eos24@cam.ac.uk
Abstract: EGU22-8804

The Reykjanes network



Introduction

Data

Seismicity

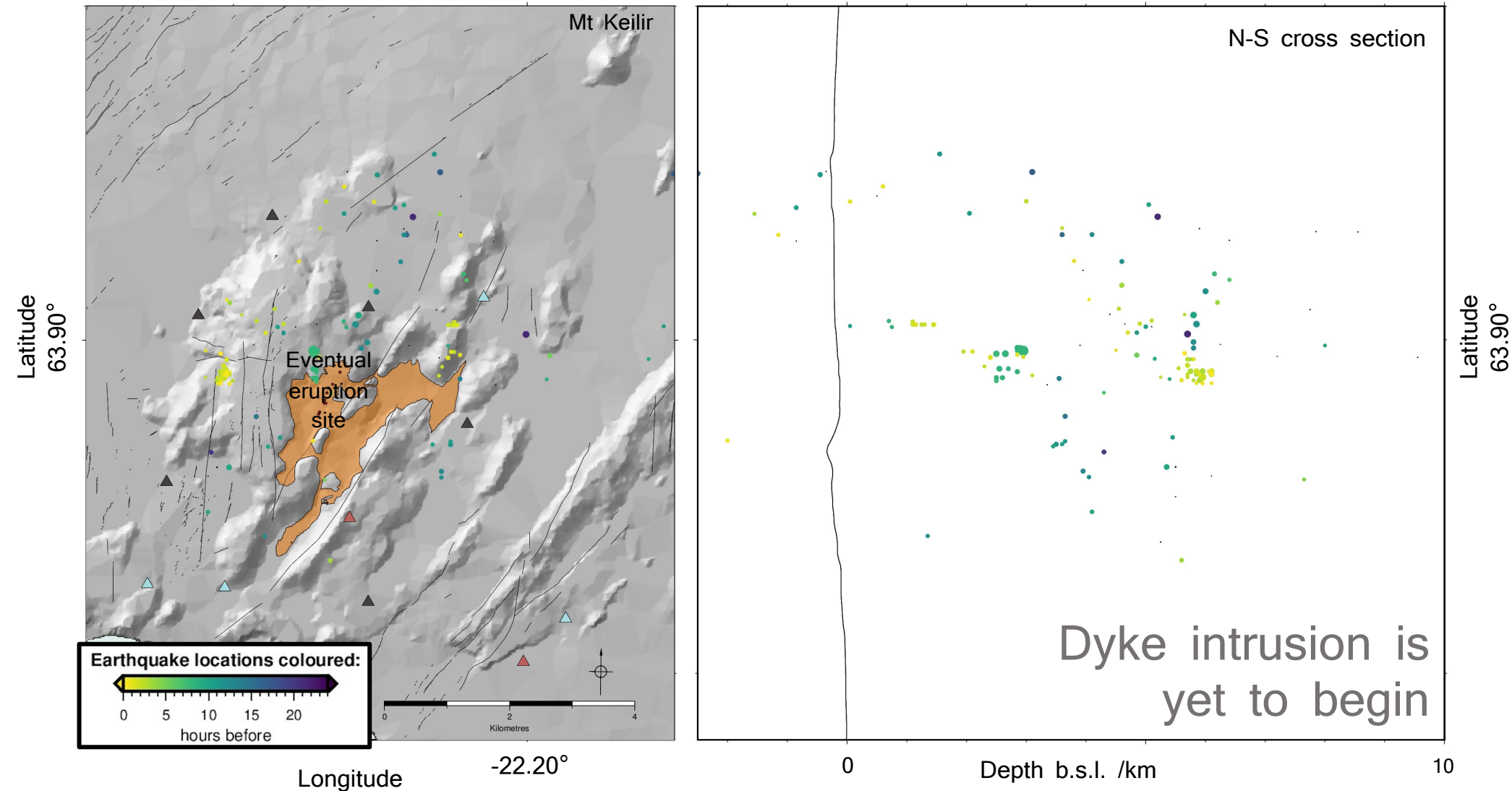
Discussion

Esme Glastonbury-Southern
eos24@cam.ac.uk
Abstract: EGU22-8804

Seismicity during the dyke intrusion

- Seismicity located using QuakeMigrate (Winder et al., 2021)
- Fault plane solutions and manual locations for events over M4

Feb 21st



Introduction

Data

Seismicity

Discussion

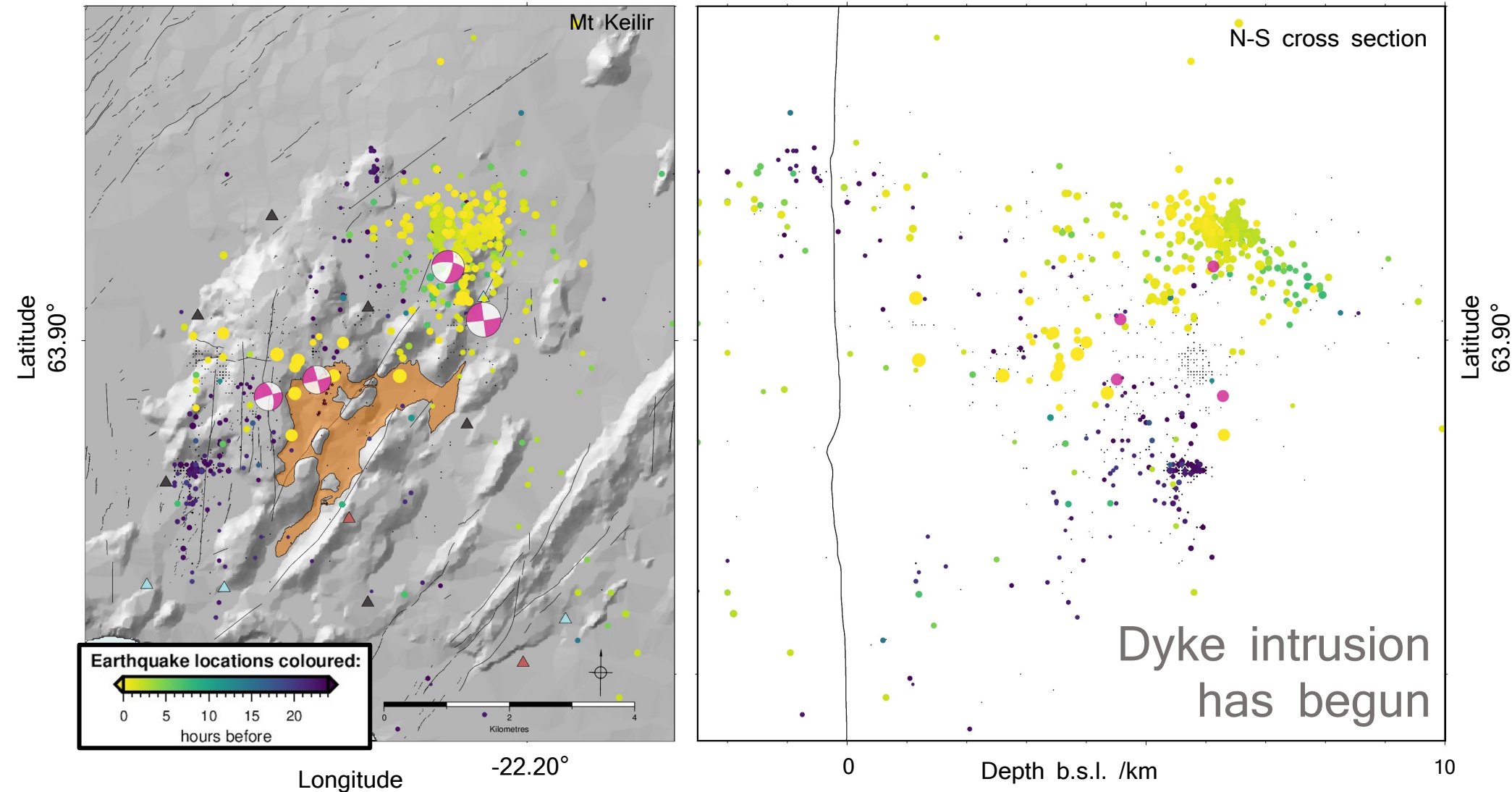
Esme Glastonbury-Southern
eos24@cam.ac.uk
Abstract: EGU22-8804



Seismicity during the dyke intrusion

- Seismicity located using QuakeMigrate (Winder et al., 2021)
- Fault plane solutions and manual locations for events over M4

Feb 24th



Introduction

Data

Seismicity

Discussion

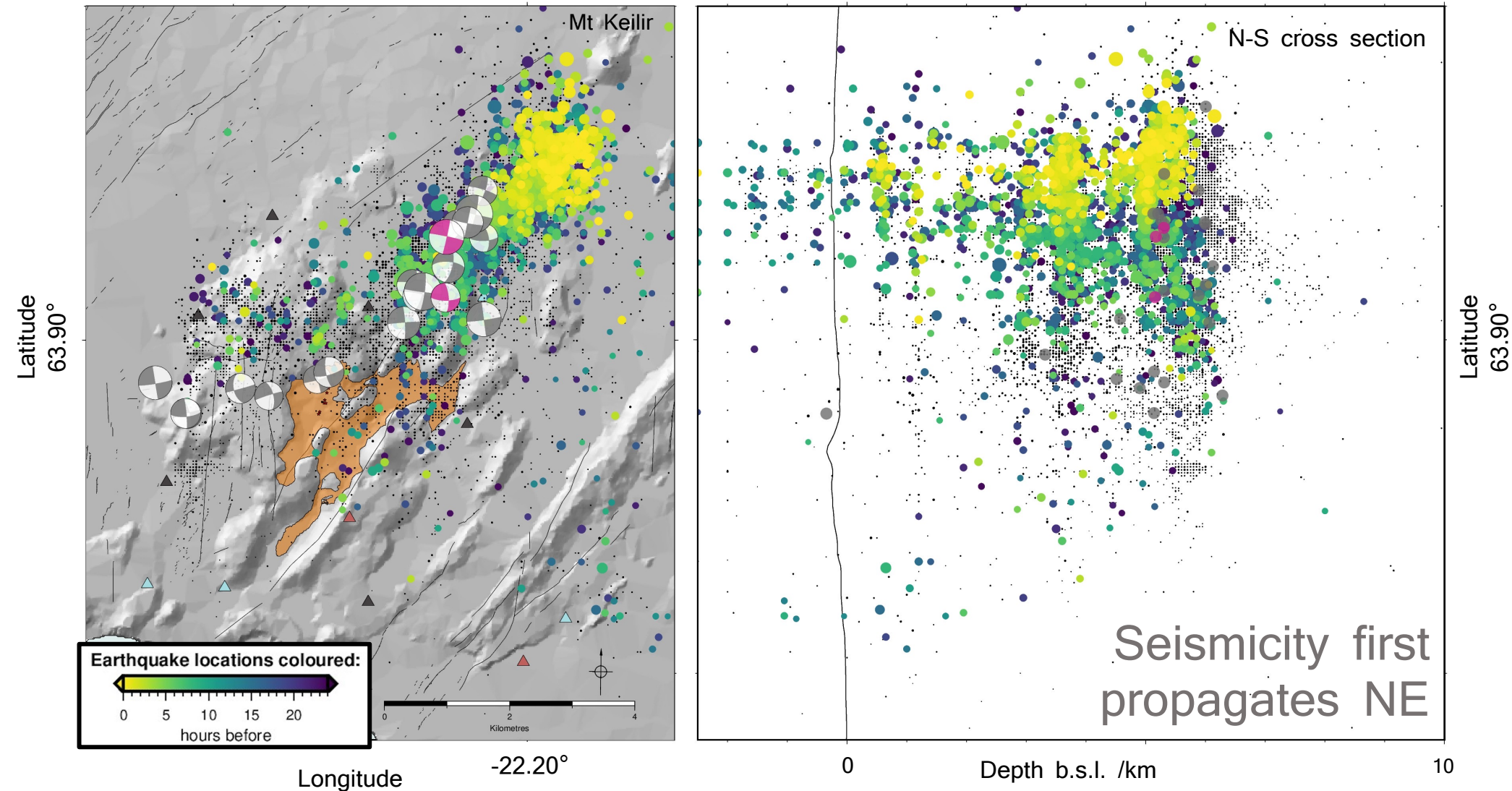
Esme Glastonbury-Southern
eos24@cam.ac.uk
Abstract: EGU22-8804



Seismicity during the dyke intrusion

- Seismicity located using QuakeMigrate (Winder et al., 2021)
- Fault plane solutions and manual locations for events over M4

