UNIVERSITY OF ICELAND
INSTITUTE OF EARTH SCIENCES

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An aeromagnetic survey over the volcanic island of Surtsey off the south coast of Iceland

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rannís

Vestmannaeyjar archipelago

The Embryonic volcanic system

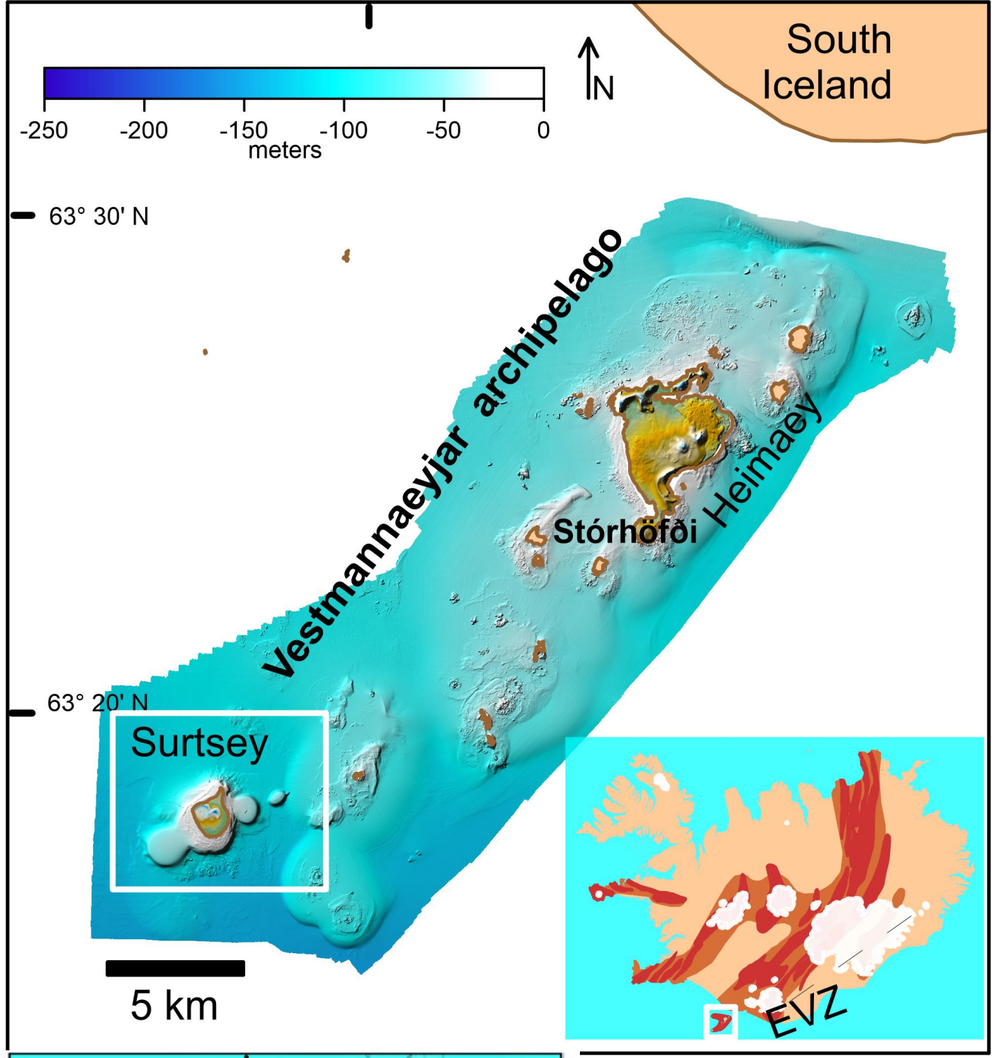
- Past eruptions
- several tens of remnants of vents over an area of 20 x 15 km - Built on sediments ~1 km thick
- Volcanics on top in places (0-200 m)
- Type locality for Surtseyjan volcanism

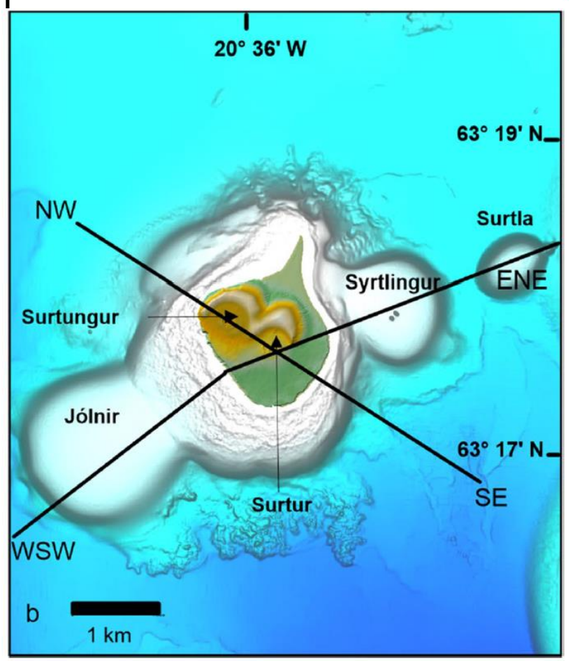
Questions to consider

• Explore the feasibility of magnetics to detect remnants of past eruptions

• Do eruptions leave pillow lavas/magnetic rocks on the sea floor and buried beneath it?

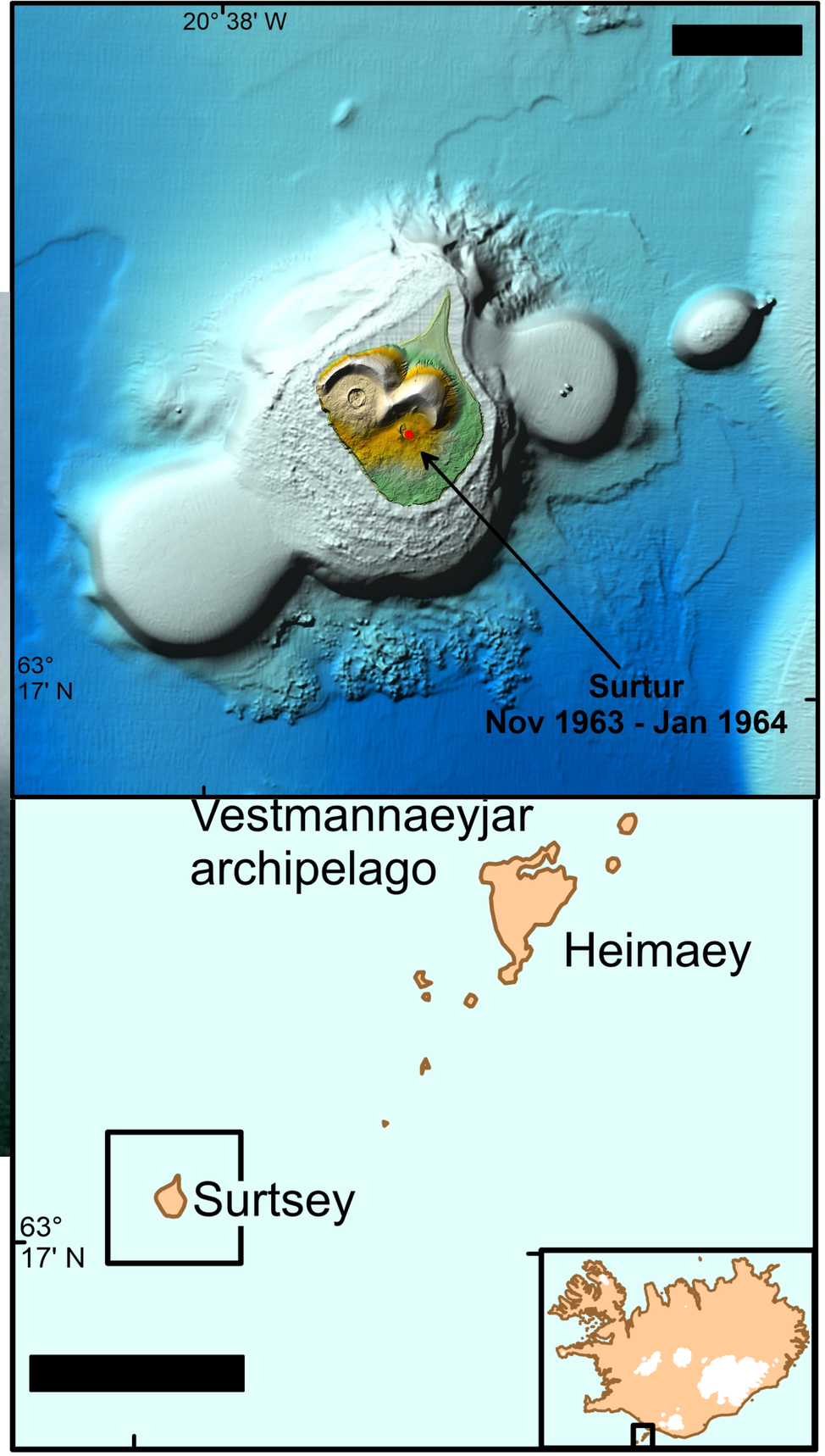
• Can magnetic surveying help be defining recurrence times of eruptions? Test case – Surtsey and associated vents – formed in 1963-1967





