

Eirik Gjerl w (he/him)
Eirik.gjerlow@uit.no

Hi, and welcome to my poster!
I am studying the Beerenberg volcano on the remote volcanic island of Jan Mayen.
In this poster I'd like to explore the geochemistry of tephra and minerals, and the structure of the magmatic storage systems for Beerenberg.



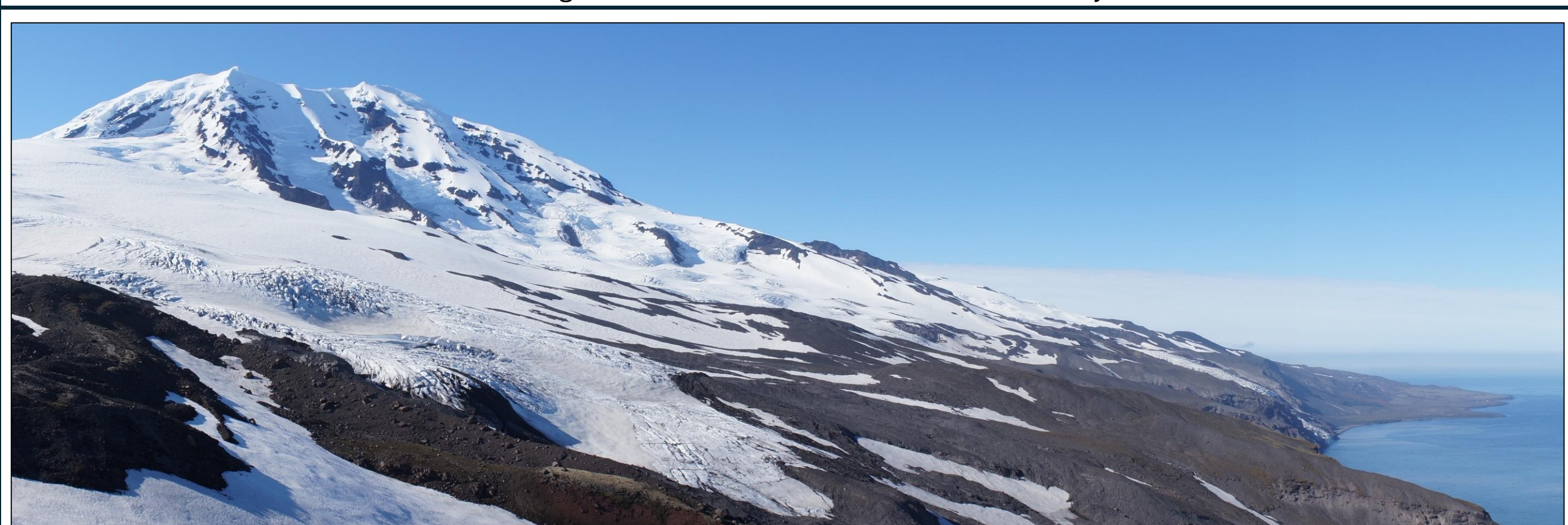
Jan Mayen lies here, north-east of Iceland at the junction between the Mohn's ridge, a transform fault and Jan Mayen Ridge. The volcanoes here are the northernmost active subaerial volcanoes in the world!

Beerenberg makes up the northern part of Jan Mayen, while the rest of the island contain mostly monogenetic vents, fissures and lava flows.

The summit cone of Beerenberg reaches a height of 2272 m.a.s.l and has steep slopes, indicating more evolved magmas, while the flanks of are more gently sloping and consists of less evolved lavas.



Beerenberg seen from the south-west. Photo: Eirik Gjerl w



Beerenberg seen from the south-east. Photo: Eirik Gjerl w



Most of the recent eruptions have taken place on the north-east tip of the island in the form of fissure eruptions. The coastal plateau seen in the right of the above image is mostly from 1970, and the aerial photo to the left shows some of the fissures and craters in this area.