Feb 28th



Introduction

Data

Seismicity

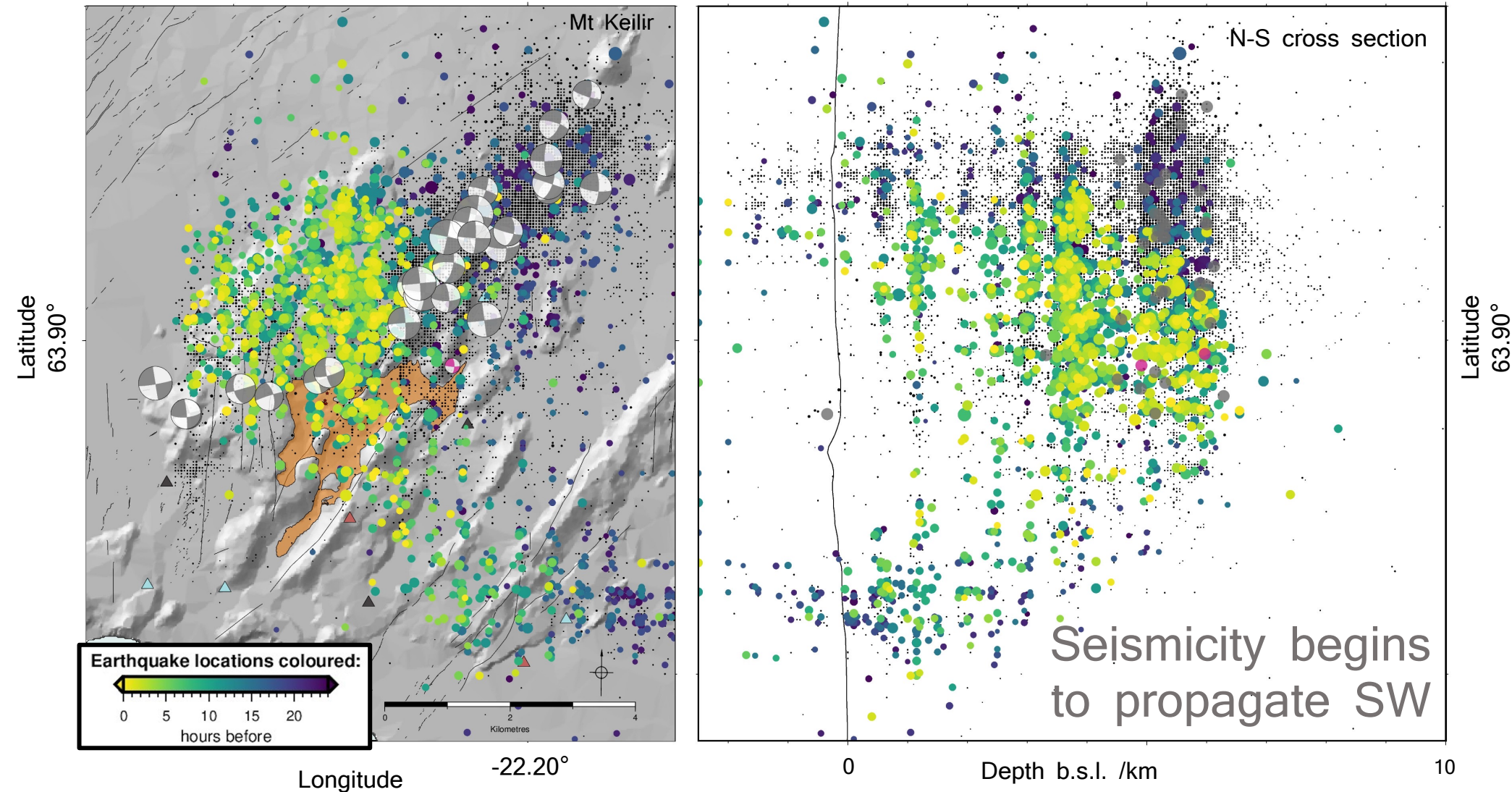
Discussion

Esme Glastonbury-Southern
eos24@cam.ac.uk
Abstract: EGU22-8804

Seismicity during the dyke intrusion

March 4th

- Seismicity located using QuakeMigrate (Winder et al., 2021)
- Fault plane solutions and manual locations for events over M4



Introduction

Data

Seismicity

Discussion

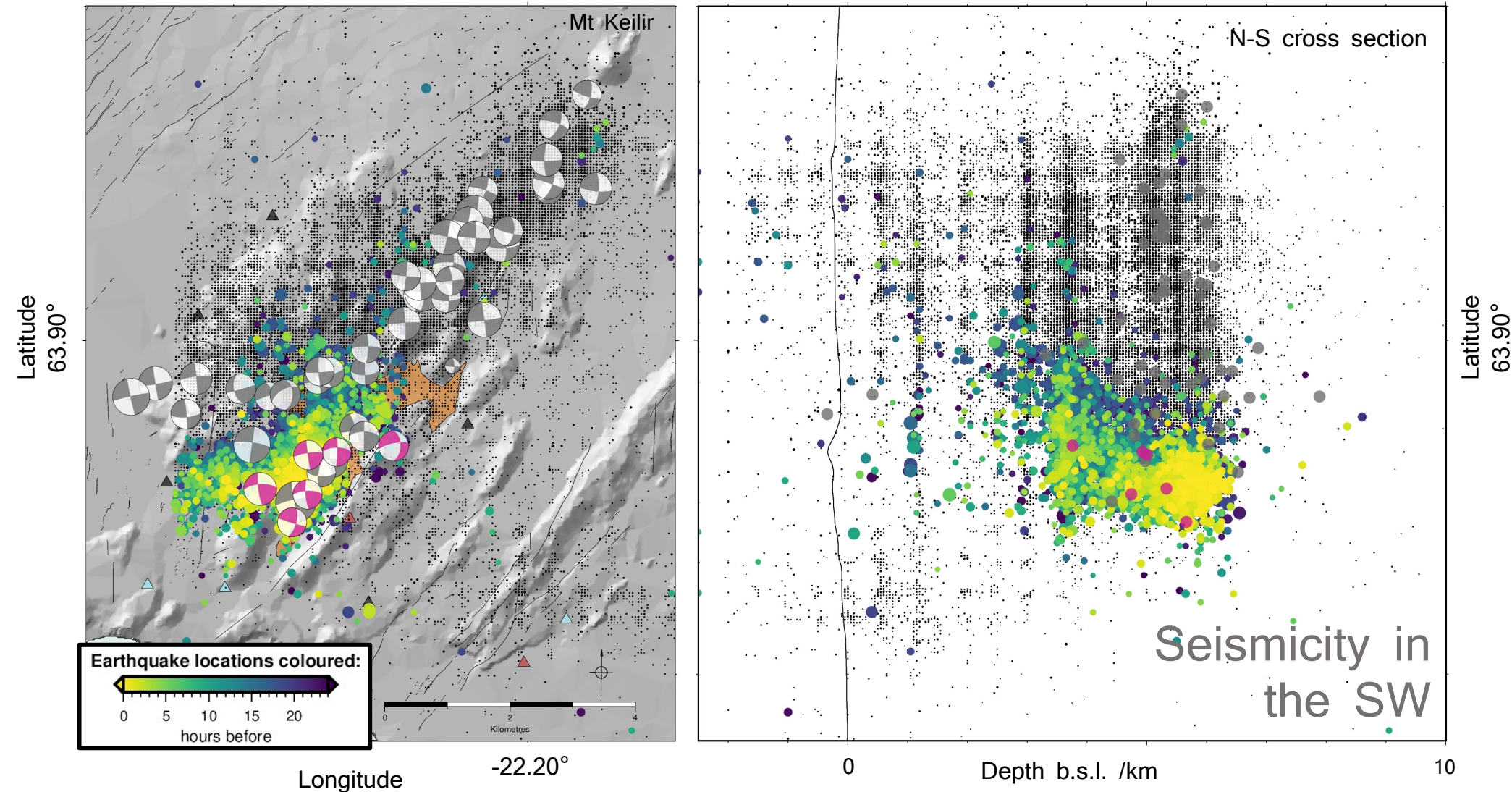
Esme Glastonbury-Southern
eos24@cam.ac.uk
Abstract: EGU22-8804



Seismicity during the dyke intrusion

- Seismicity located using QuakeMigrate (Winder et al., 2021)
- Fault plane solutions and manual locations for events over M4

March 12th



Introduction

Data

Seismicity

Discussion

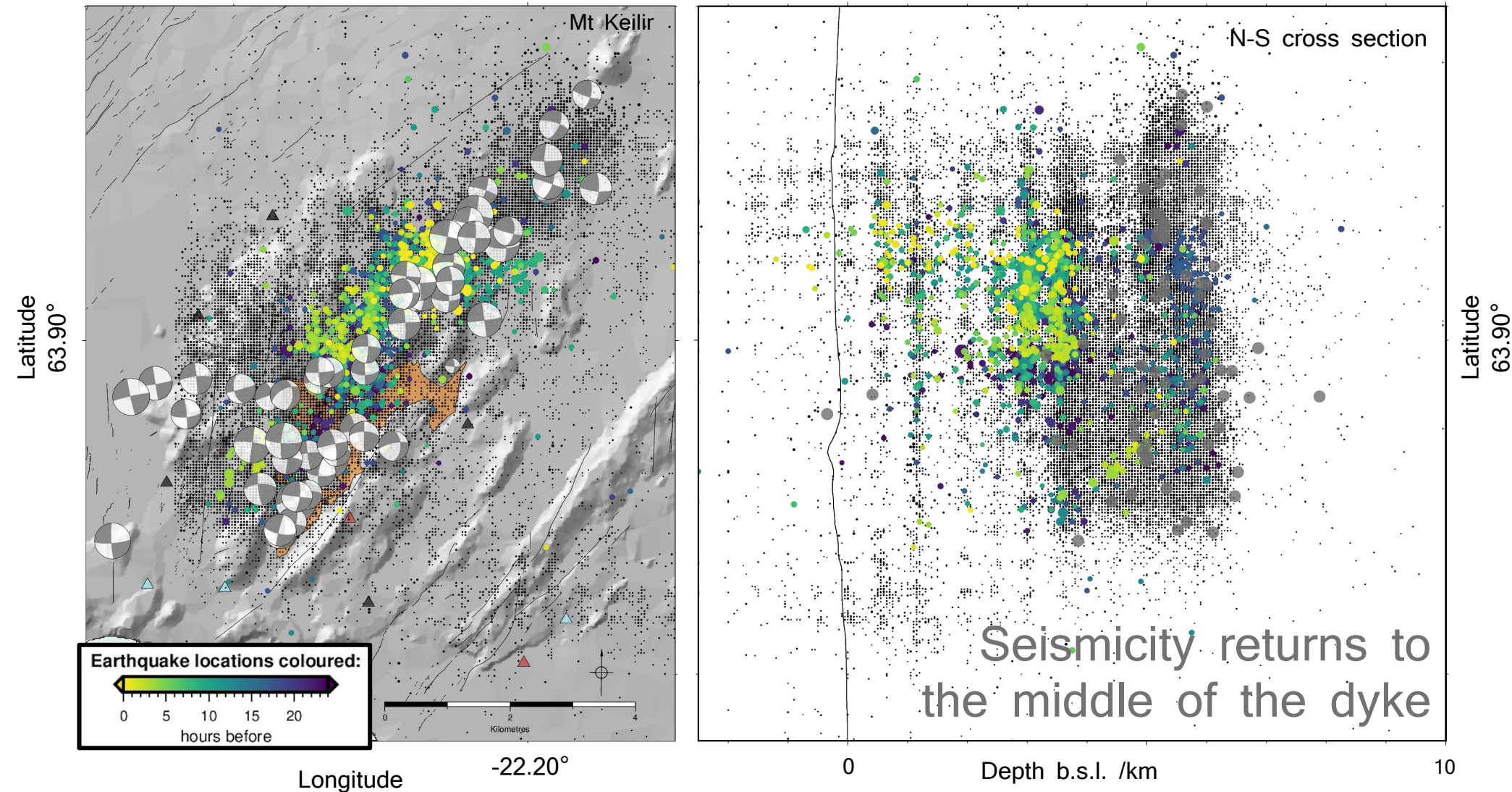
Esme Glastonbury-Southern
eos24@cam.ac.uk
Abstract: EGU22-8804



Seismicity during the dyke intrusion

- Seismicity located using QuakeMigrate (Winder et al., 2021)
- Fault plane solutions and manual locations for events over M4