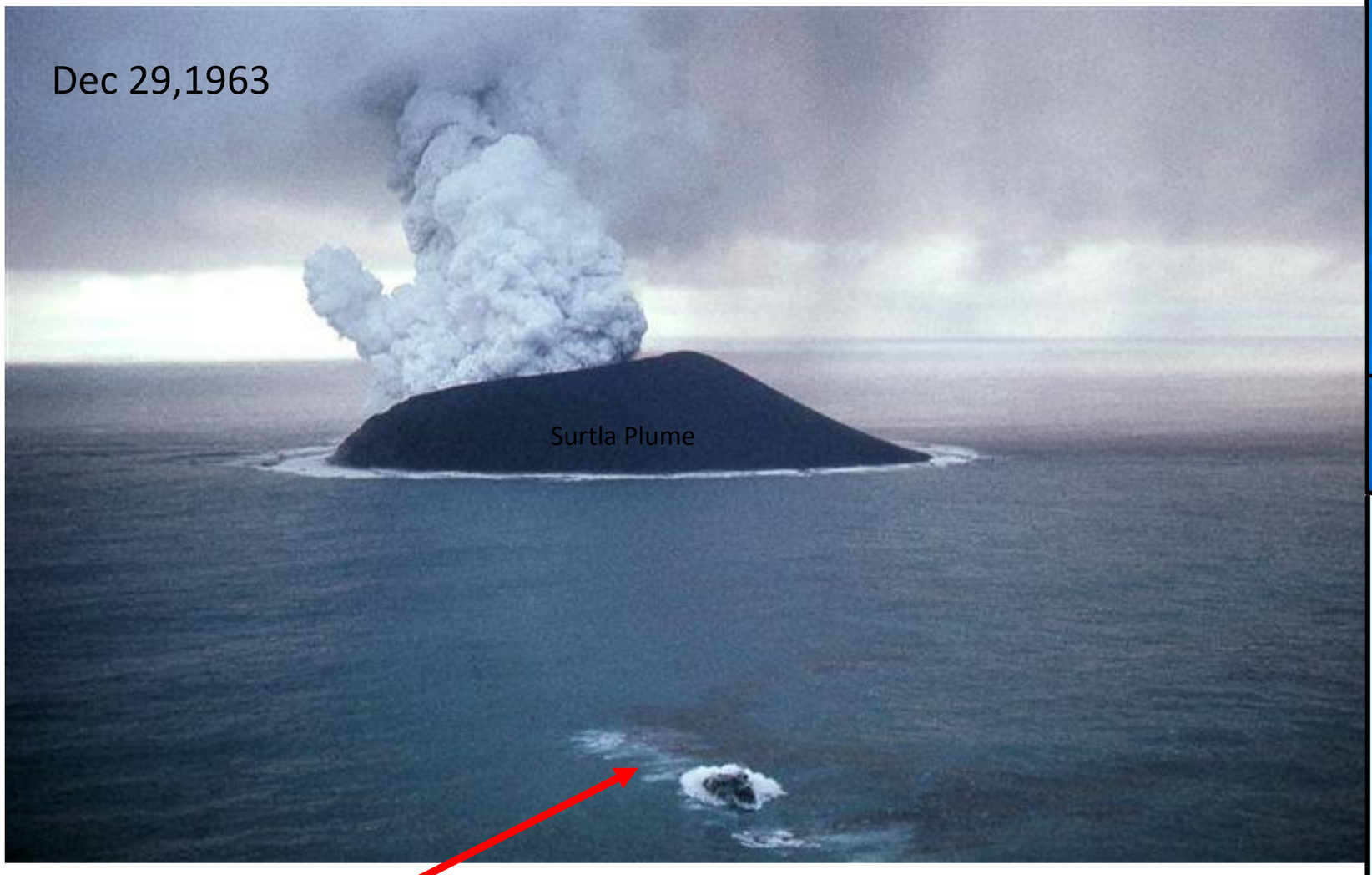
Surstey 1963-1967

1) Onset of the submarine eruption-Surtur crater, Nov1963

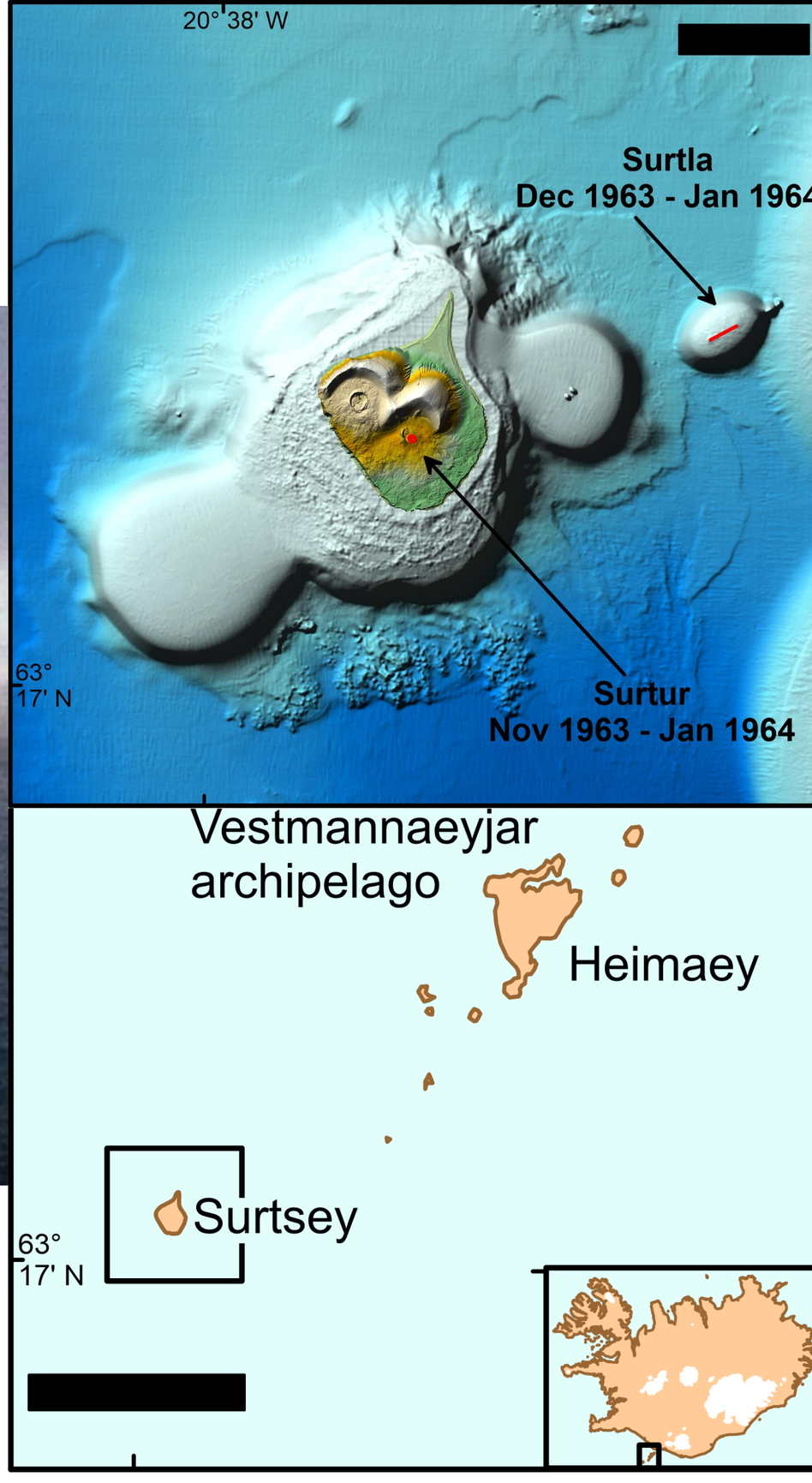


Surstey 1963-1967

2) Submarine eruption-Surtla, Dec1963-Jan 1964