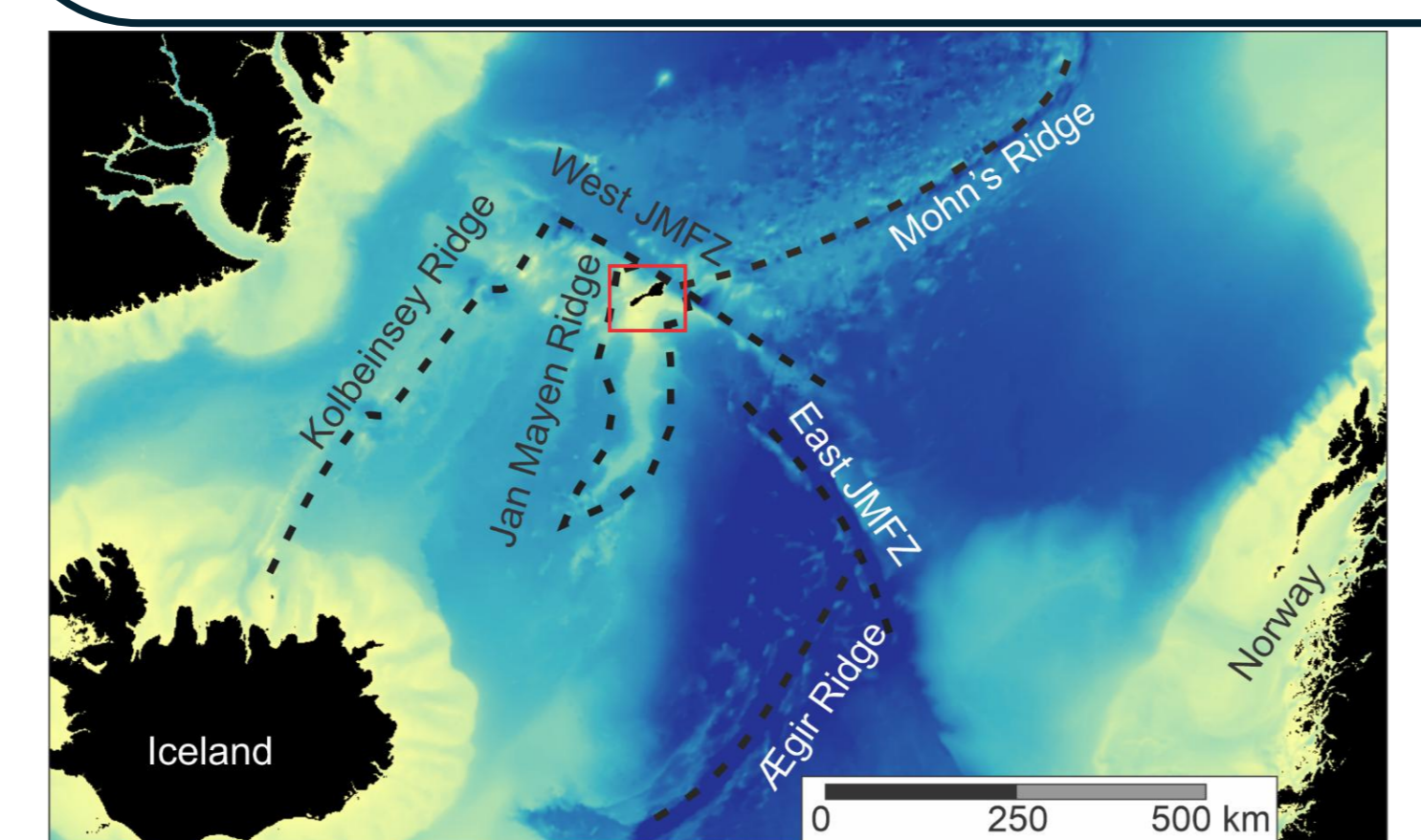
The south-west flank is also a more active area and the aerial photo to the left shows a tuff cone from 1732 (Gjerl w et al. 2014), two recent but undated lava flows and craters from strombolian eruptions.

Aerial photos of Jan Mayen, with permission   Norsk polarinstitutt



Shallow magma storage and volcanism at Beerenberg volcano, Jan Mayen

Eirik Gjerl w¹,  rmann H skuldsson²
1: UiT the Arctic University of Norway, Department of building, energy and material technology
2: H skola Islands, Faculty of Earth sciences