March 18th



Introduction

Data

Seismicity

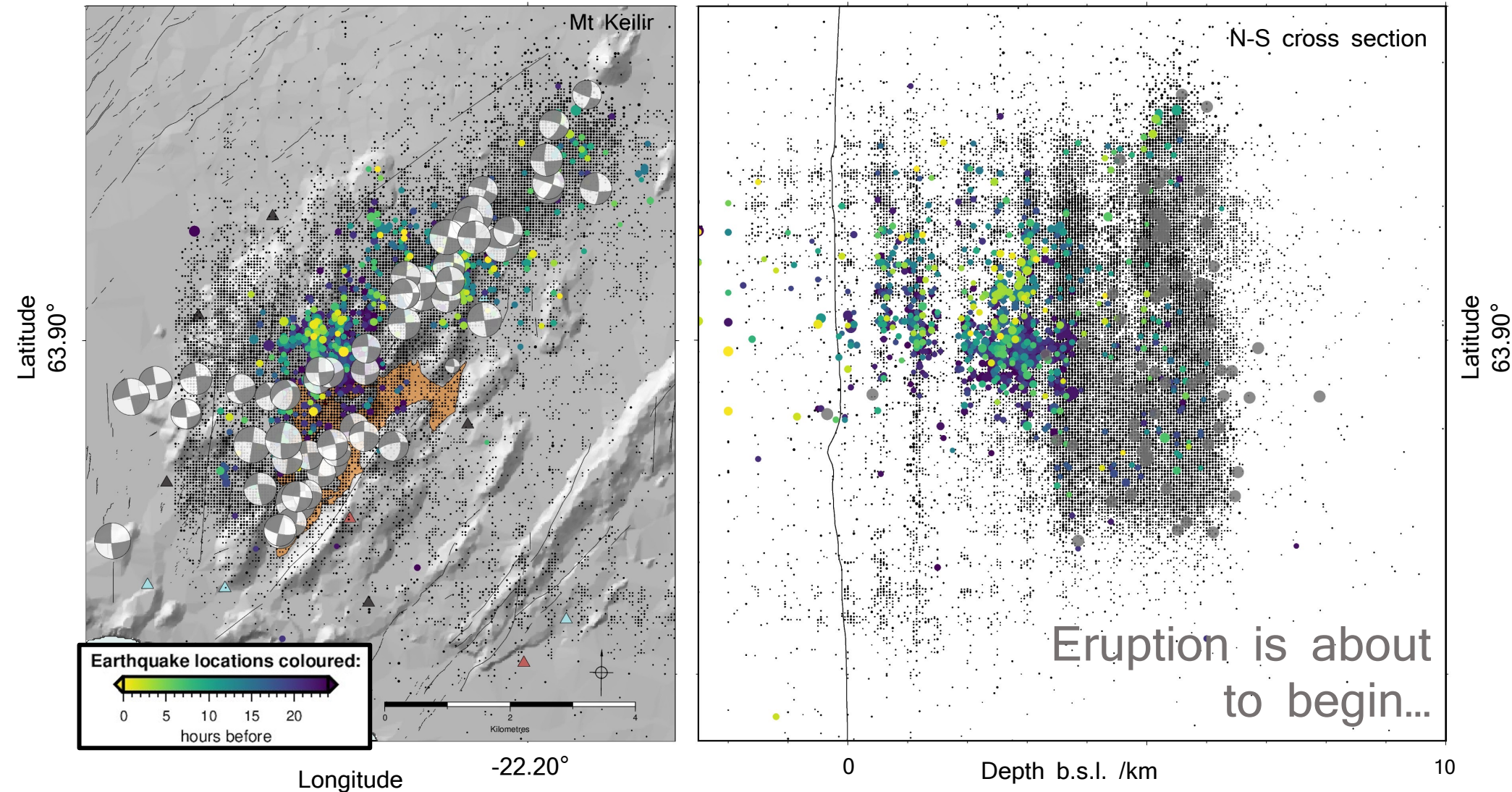
Discussion

Esme Glastonbury-Southern
eos24@cam.ac.uk
Abstract: EGU22-8804

Seismicity during the dyke intrusion

- Seismicity located using QuakeMigrate (Winder et al., 2021)
- Fault plane solutions and manual locations for events over M4

March 19th



Introduction

Data

Seismicity

Discussion

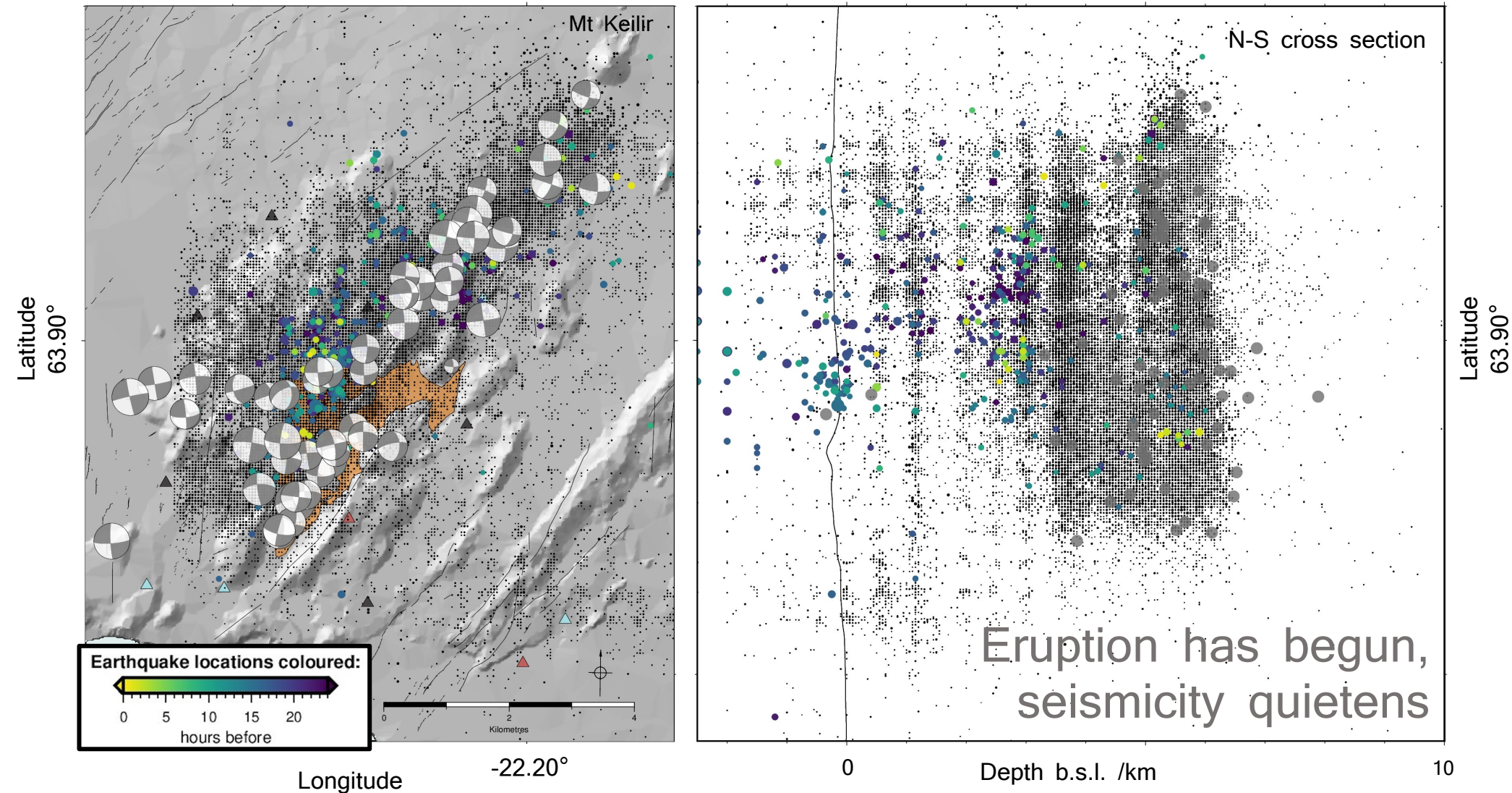
Esme Glastonbury-Southern
eos24@cam.ac.uk
Abstract: EGU22-8804



Seismicity during the dyke intrusion

- Seismicity located using QuakeMigrate (Winder et al., 2021)
- Fault plane solutions and manual locations for events over M4

March 20th



Introduction

Data

Seismicity

Discussion

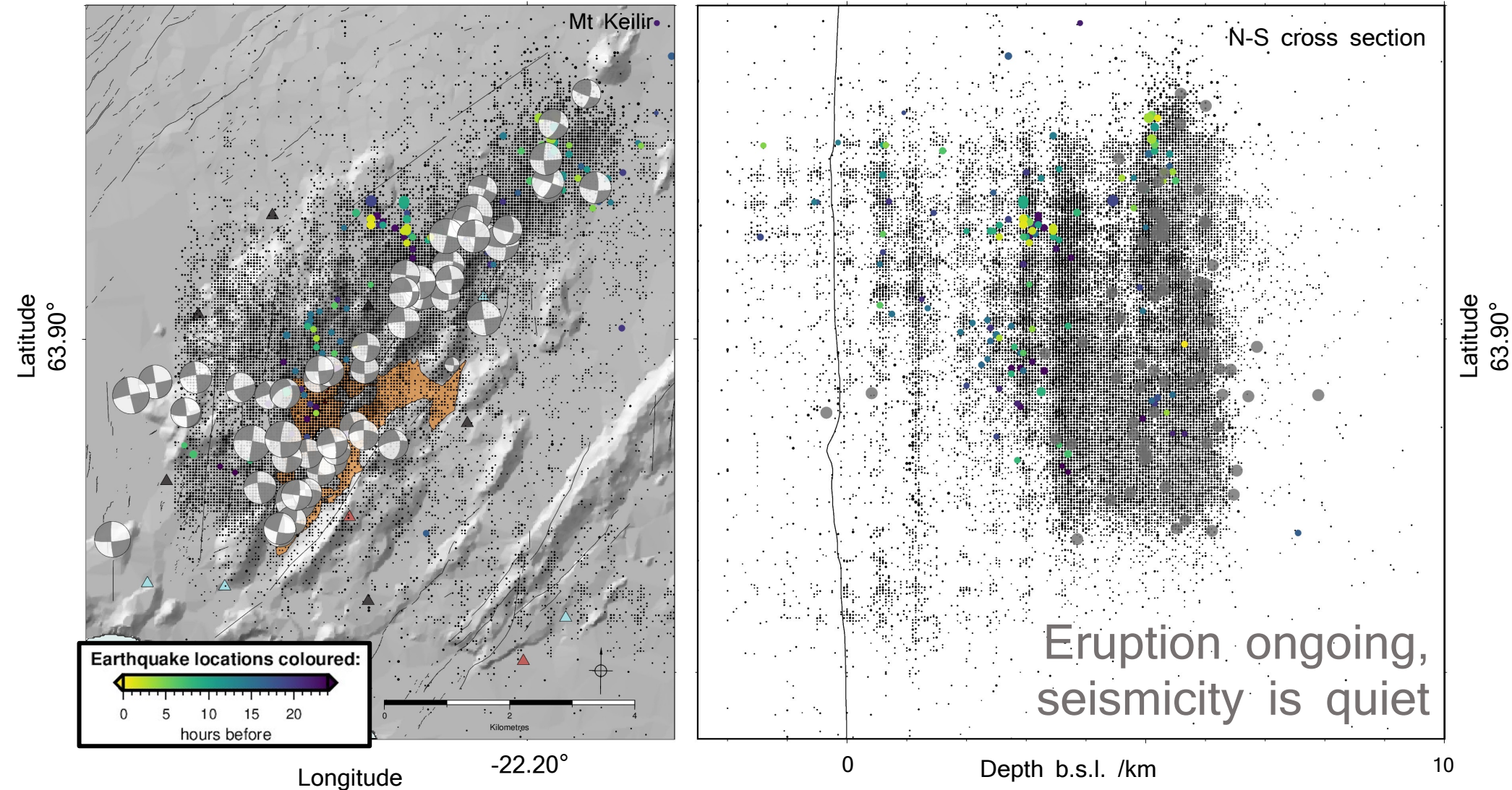
Esme Glastonbury-Southern
eos24@cam.ac.uk
Abstract: EGU22-8804



Seismicity during the dyke intrusion

- Seismicity located using QuakeMigrate (Winder et al., 2021)
- Fault plane solutions and manual locations for events over M4