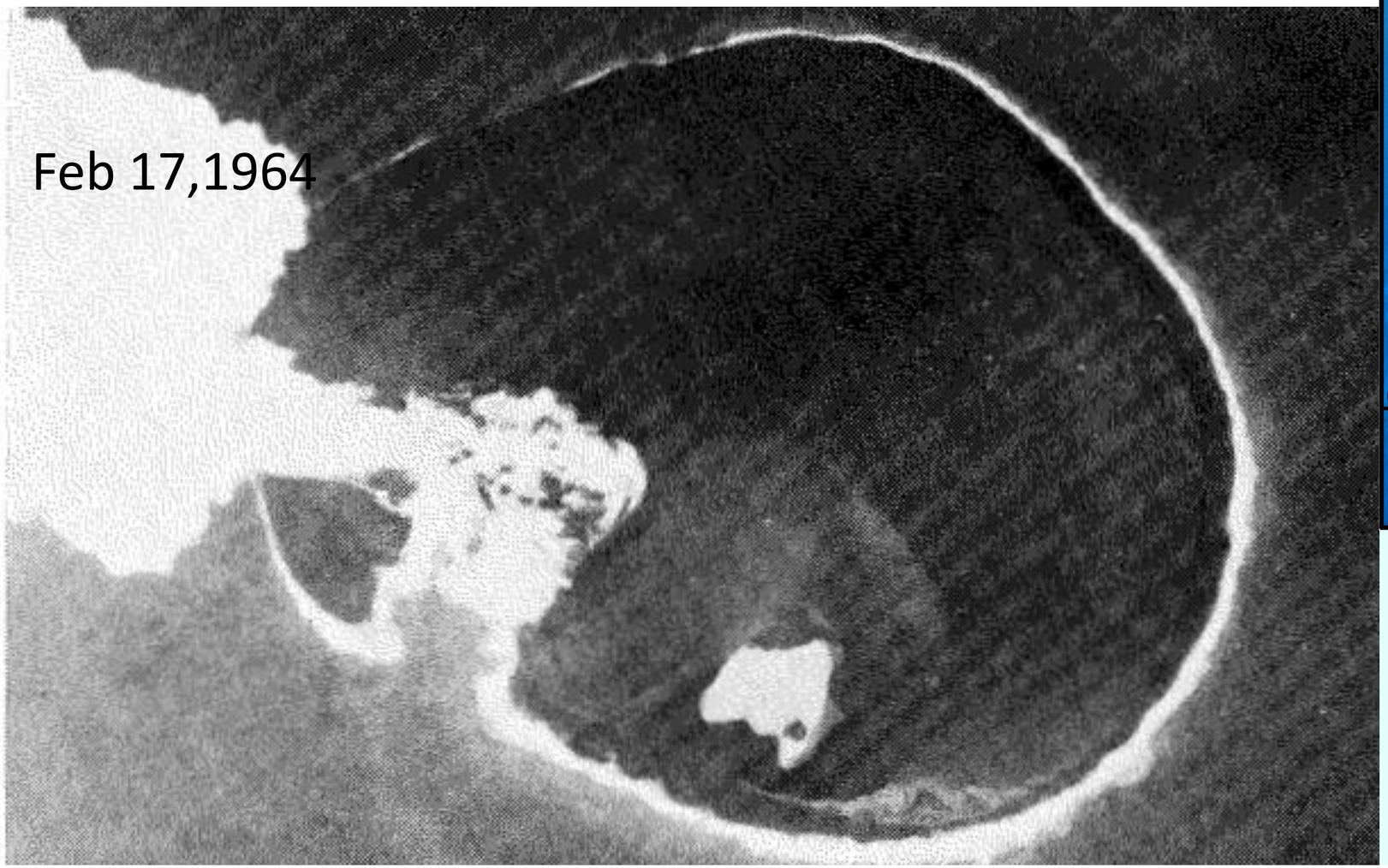


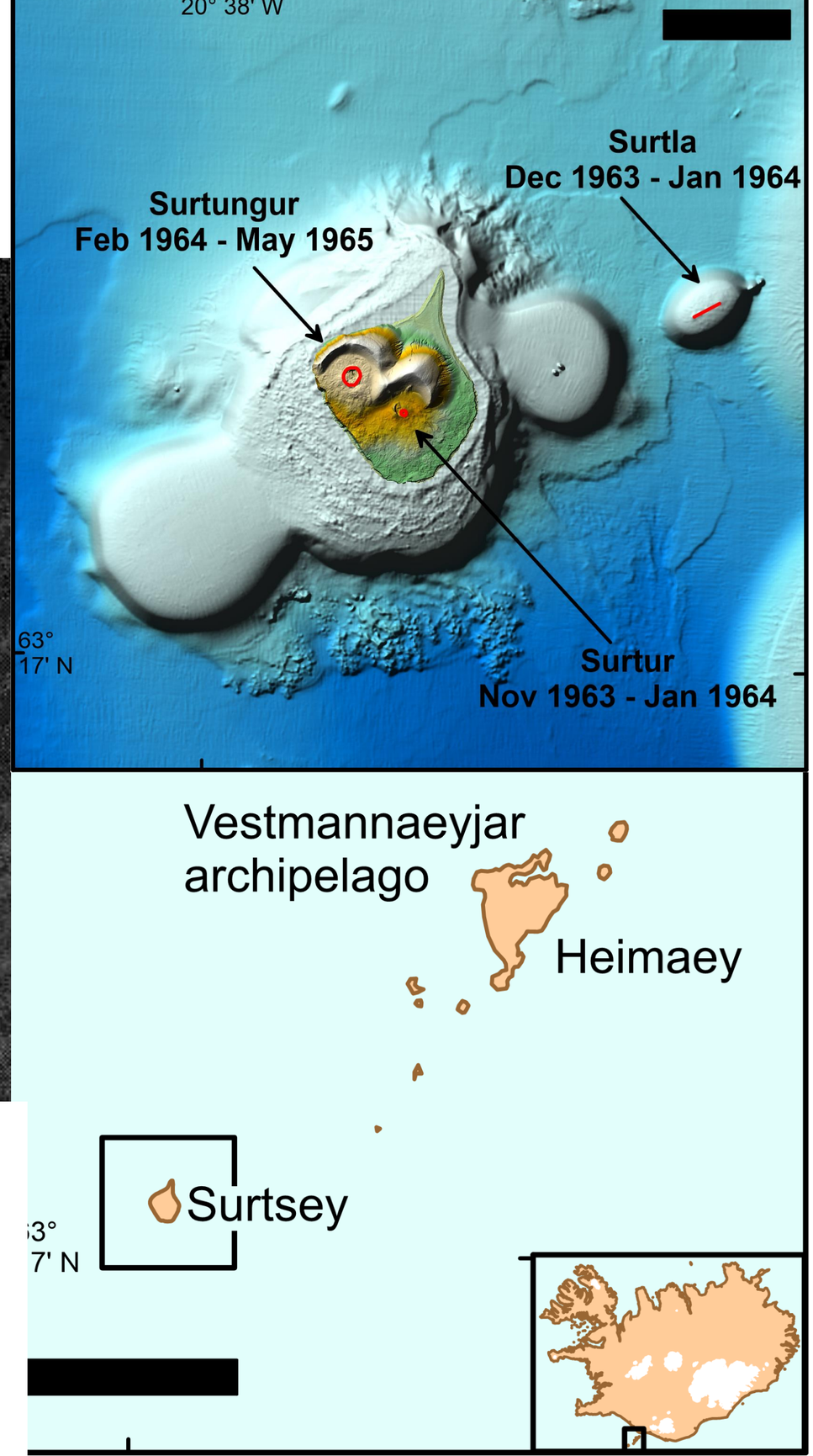
Surtla Plume



Surstey 1963-1967

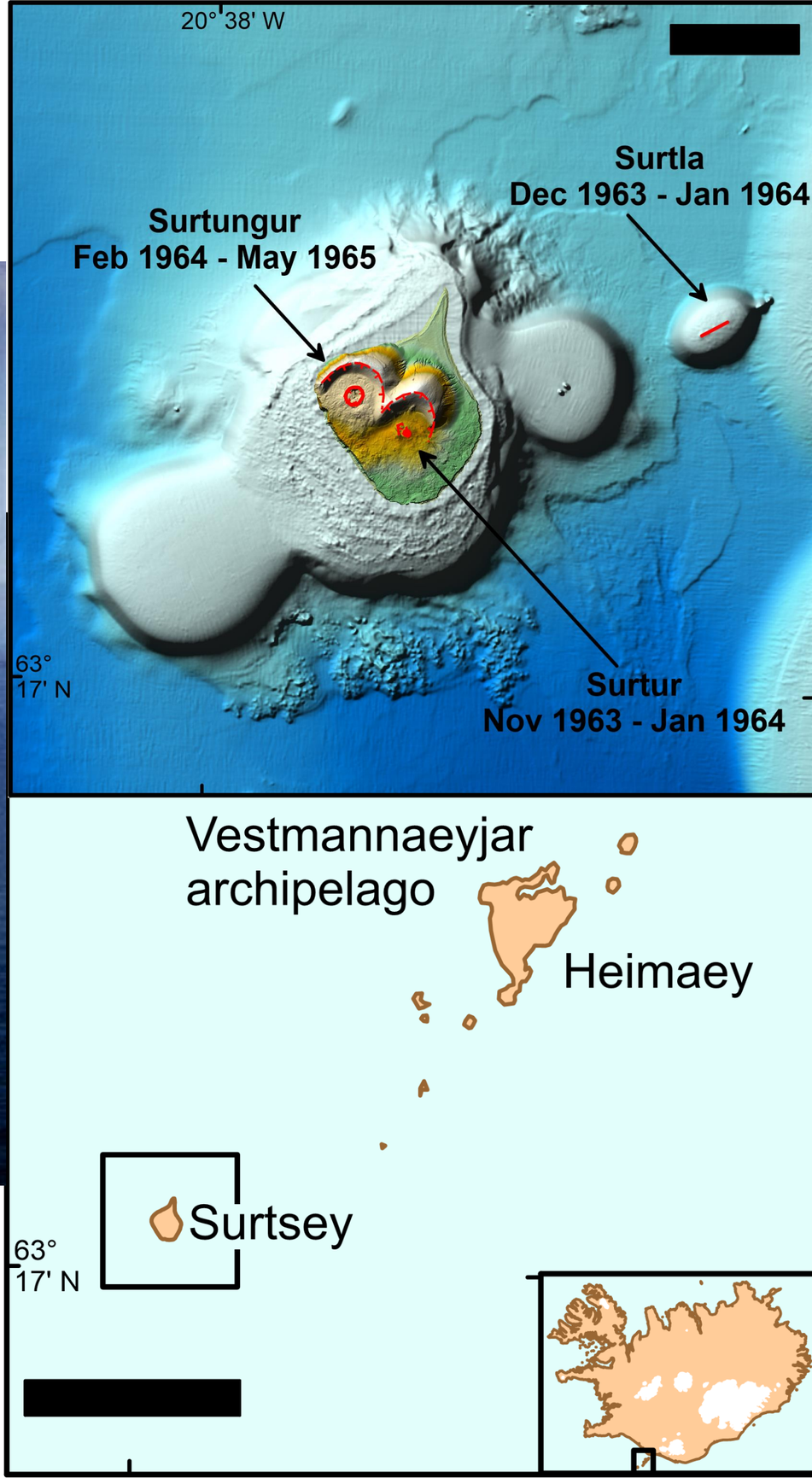
3) Formation of the parasitic cone of Surtungur, Jan-April 1964,