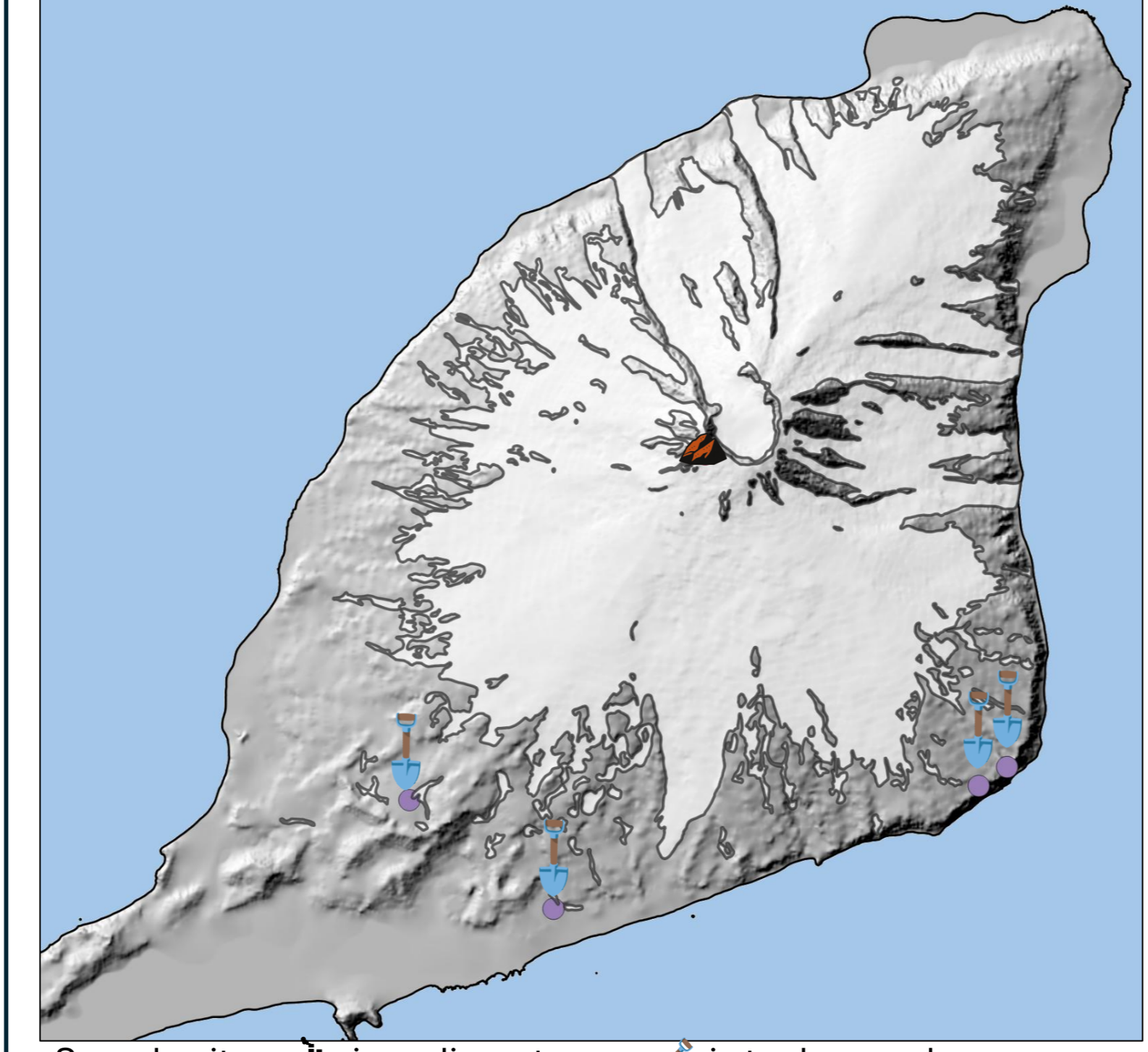


Bathymetric map (modified from Jakobsson et al. 2012).



Points of interest on Jan Mayen, modified from Gjerl w et al. 2022

| Sample ID | Description | Type | Glass | Pyroxene | Olivine |
|-------------|--------------------|--------|-------|----------|---------|
| 12-175-15GC | 12,5-13 cm depth | Tephra | x | x | x |
| 12-175-15GC | 15-15,5 cm depth | Tephra | x | x | x |
| 12-175-15GC | 17-17,5 cm depth | Tephra | x | x | x |
| 12-175-15GC | 21-21,5 cm depth | Tephra | x | x | - |
| 12-175-15GC | 25,5-26 cm depth | Tephra | x | x | - |
| 12-175-15GC | 28,5-29 cm depth | Tephra | x | x | - |
| 25/6-11-1 | Ox. vesicular lava | Rock | - | x | - |
| 25/6-11-2 | Vesicular lava | Rock | - | x | x |
| Egg ya | 1732 tephra | Tephra | x | x | x |
| Torn e | Torn e, tephra | Tephra | x | x | - |
| P11-11 | Recent tephra | Tephra | x | x | - |
| P11-13 | Recent tephra | Tephra | x | x | - |
| S8 | Possibly 1818 | Tephra | x | x | - |
| S9 | Possibly 1818 | Tephra | x | x | - |