March 21st



Introduction

Data

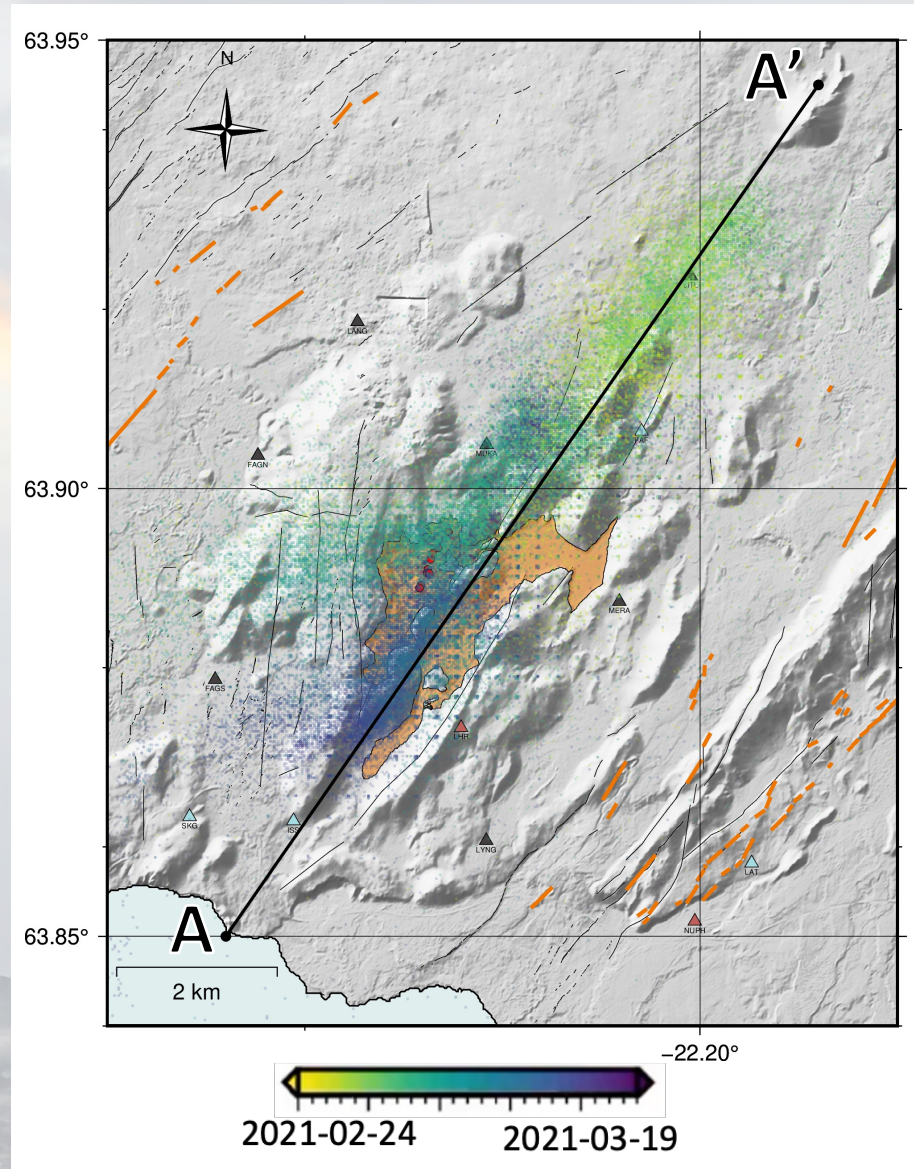
Seismicity

Discussion

Esme Glastonbury-Southern
eos24@cam.ac.uk
Abstract: EGU22-8804



Seismicity during the dyke intrusion



Introduction

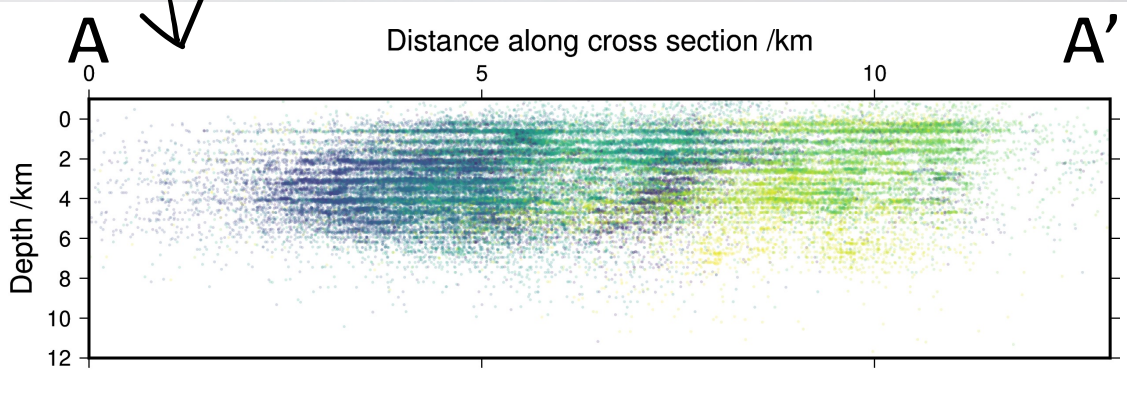
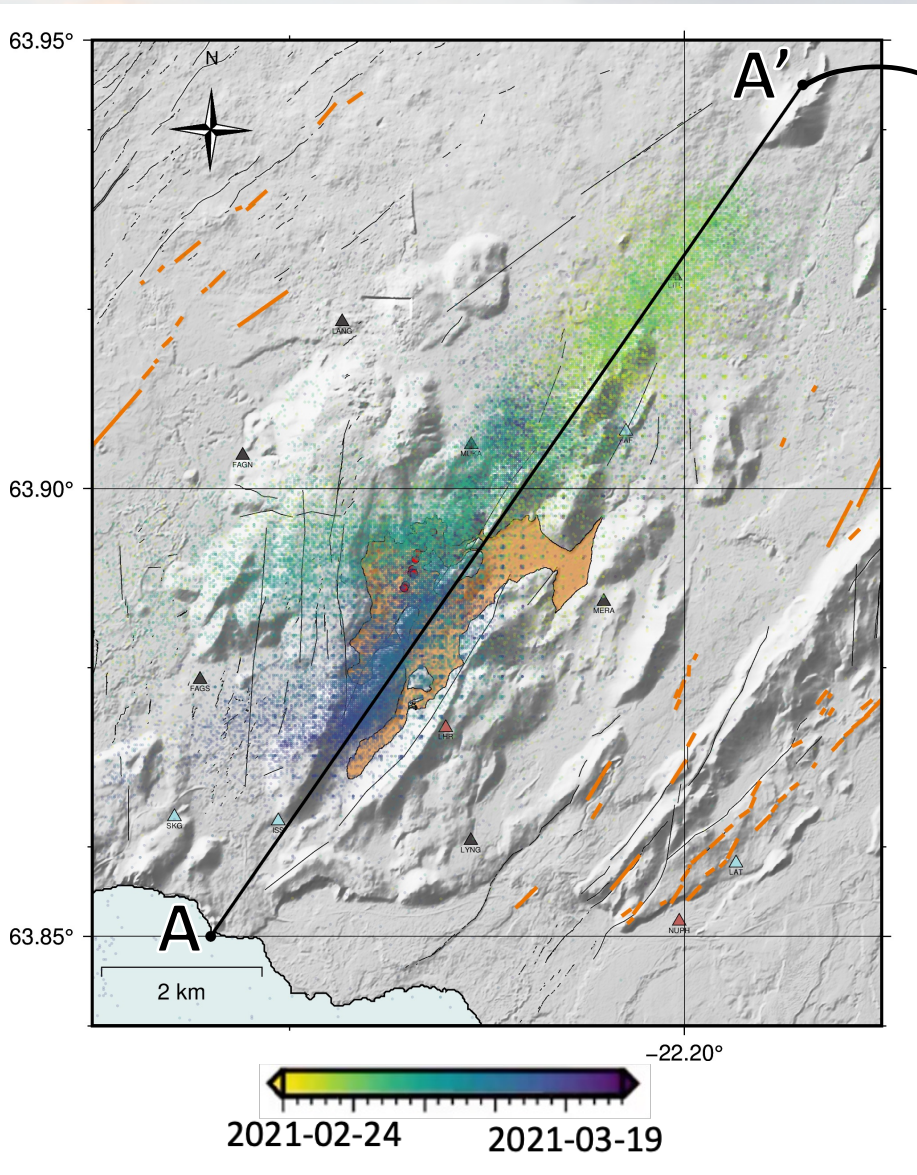
Data

Seismicity

Discussion

Esme Glastonbury-Southern
eos24@cam.ac.uk
Abstract: EGU22-8804

Seismicity during the dyke intrusion



Projected cross section along strike of the dyke

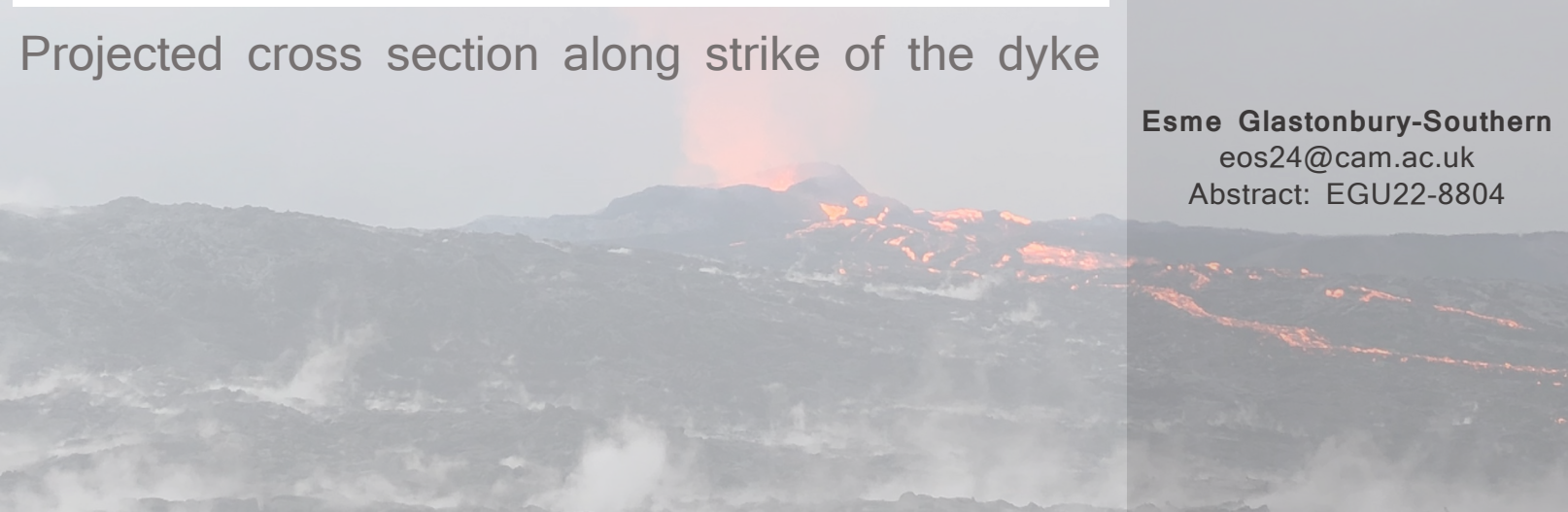
Introduction

Data

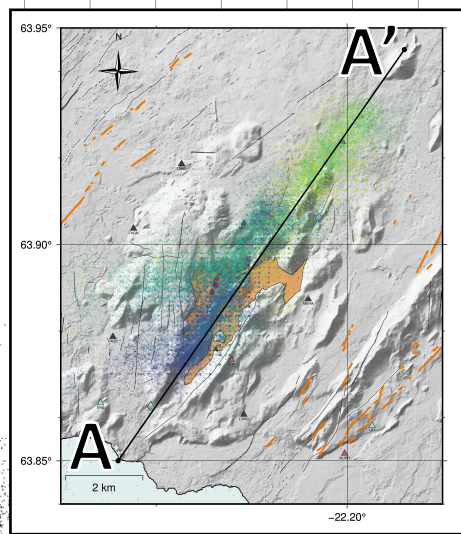
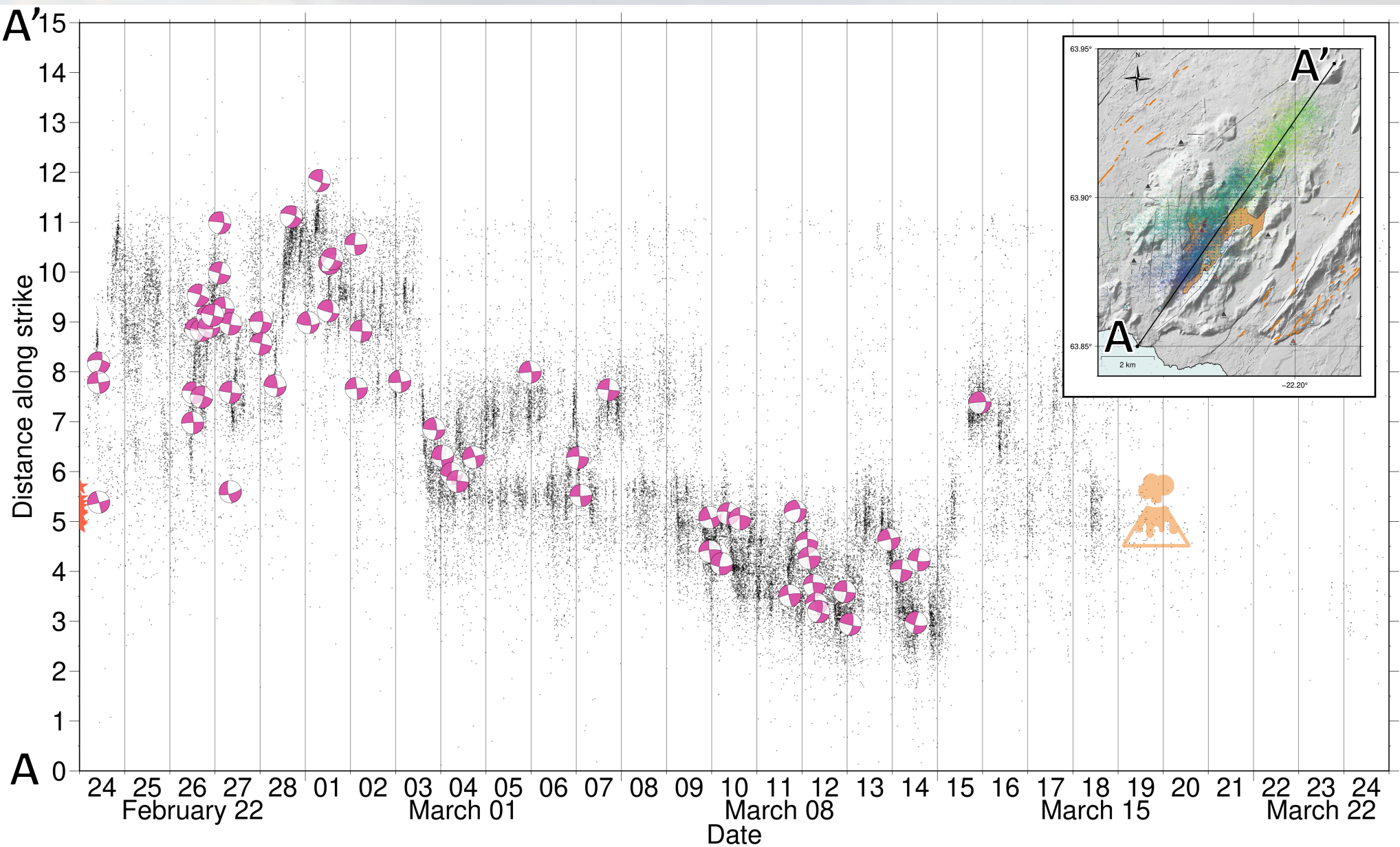
Seismicity