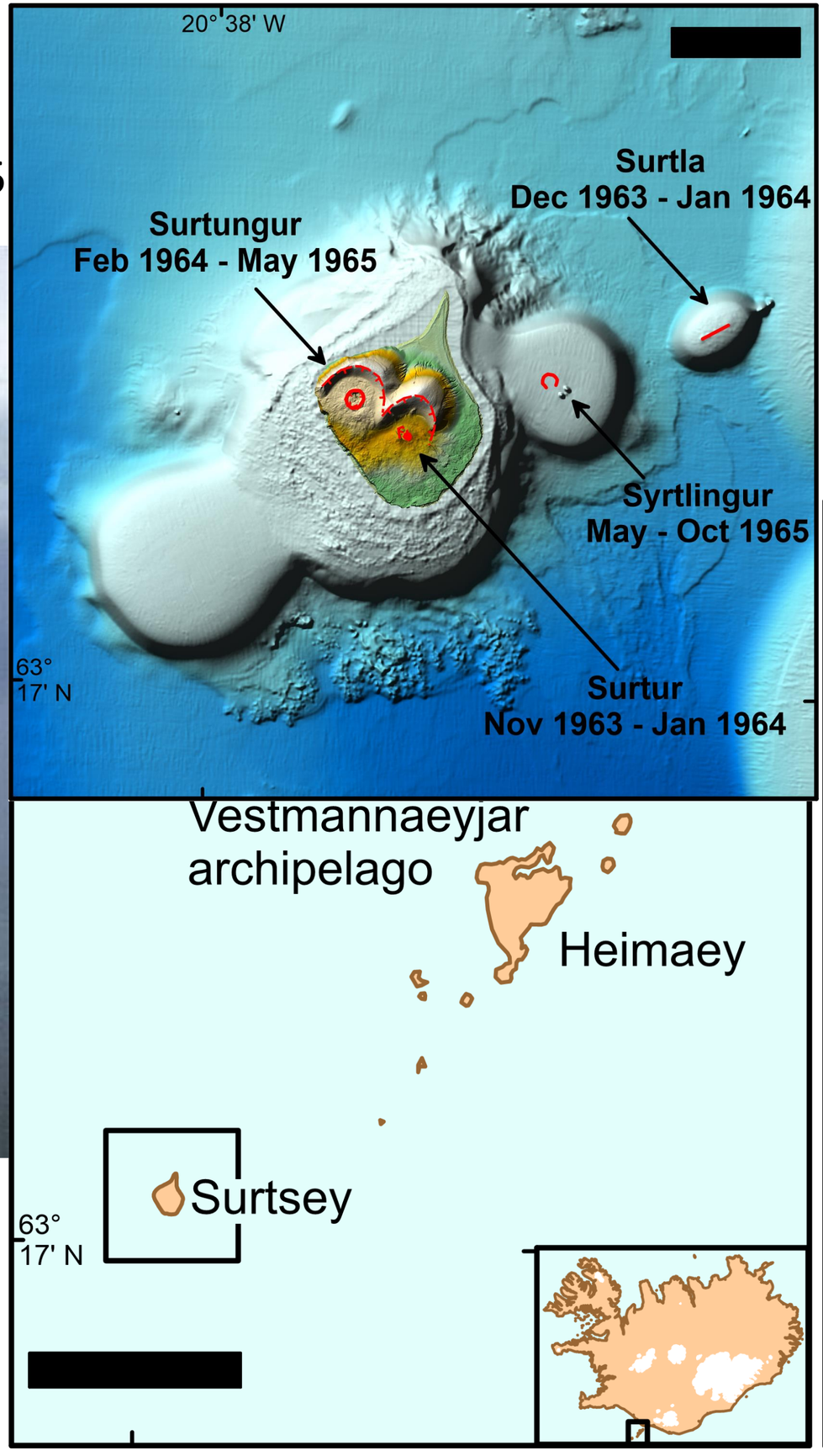
Surstey 1963-1967

4) Lava effusion from Surtungur April-July 1964,



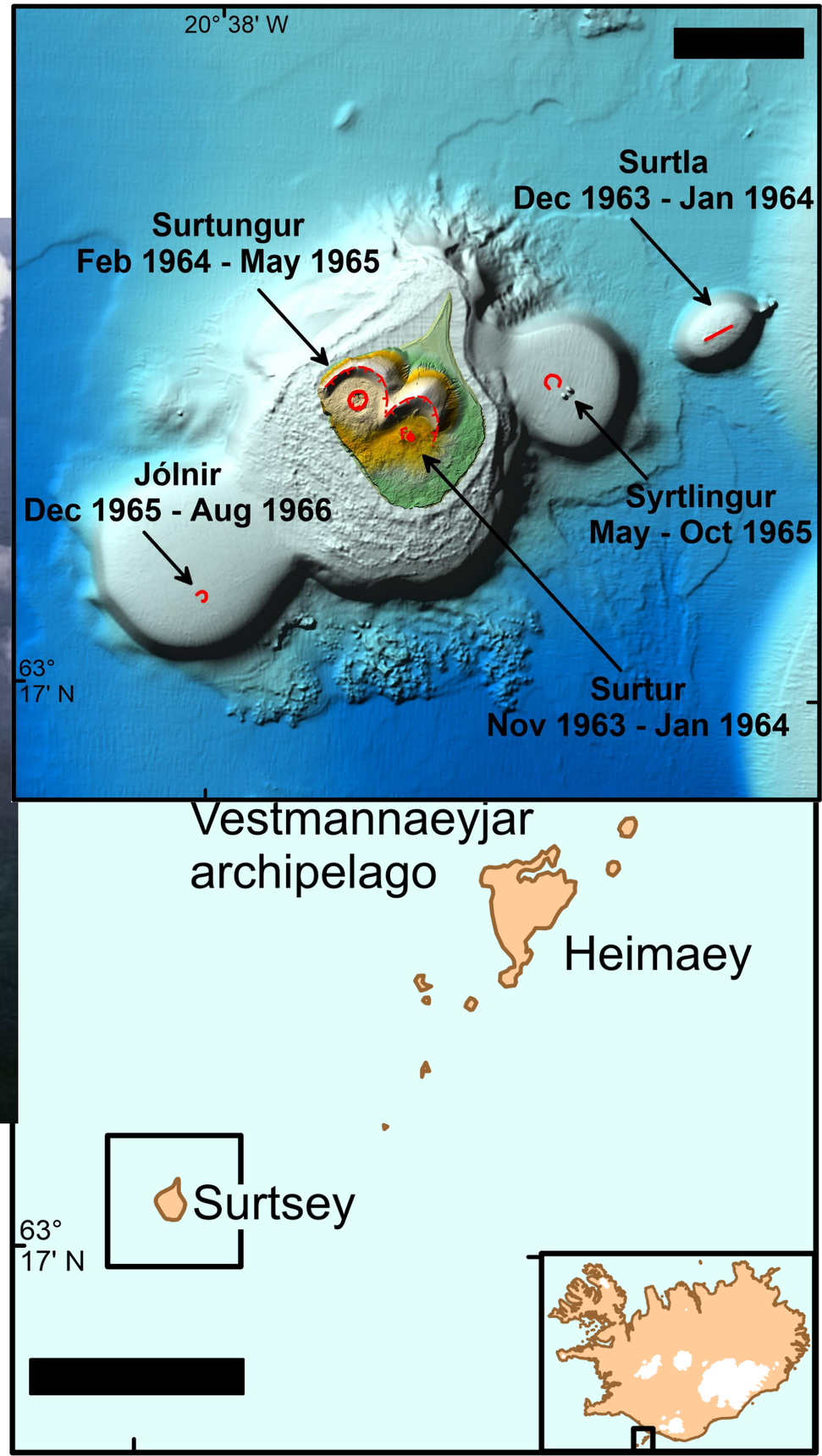
Surstey 1963-1967

5) Formation of the temporary island of Syrtlingur, May-Oct 1965



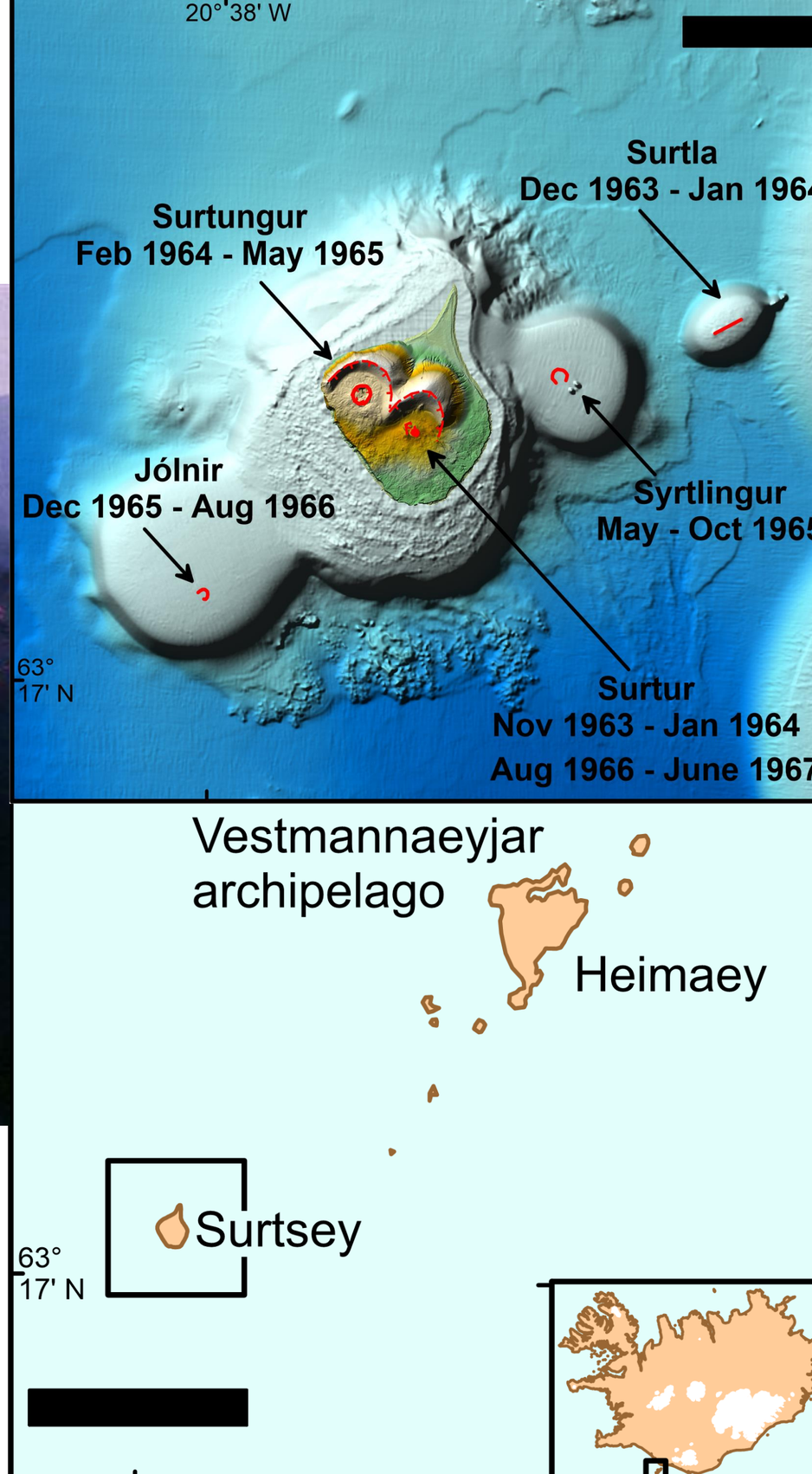
Surstey 1963-1967

6) Formation of the temporary island of Jólnir, Dec 1965-Aug 1966,



Surstey 1963-1967