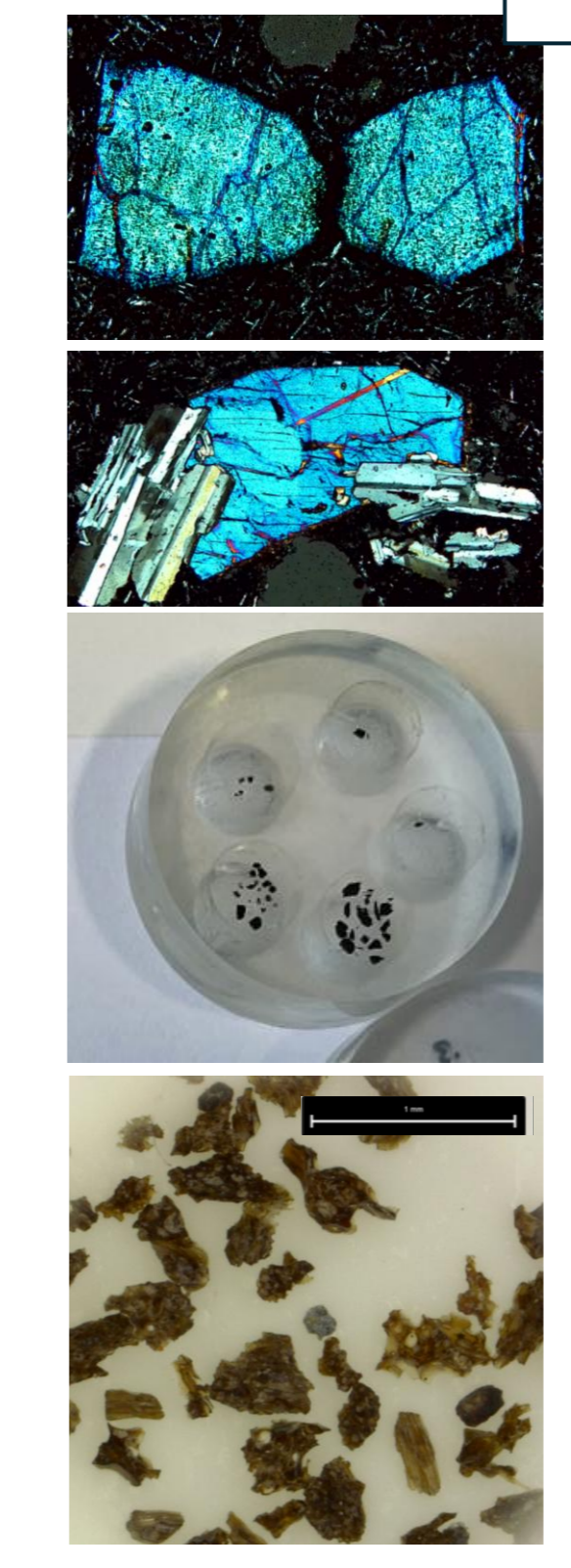


Sample sites,   is sediment core,   is tephra, and   is rock sample.

Beerenberg is heavily glaciated making it tough to get samples from all the flanks, tephra samples are from the south flanks and a sediment core to the north, and these were supplemented with rock samples from the central crater.

Rock samples were prepared for analysis by making thin sections, and tephra samples by embedding them in epoxy and polishing them.