Discussion

Esme Glastonbury-Southern
eos24@cam.ac.uk
Abstract: EGU22-8804



Seismicity of the dyke intrusion



Introduction

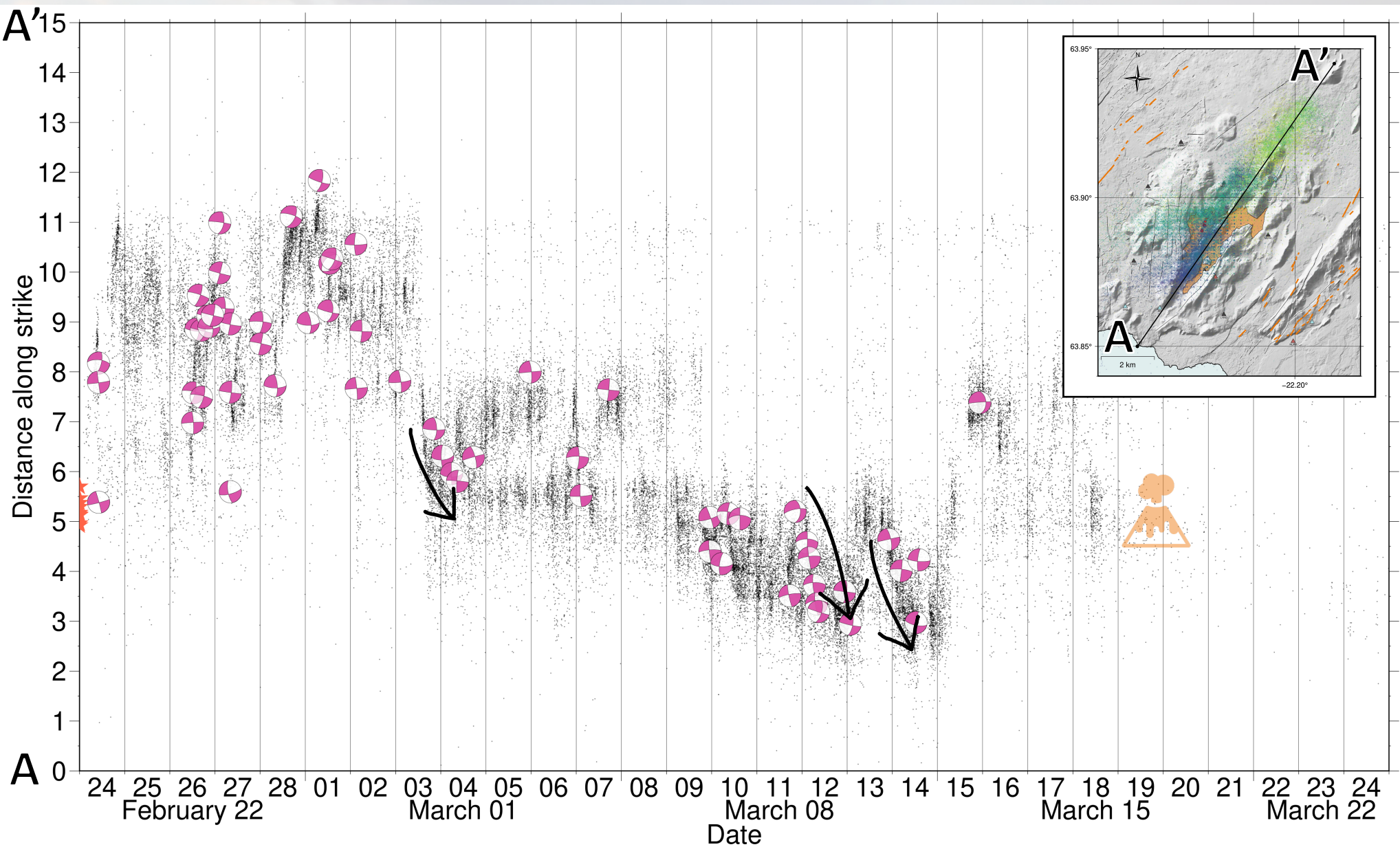
Data

Seismicity

Discussion

Esme Glastonbury-Southern
eos24@cam.ac.uk
Abstract: EGU22-8804

Seismicity of the dyke intrusion



Introduction

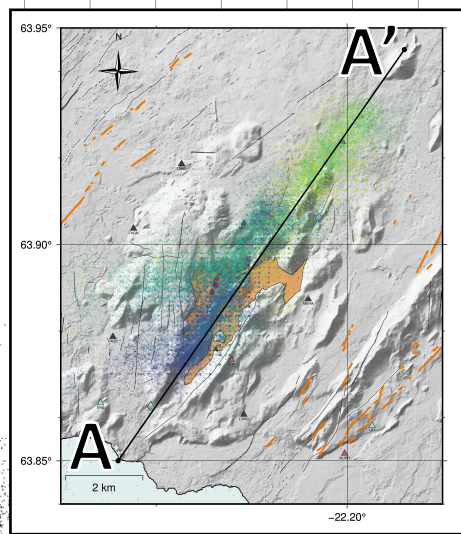
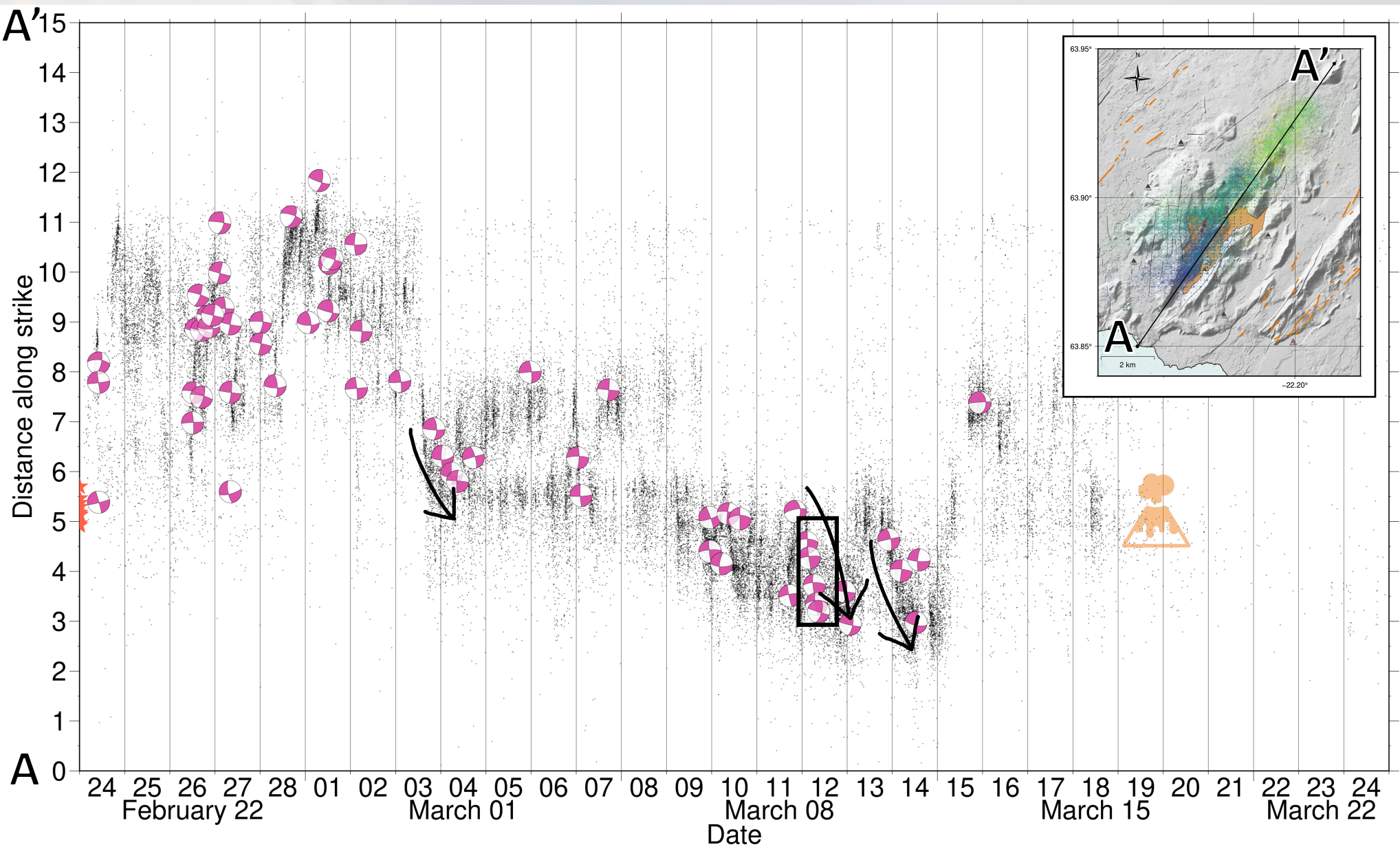
Data