7) Lava eruption -Surtur crater, Aug 1966- June 1967

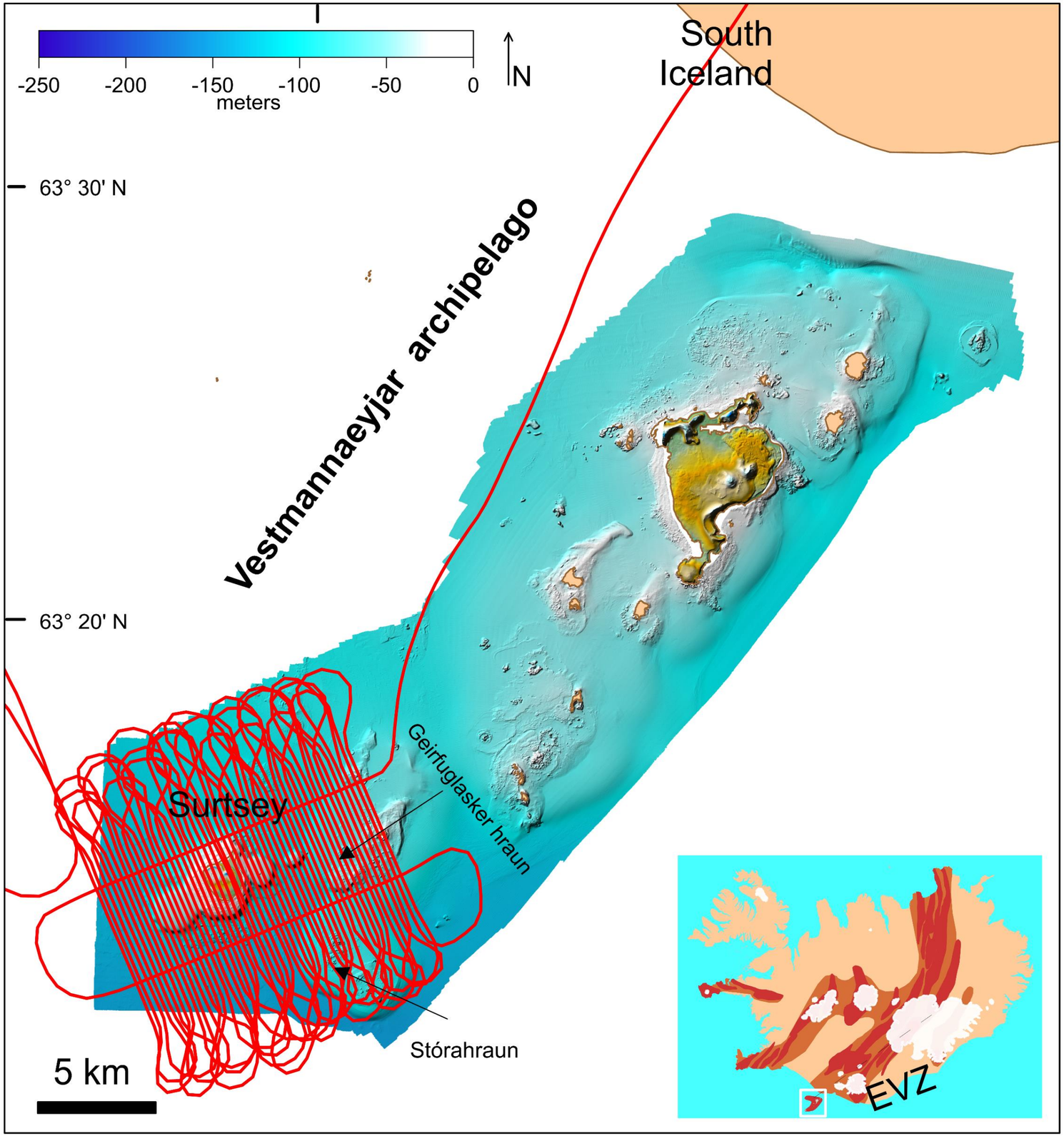


Survey lines on October 30,2021

Survey map details and planning

Available Data:

(Magnetic and bathymetry)



Operation equipment

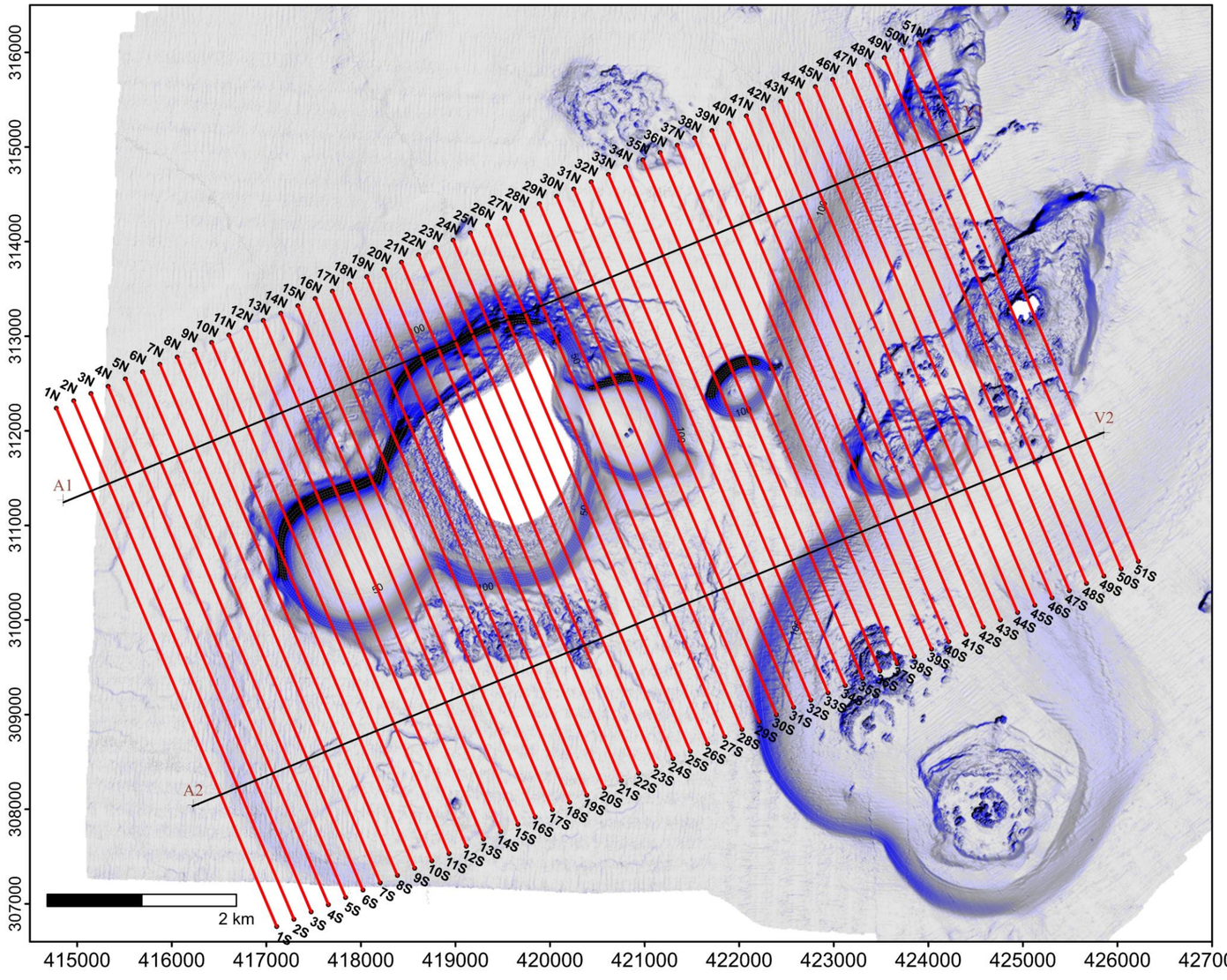
MagArrow uses a MFAM sensor to provide high quality magnetic data with noise/sensitivity range of only 5 nT