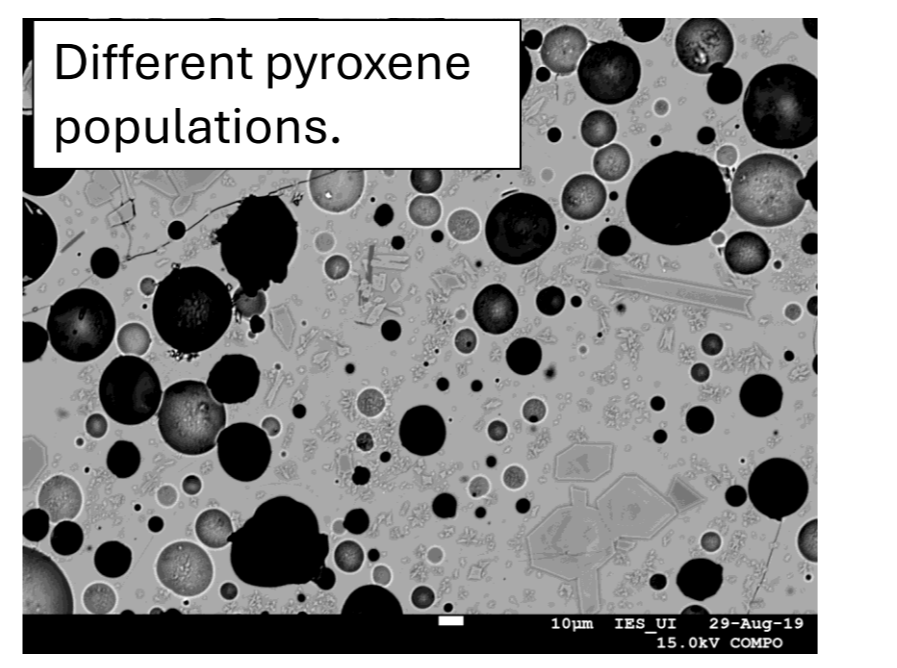
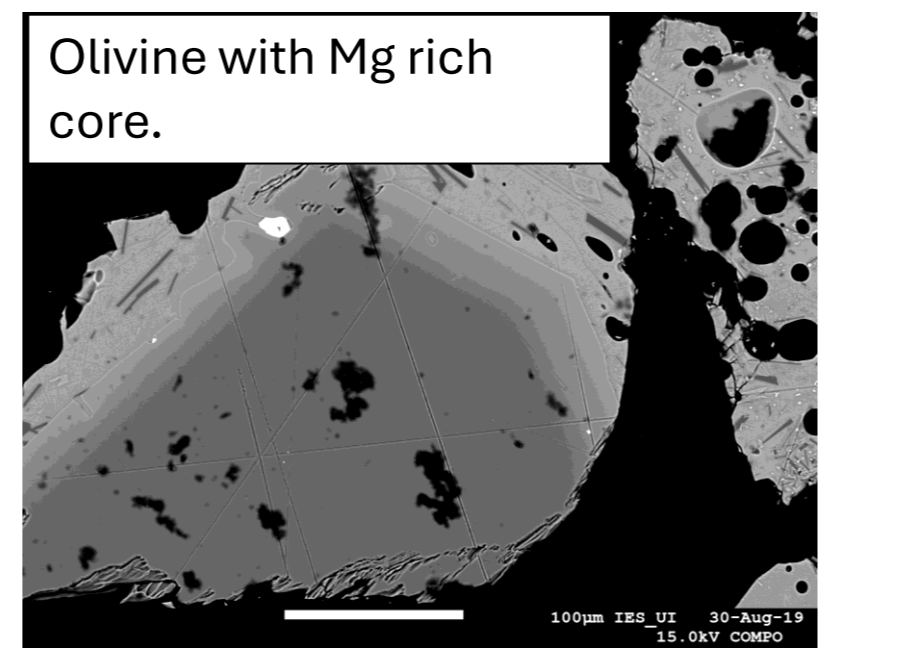
Using an electron microprobe we have analysed the glasses and minerals in the samples to uncover different magmas and crystal populations that originate at different depths underneath Beerenberg.