Seismicity

Discussion

Esme Glastonbury-Southern
eos24@cam.ac.uk
Abstract: EGU22-8804

Seismicity of the dyke intrusion



Introduction

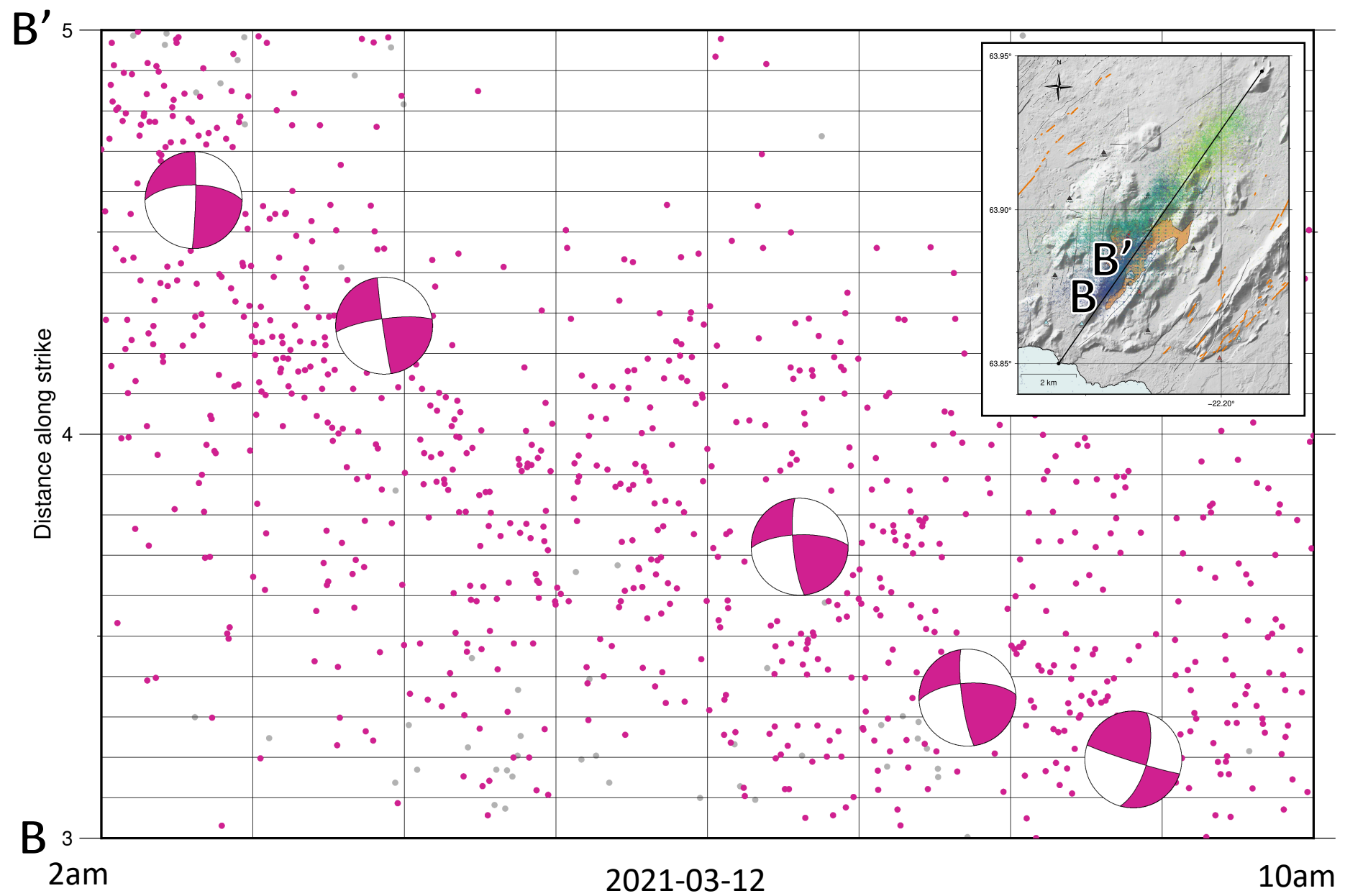
Data

Seismicity

Discussion

Esme Glastonbury-Southern
eos24@cam.ac.uk
Abstract: EGU22-8804

Seismicity of the dyke intrusion



Introduction

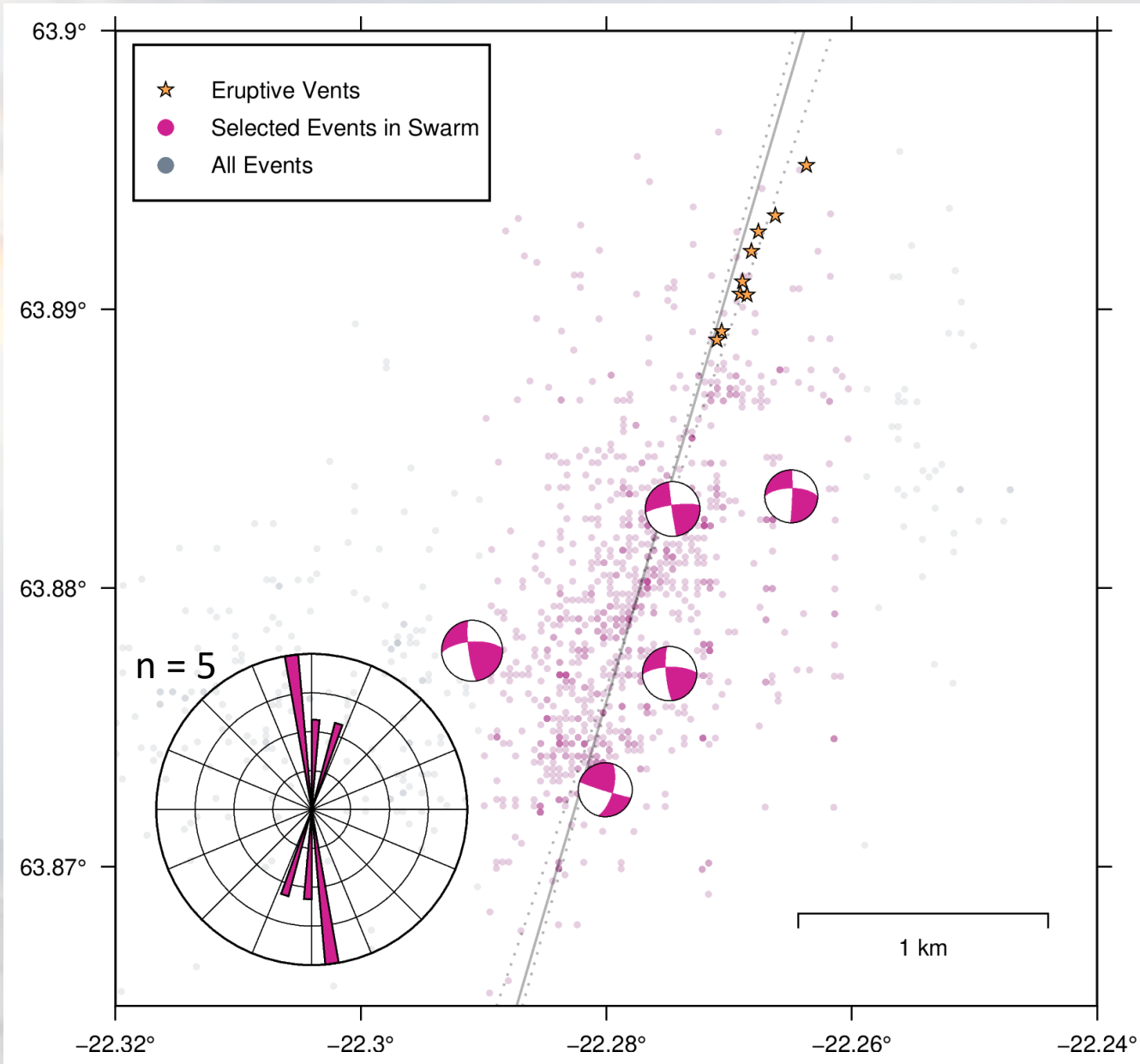
Data

Seismicity

Discussion

Esme Glastonbury-Southern
eos24@cam.ac.uk
Abstract: EGU22-8804

Strike of dyke vs fault planes



Introduction

Data

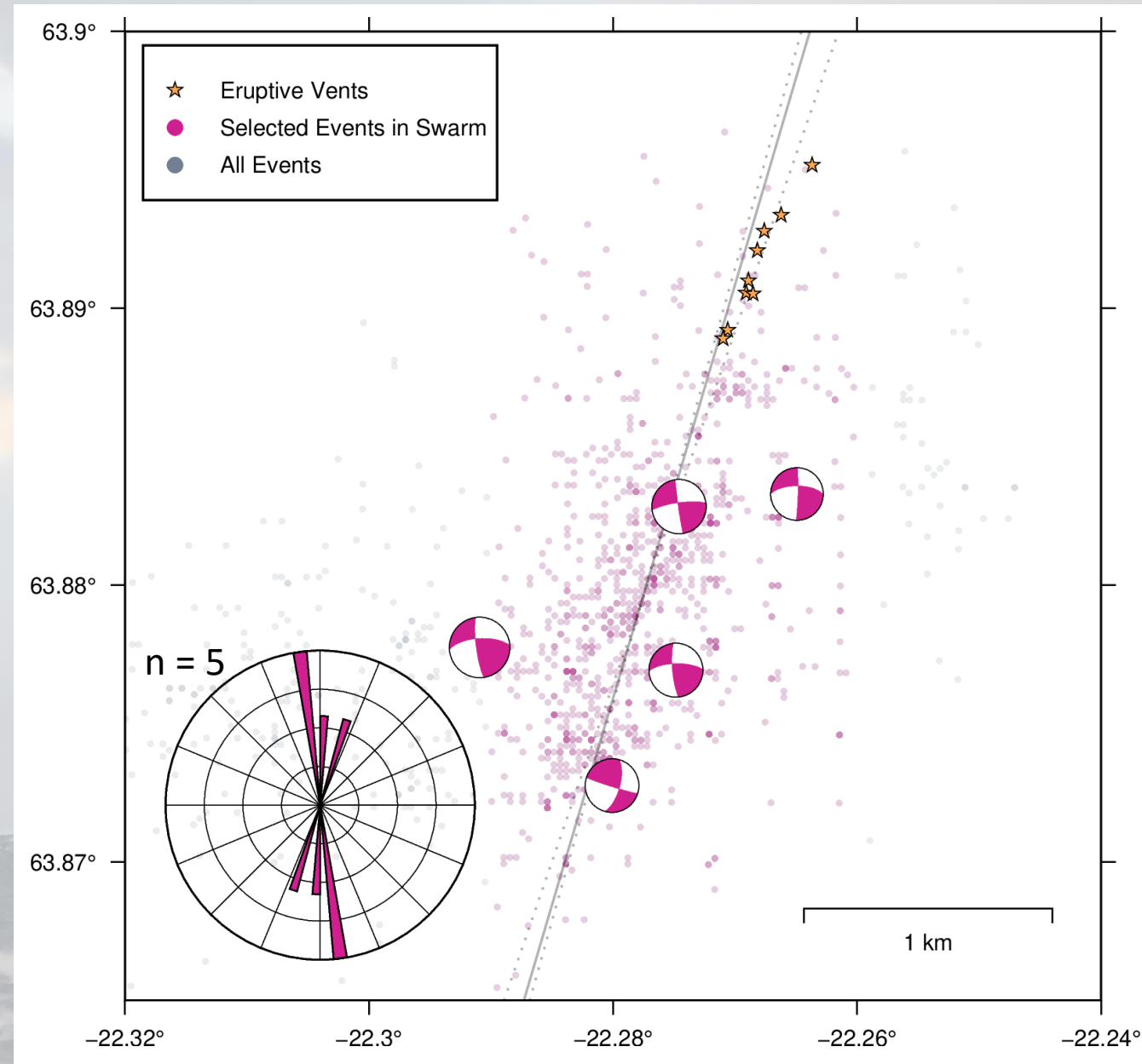
Seismicity

Discussion

Esme Glastonbury-Southern
eos24@cam.ac.uk
Abstract: EGU22-8804

Strike of dyke vs fault planes

Strike of best fit:
016°



Introduction

Data

Seismicity

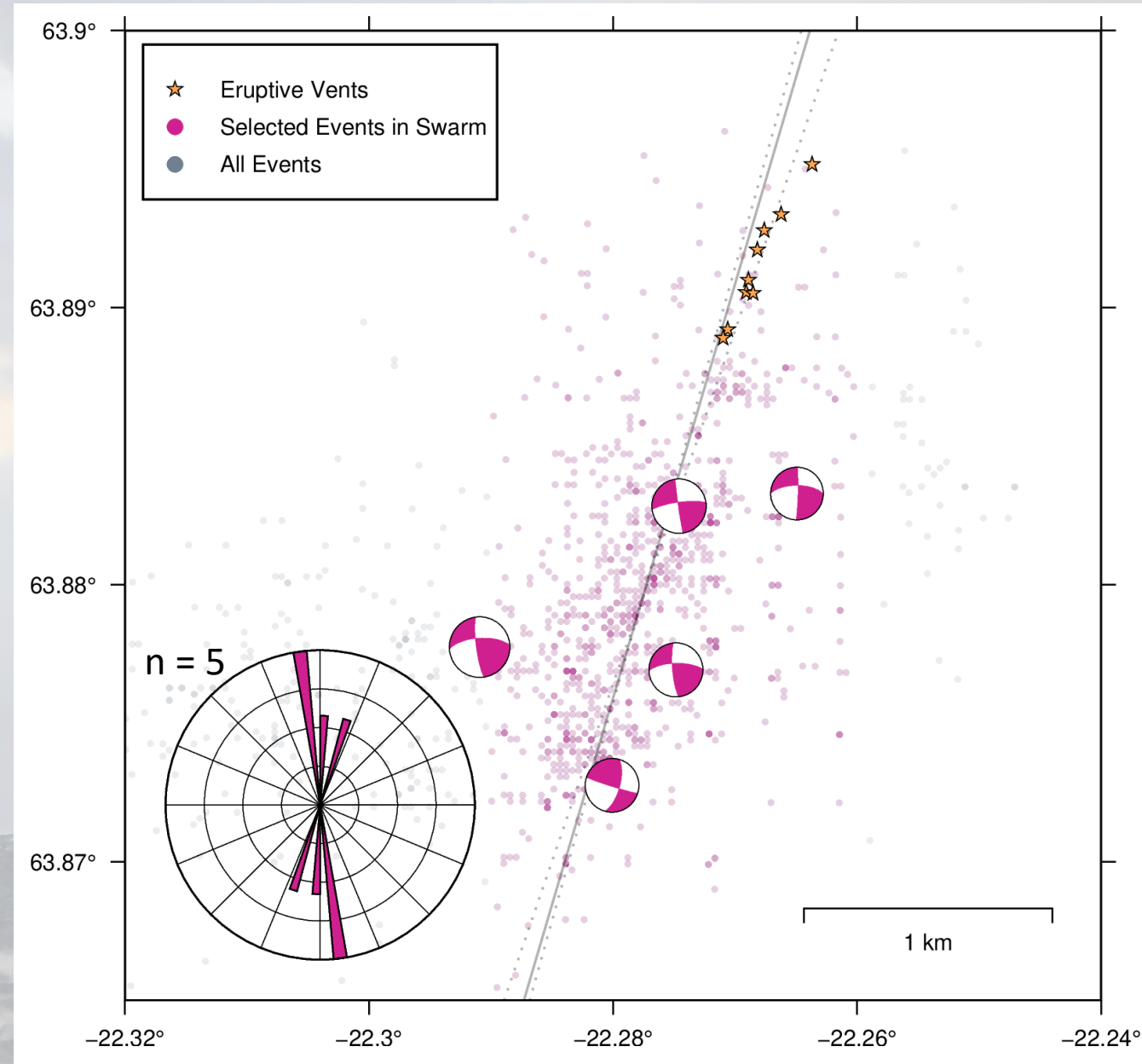
Discussion

Esme Glastonbury-Southern