Magnetometer

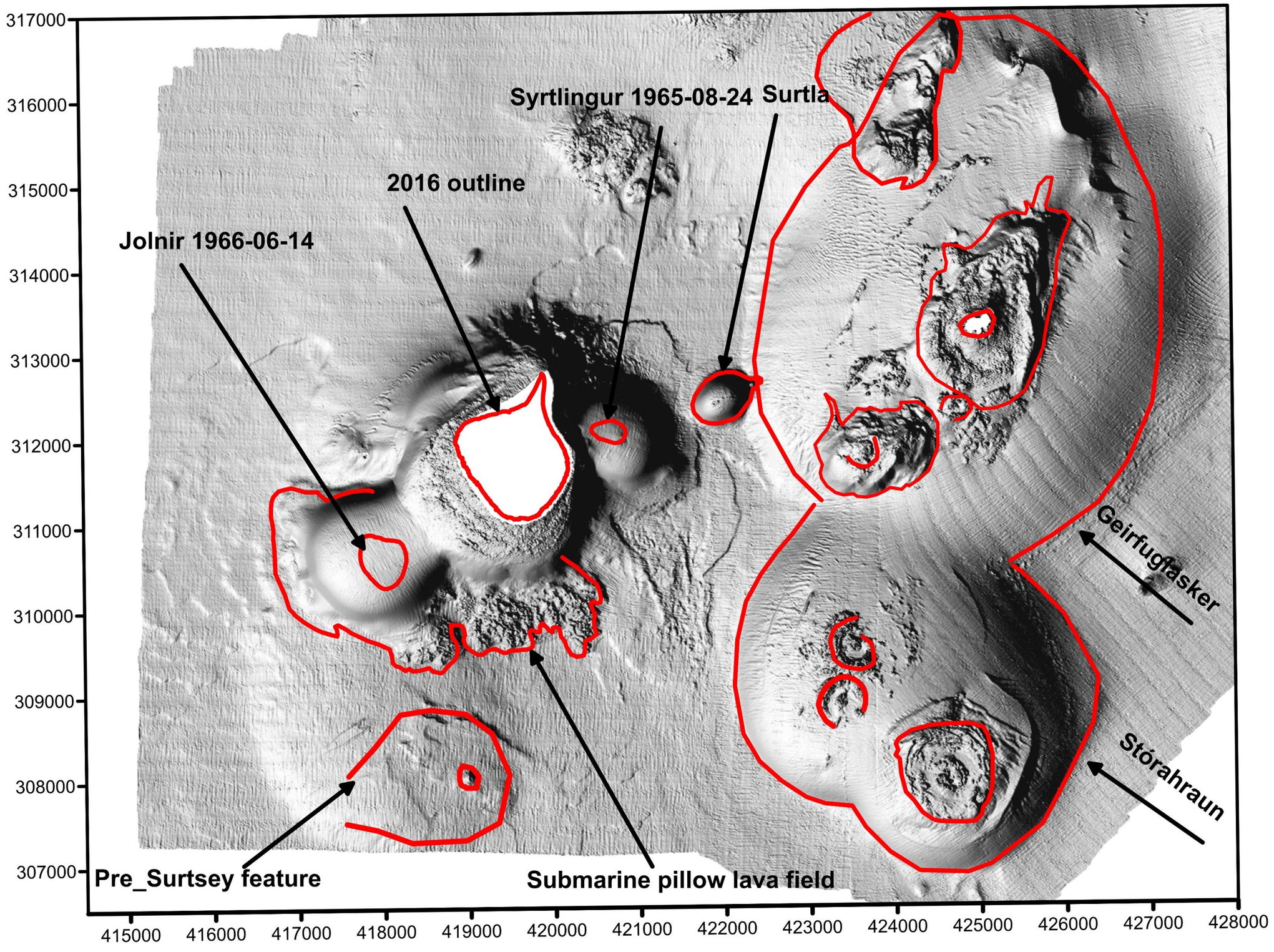
https://www.geometrics.com/product/magarrow/

Data processing summary:

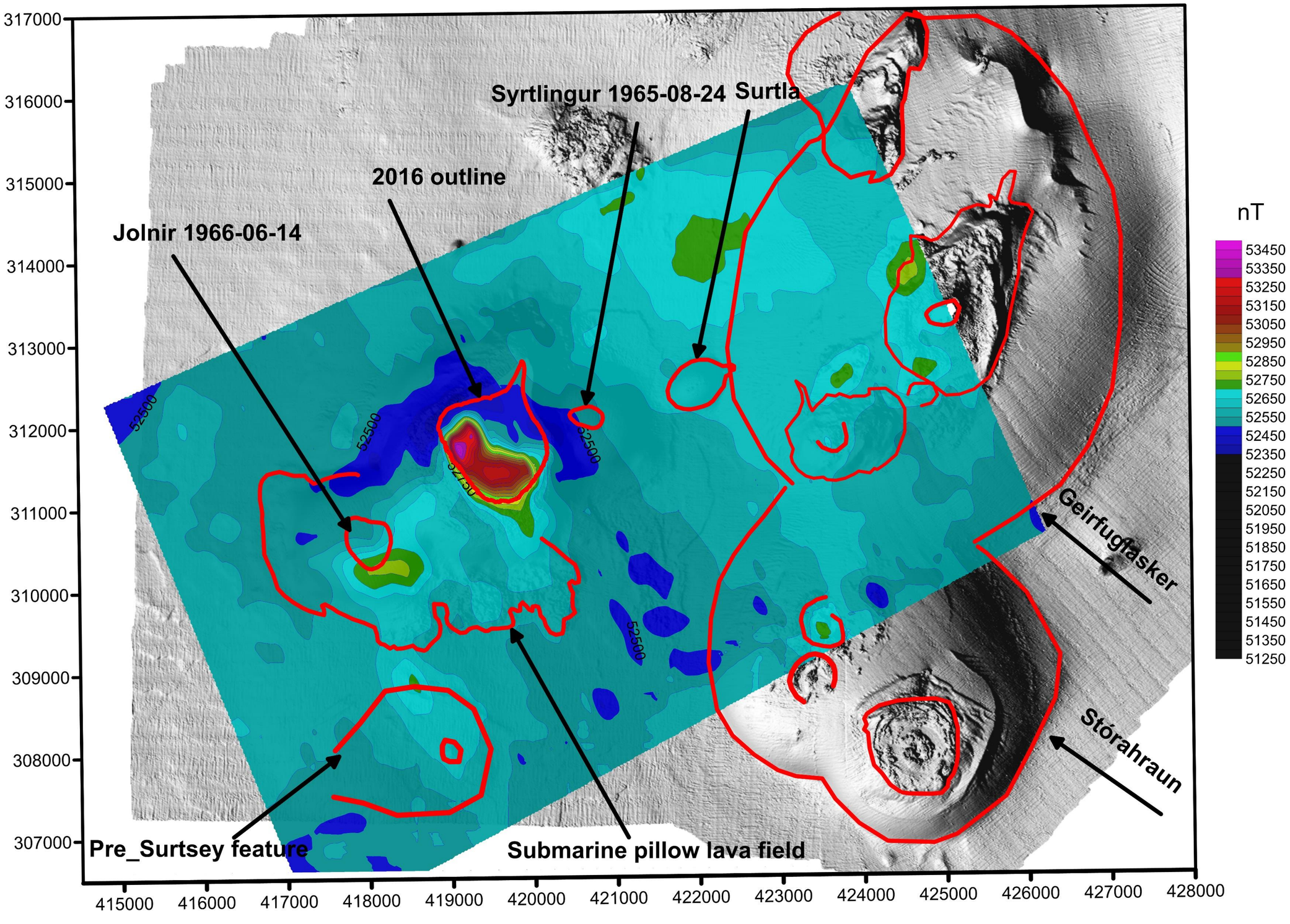
- Resampling and survey line setup
- Flight direction effect removal
- Low Pass filtering
- Temporal variations (Leirvogur base in Iceland)