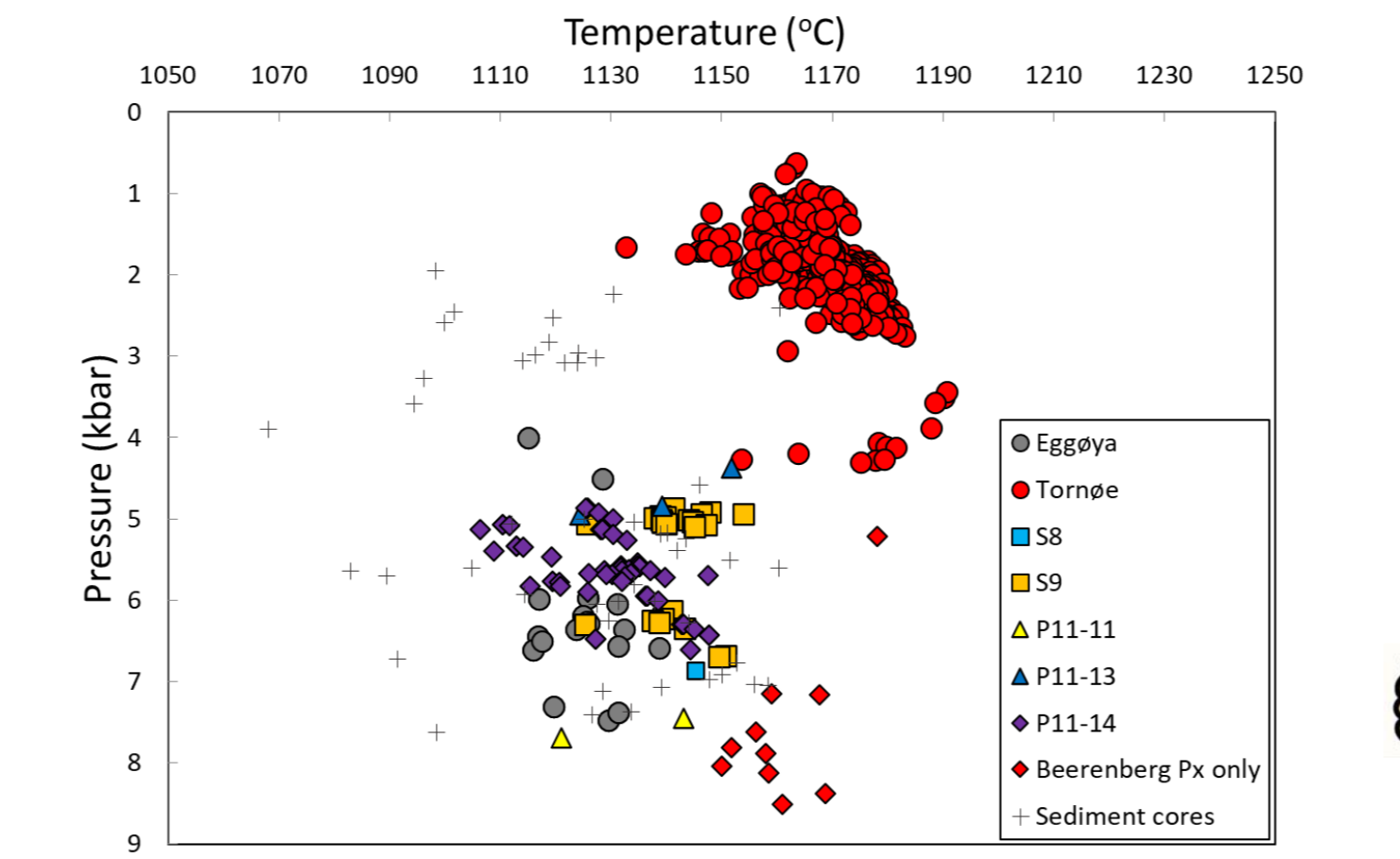
Top: olivine, pyroxene and feldspar in thin section
Middle: epoxy plug,
Bottom: hand picked tephra.

Beerenberg seems to erupt on average one to two times per century and has had at least 4-5 eruptions in its short historical period (since 1608) (Imslund 1978).
All the recent eruptions have been flank eruptions and the only activity seen in the summit crater has been fumaroles following the two most recent flank eruptions in 1970 and 1985 (Gjerl w et al. 2016).