eos24@cam.ac.uk
Abstract: EGU22-8804

Strike of dyke vs fault planes

Strike of best fit:
016°

Strike of fault planes:
172°



Introduction

Data

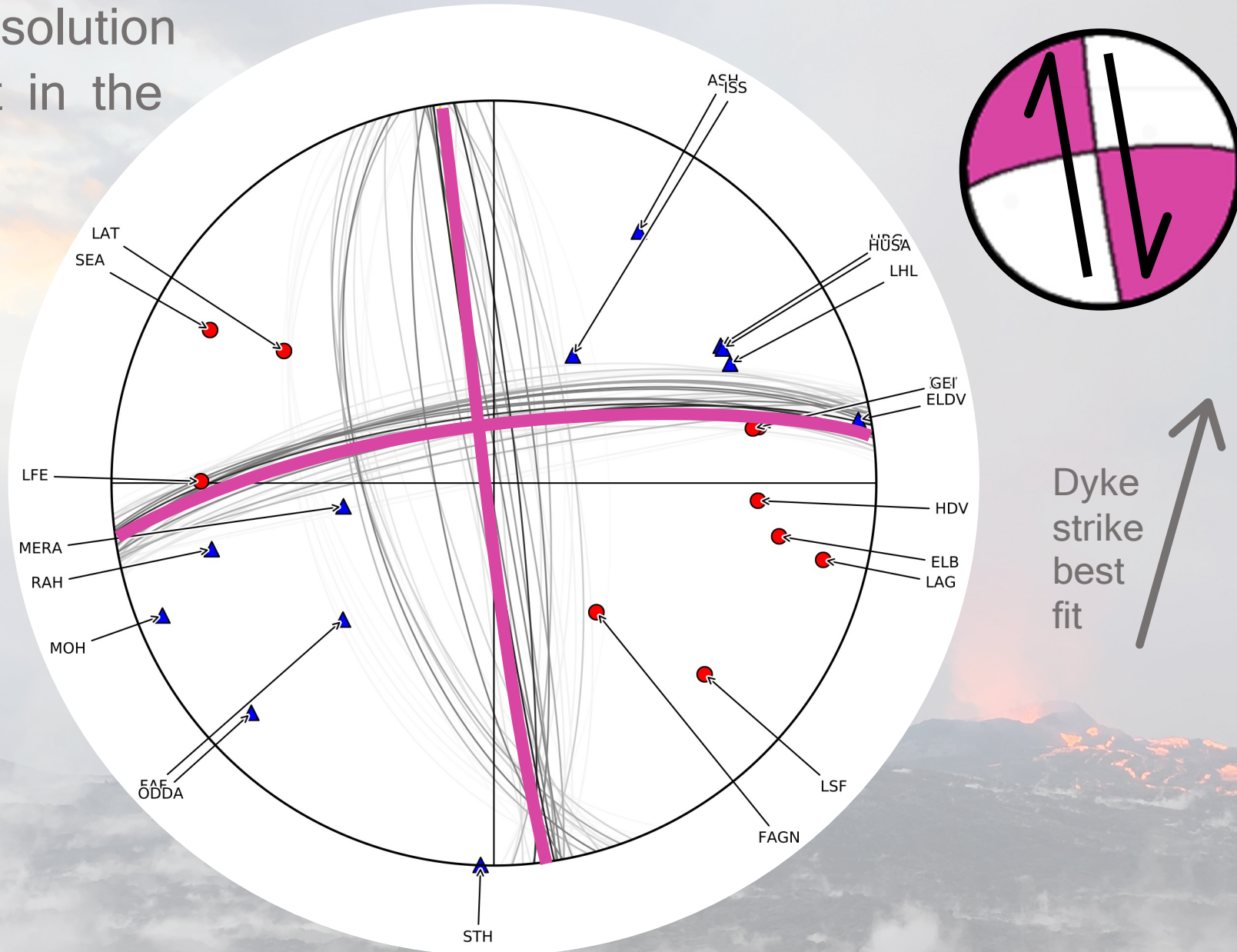
Seismicity

Discussion

Esme Glastonbury-Southern
eos24@cam.ac.uk
Abstract: EGU22-8804

Seismicity of the dyke intrusion

Fault plane solution
for an event in the
swarm, on
12/03/2021



Introduction

Data

Seismicity

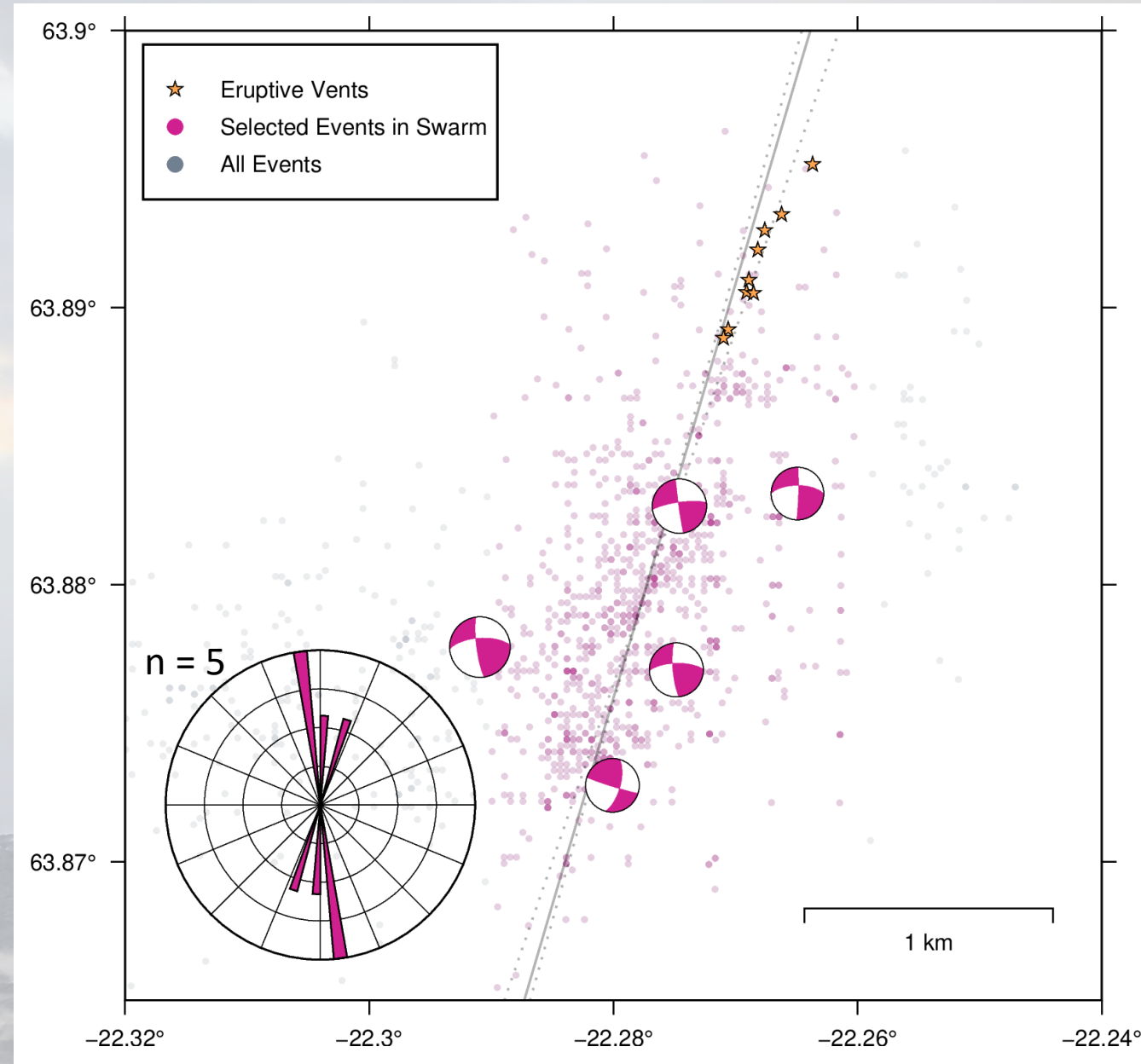
Discussion

Esme Glastonbury-Southern
eos24@cam.ac.uk
Abstract: EGU22-8804

Strike of dyke vs fault planes

Outlook:

- Analyse more events in this swarm
- Repeat process for multiple swarms
- Relatively relocate seismicity



Introduction

Data

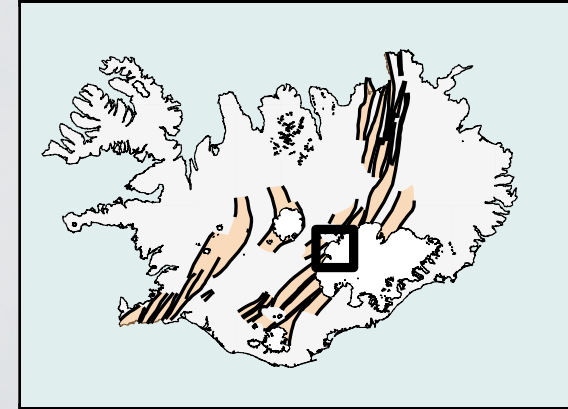
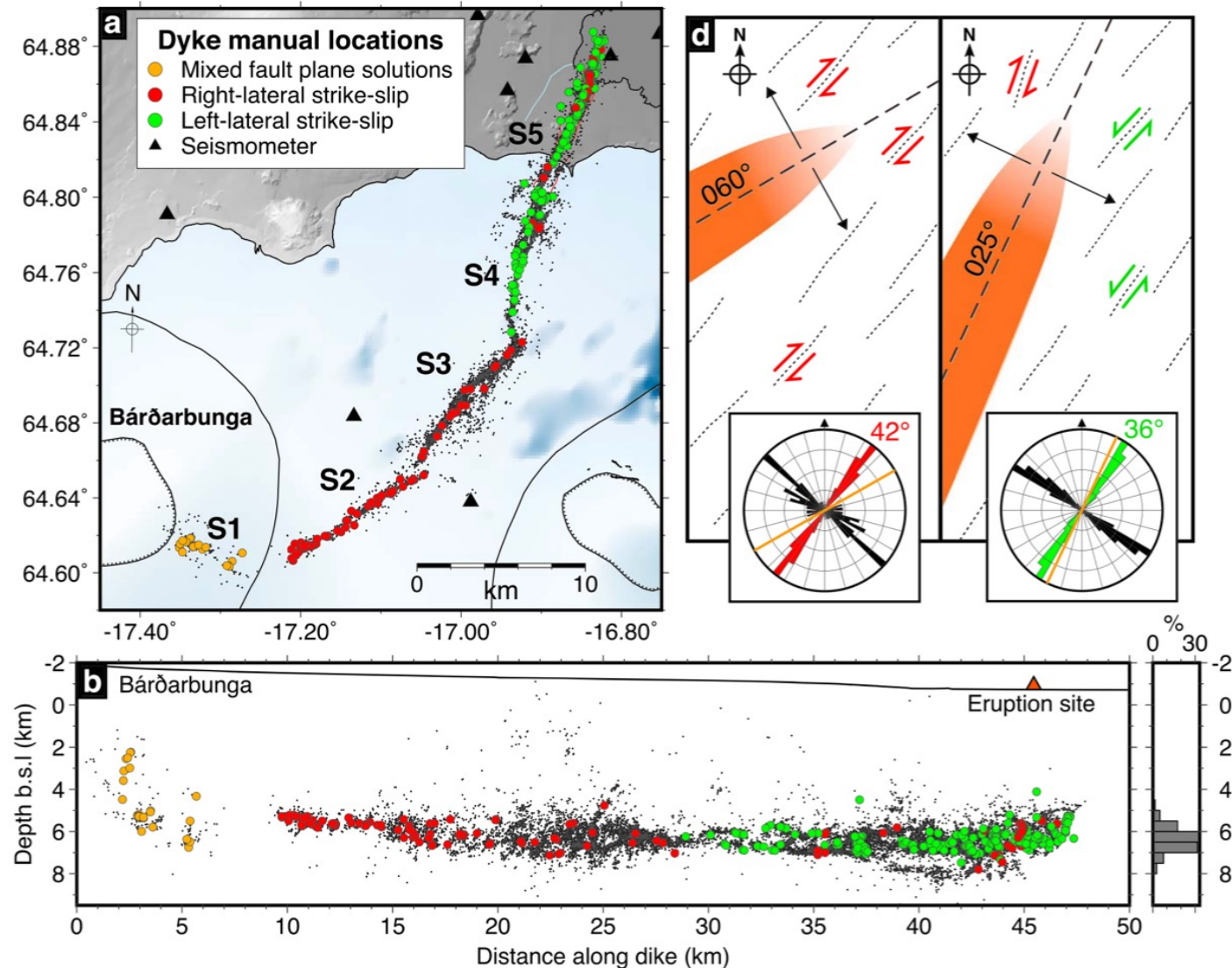
Seismicity