Magnetic Map survey 2021 at 100 height



Magnetic Map survey 2021 at 100 height



1965 helicopter survey at 200 m height

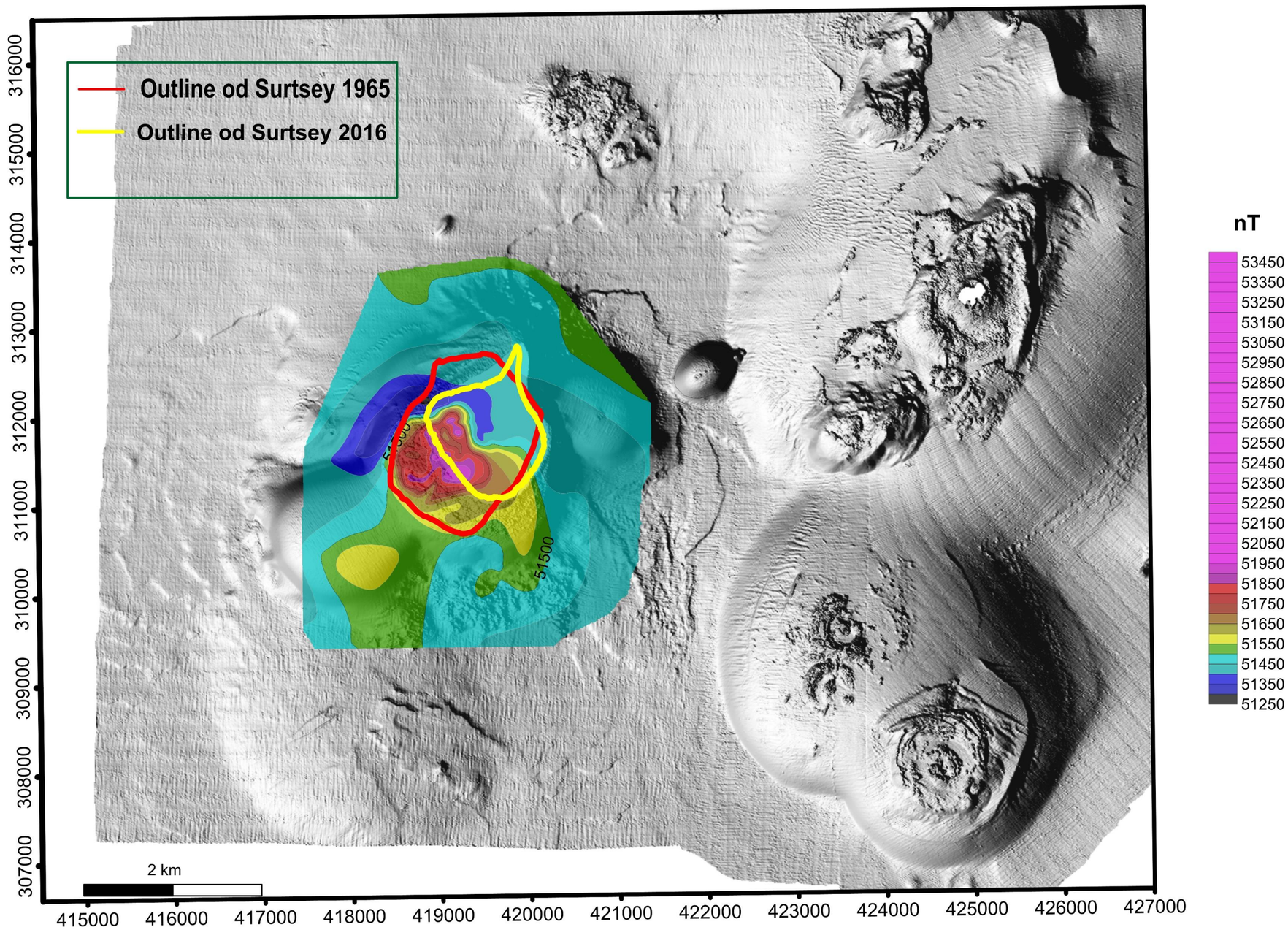
Adjusting Magnetic Map of 1965

Magnetic field measured at **Leirvogur Magnetic Observatory, Iceland:**

31 August 1965: 50960

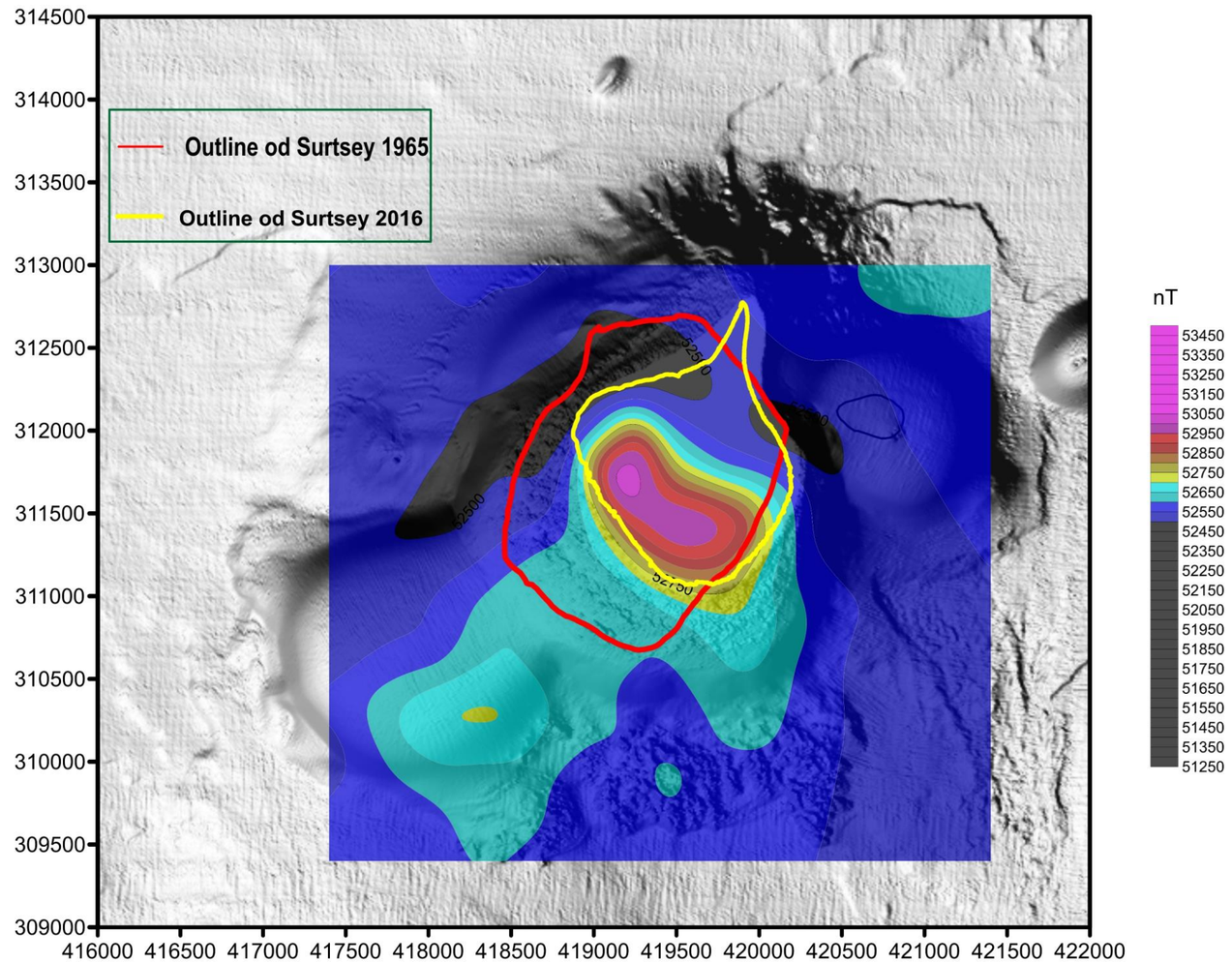