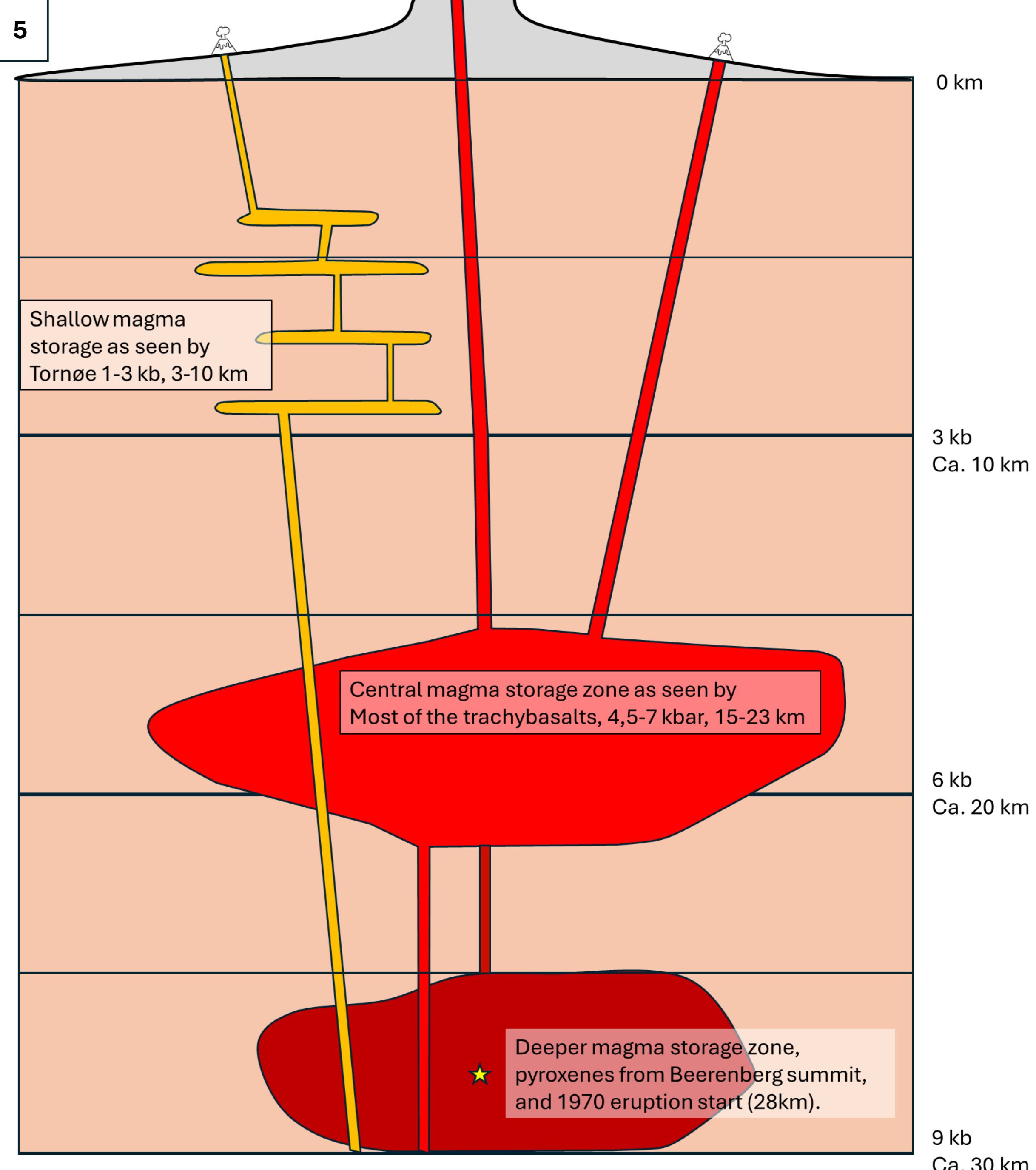
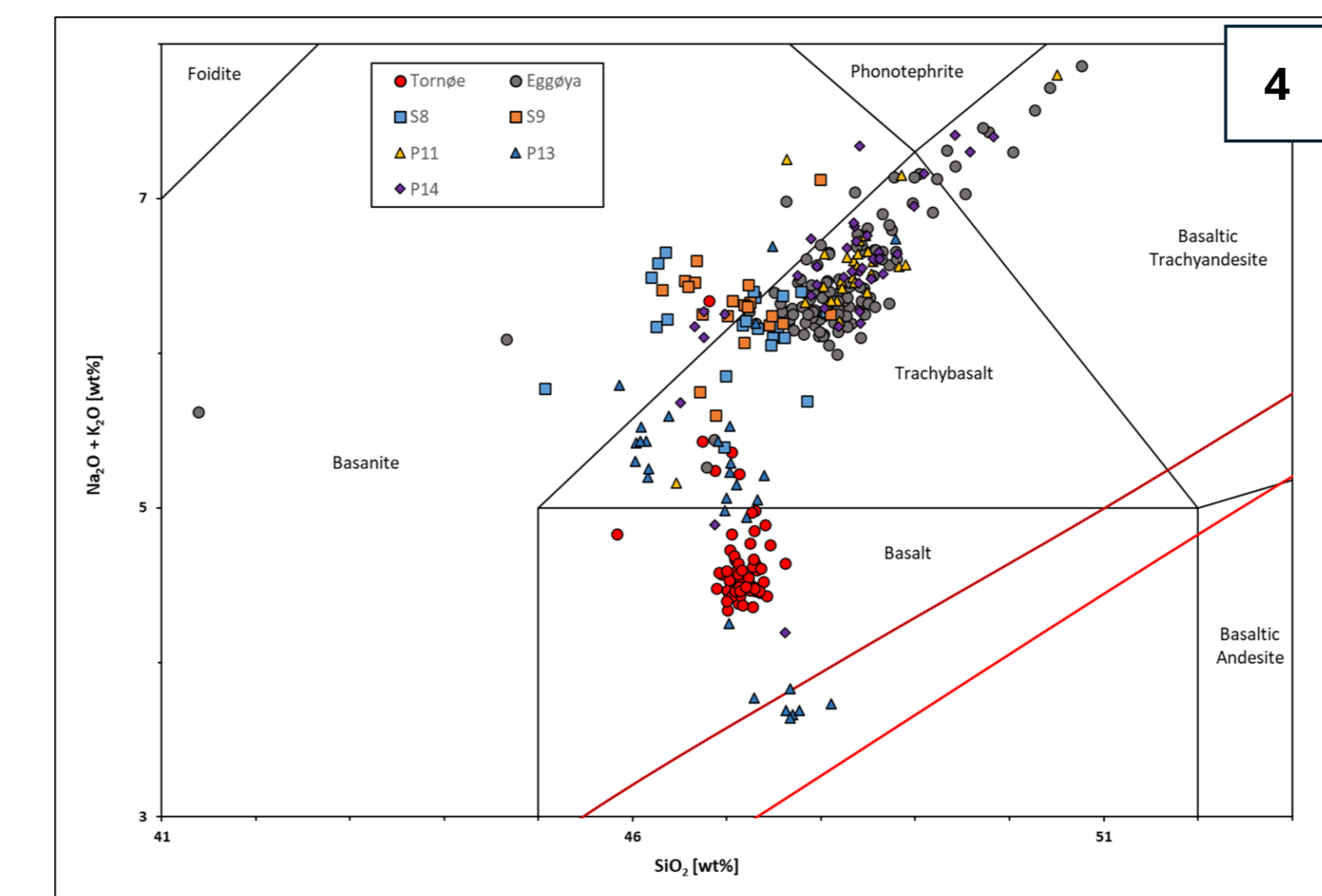
Previous work by Imslund (1984) has identified three primary magma types from the Jan Mayen volcanic systems. One is a primitive mantle generated basaltic magma corresponding to the Torn e sample, one is a normative (trachy-) basaltic magma and the last is a trachytic magma that is not found at Beerenberg. We used the EPMA results to infer temperature and pressure conditions with the thermobarometers of Neave & Putirka (2017).