Discussion

Esme Glastonbury-Southern
eos24@cam.ac.uk
Abstract: EGU22-8804

Comparing to Holuhraun

Ágústsdóttir et al., 2019, *JGR Solid Earth*



Introduction

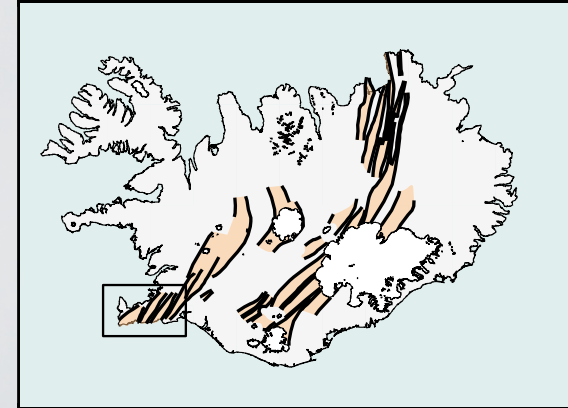
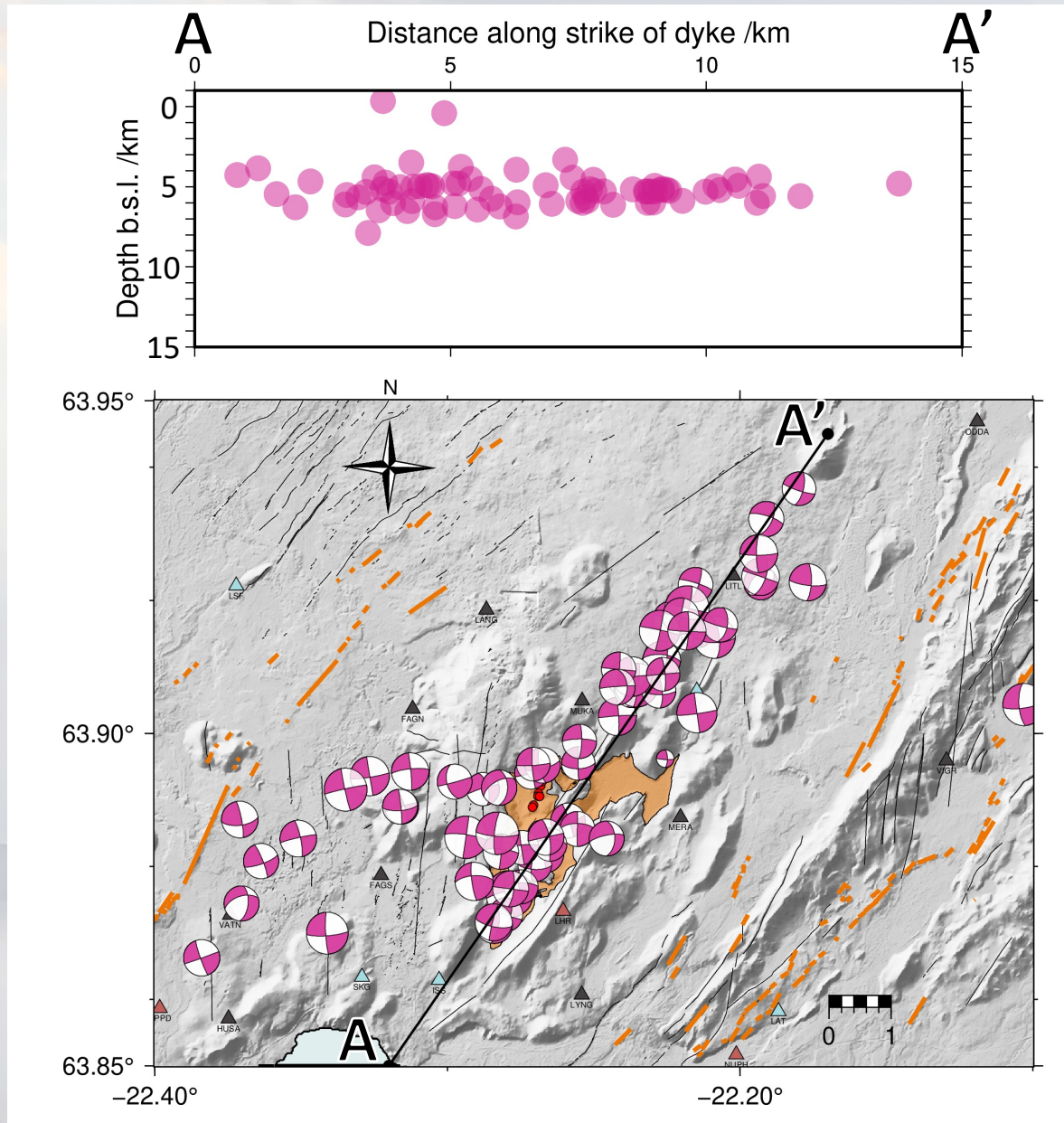
Data

Seismicity

Discussion

Esme Glastonbury-Southern
eos24@cam.ac.uk
Abstract: EGU22-8804

Comparing to Holuhraun



Introduction

Data

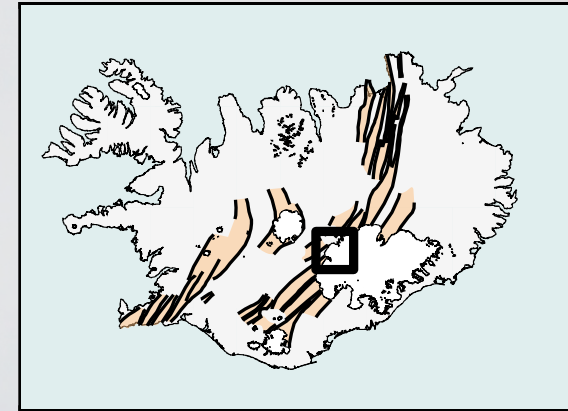
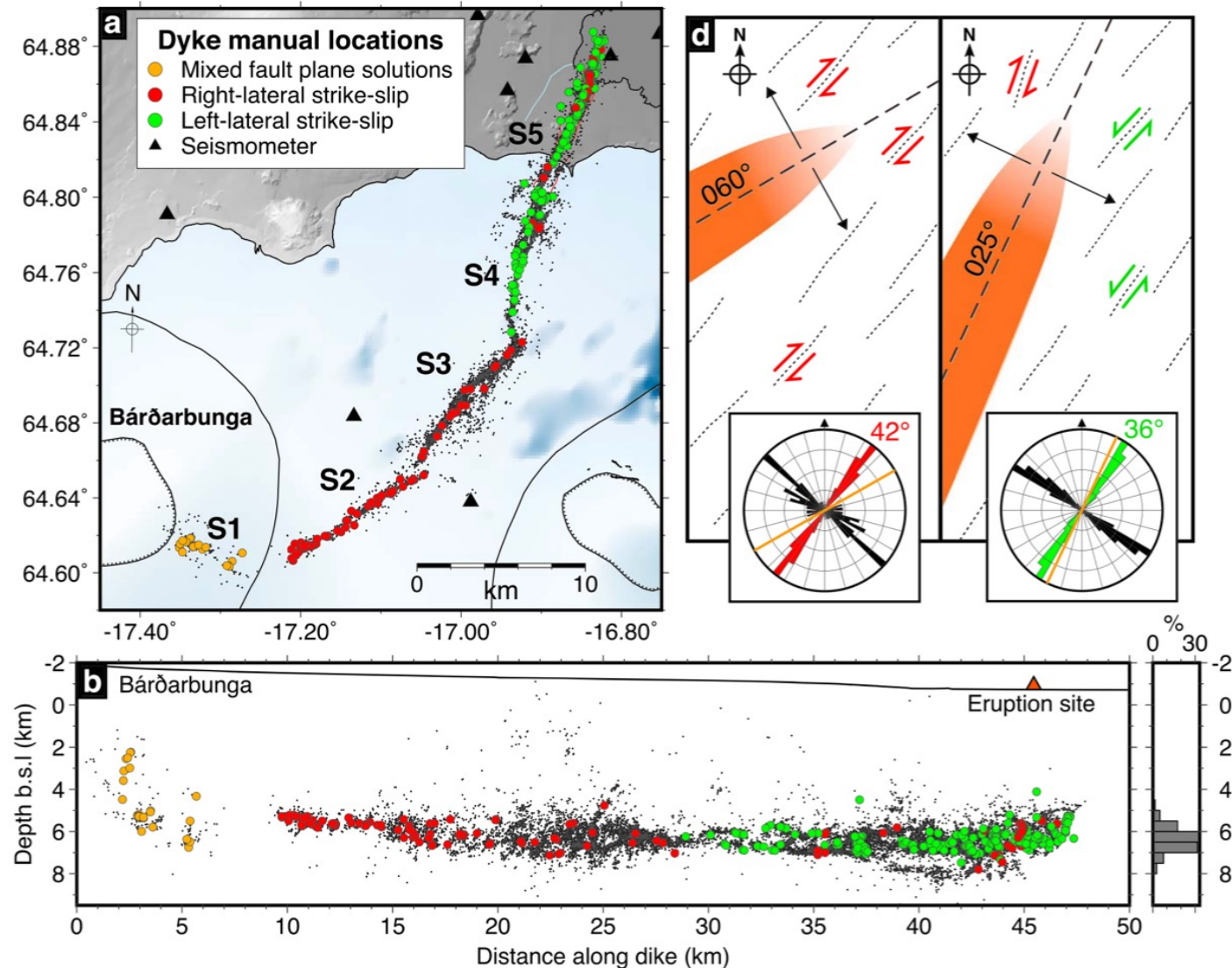
Seismicity

Discussion

Esme Glastonbury-Southern
eos24@cam.ac.uk
Abstract: EGU22-8804

Comparing to Holuhraun

Ágústsdóttir et al., 2019, *JGR Solid Earth*



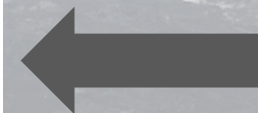
Introduction

Data

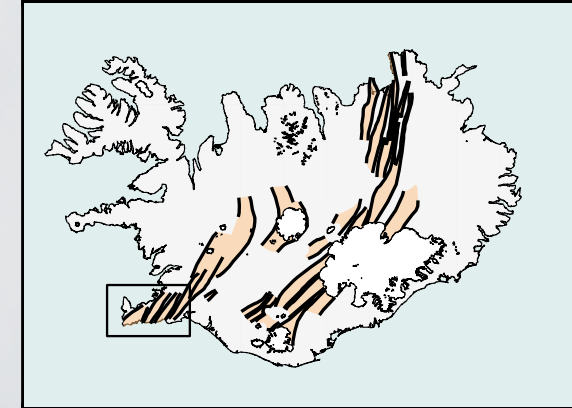
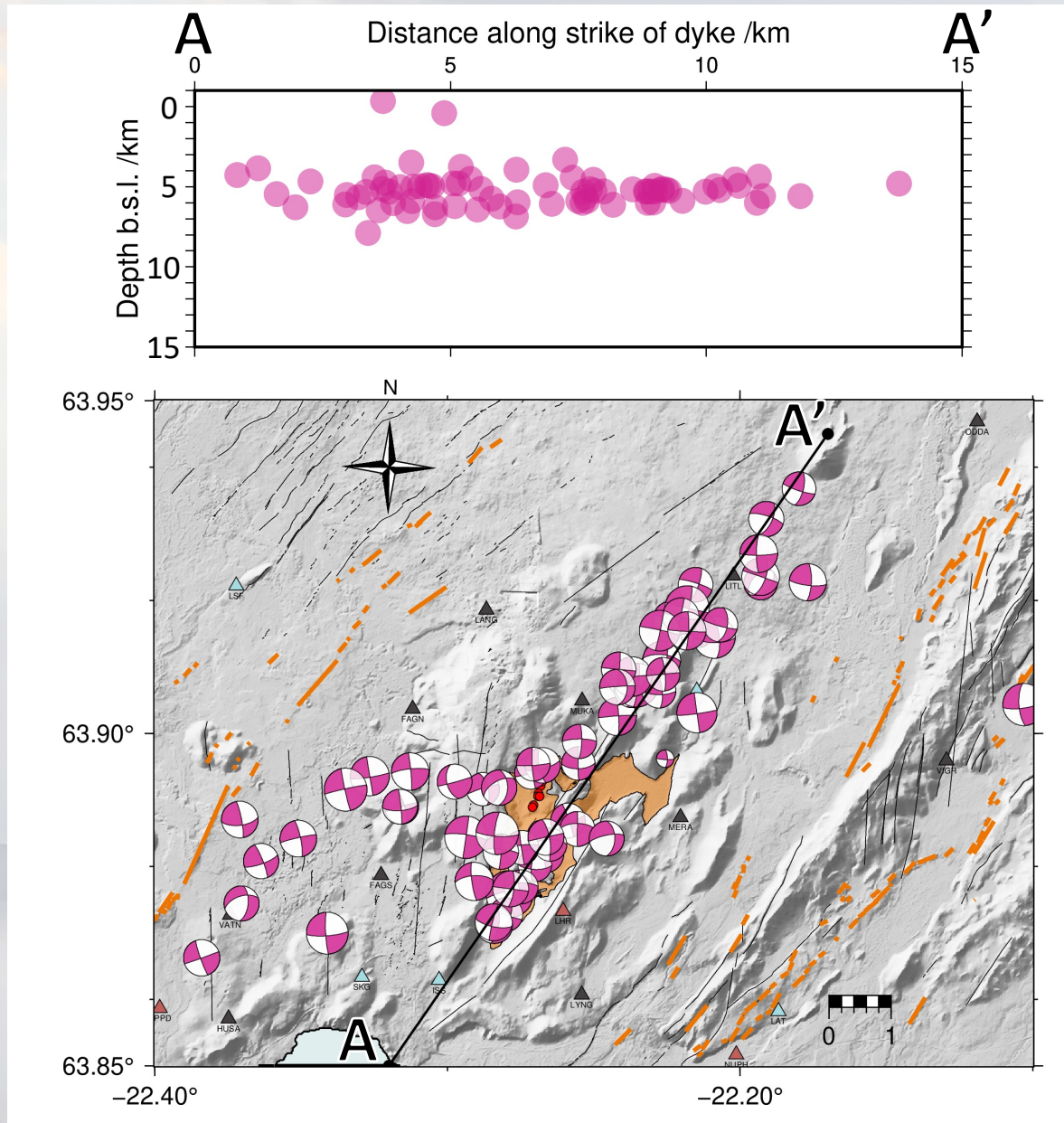
Seismicity

Discussion

Esme Glastonbury-Southern
eos24@cam.ac.uk
Abstract: EGU22-8804



Comparing to Holuhraun



Outlook:

Refine the earthquake catalogue using

- New velocity model
- Relative relocations

Introduction

Data

Seismicity

Discussion

Esme Glastonbury-Southern
eos24@cam.ac.uk
Abstract: EGU22-8804

- Preliminary catalogue of seismicity for dyke intrusion
- Propagating swarms show fault planes strike differently to dyke path
- Ongoing investigation into depths

Introduction

Data

Seismicity

Discussion

Abstract: EGU22-8804

Esme Glastonbury-Southern¹ (eos24@cam.ac.uk), Tim Greenfield¹, Tom Winder¹, Þorbjörg Ágústsdóttir², Bryndís Brandsdóttir³, Tomas Fischer⁴, Jana Doubravová⁵, Nick Rawlinson¹, Robert White¹, Egill Árni Gudnason², Gylfi Páll Hersir², Pavla Hrubcova⁵, Conor Bacon¹, Eva P. S. Eibl⁶

¹University of Cambridge, ²Iceland GeoSurvey, Reykjavík, ³University of Iceland, ⁴Charles University,

⁵Institute of Geophysics, Prague, ⁶University of Potsdam