Previous work by Imslund (1984) has identified three primary magma types from the Jan Mayen volcanic systems. One is a primitive mantle generated basaltic magma corresponding to the Torn e sample, one is a normative (trachy-) basaltic magma and the last is a trachytic magma that is not found at Beerenberg. We used the EPMA results to infer temperature and pressure conditions with the thermobarometers of Neave & Putirka (2017).



TiO₂ vs K₂O variations reflect differences in the source and degree of melting, and Al₂O₃ vs Mg# variations also record differentiation controlled by plagioclase.



This is our simplified model of the magma storage zones underneath of Beerenberg. At the deeper level the more primitive ankaramites (with compositions similar to Torn e) start crystallizing. The 1970 eruption of Beerenberg started after an earthquake at approximately 28 km depth (Sylvester 1974).

The trachybasalts are the most common eruptions in recent times and all seem to originate from a broader zone with pressures ranging from 4,5 to 7 kbar. And finally, we have the shallow magma storage, this is documented in the Torn e sample, and crystallization seems to have been ongoing while the magma migrated towards the surface.

References:
Gjerl w et al. 2015 The 1732 Surtseyan eruption of Egg ya, Jan Mayen, North Atlantic: deposits, distribution, chemistry and chronology
Gjerl w et al. 2022 The Volcanic Hazards of Jan Mayen Island (North-Atlantic)
Imslund 1984, Petrology, mineralogy and evolution of the Jan Mayen magma system
Neave & Putirka 2017 A new clinopyroxene-liquid barometer, and implications for magma storage pressures under Icelandic rift zones.
Sylvester 1974 Faulting and fumarolic activity since the 1970 Beerenberg eruption Jan Mayen

Acknowledgements:
Fieldwork was performed while the main author was supported by a grant from the Nordic volcanological center- The analytical work was supported by grants from Nansenfondet and Elkem & Olge Adamsons stiftelse til st tte av geologisk forskning.
Cartoon characters in this poster were generated using Microsoft Copilot