30 October 2021:51925.33

Difference: 96533

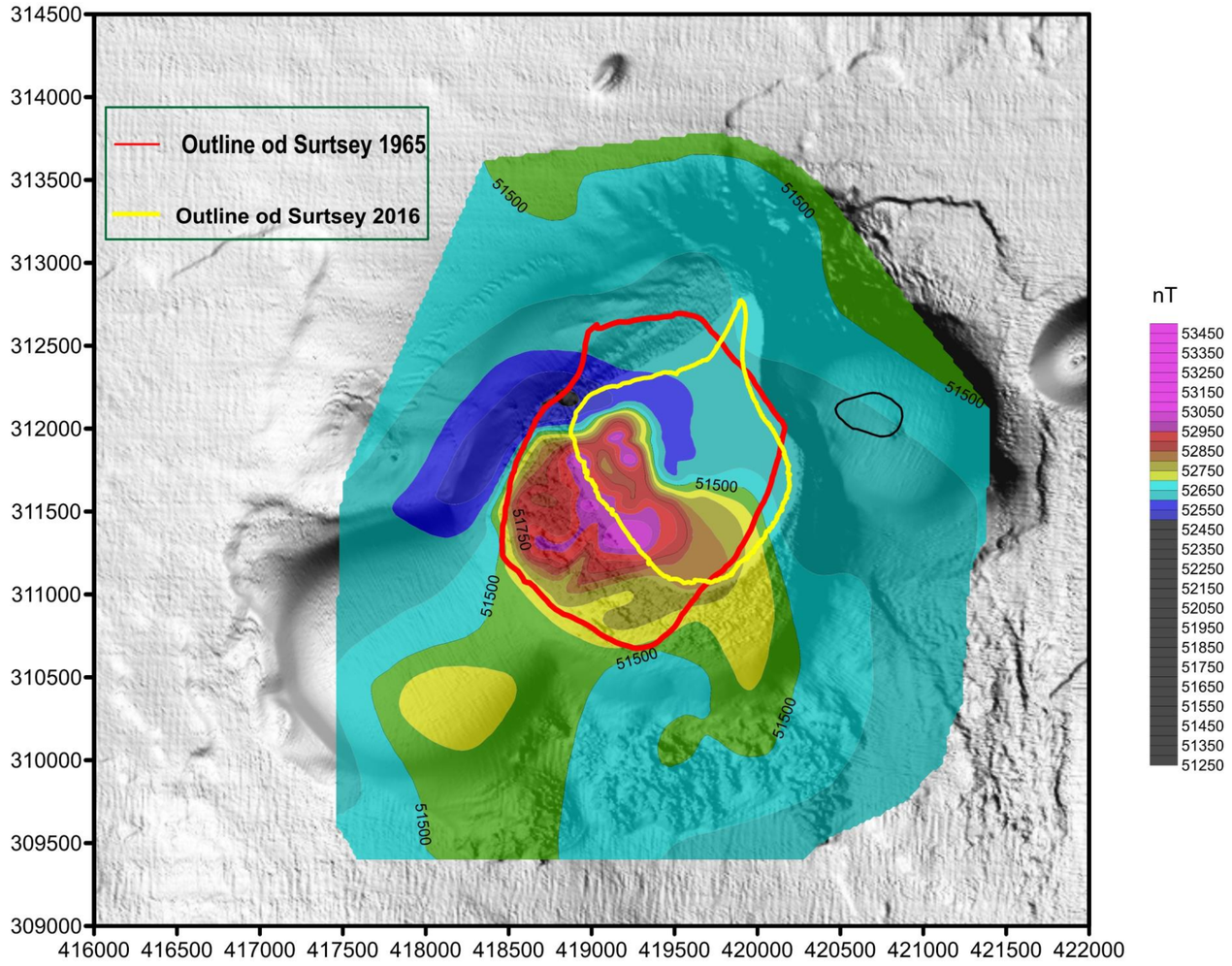


Comparison of 2021 survey and helicopter survey 1965

upward continuation of Oct 2021 Survey

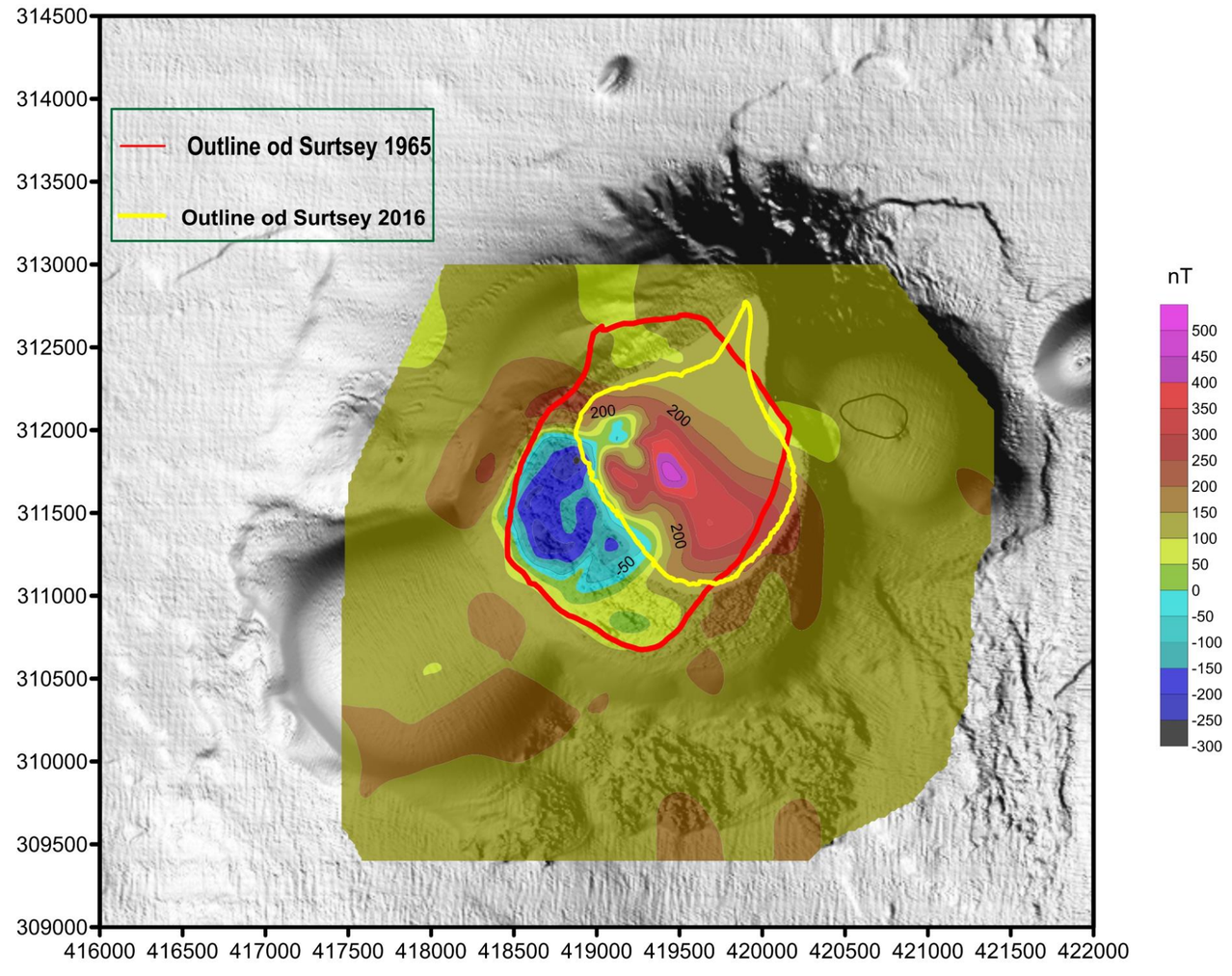


1965 helicopter survey

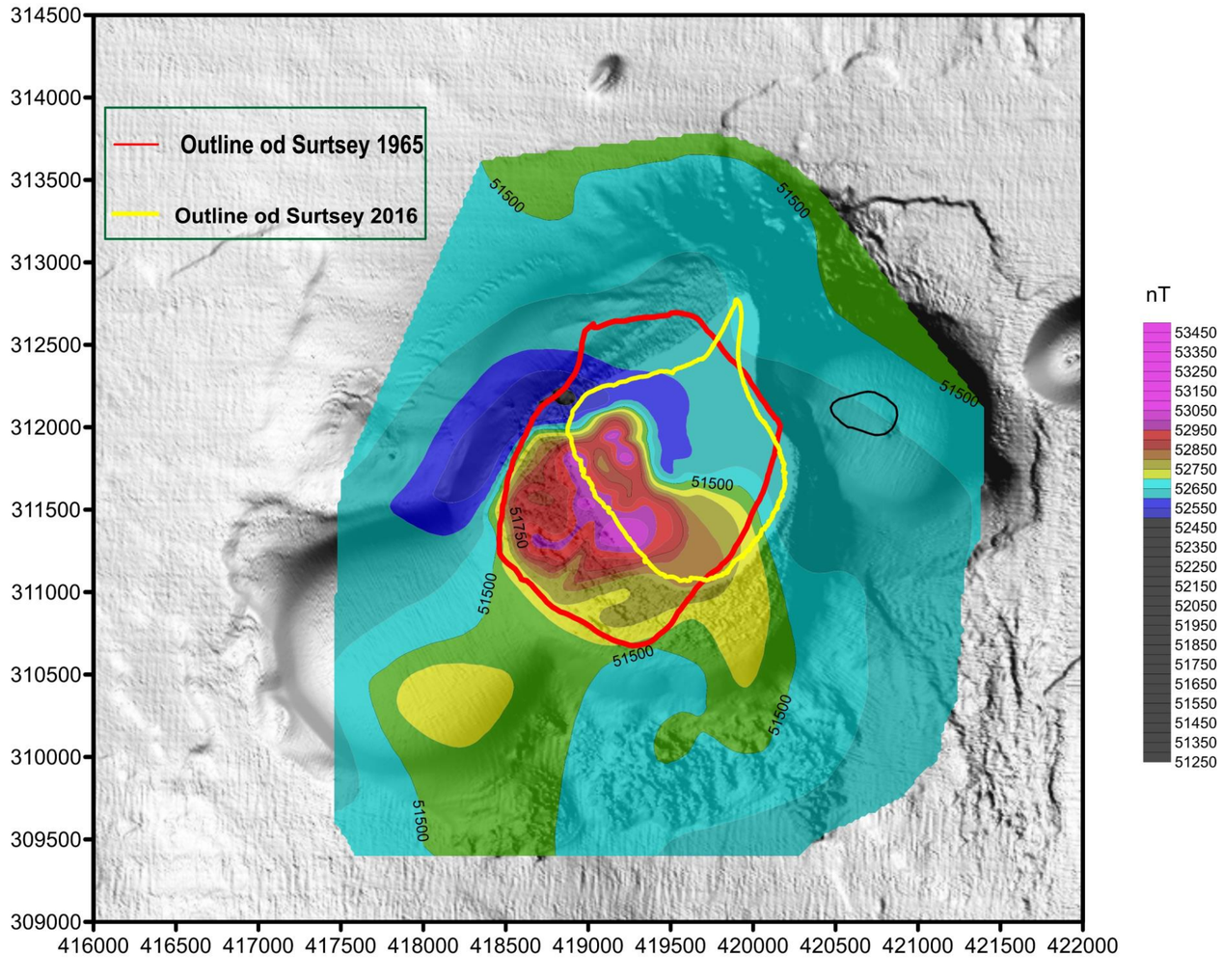


Comparison of 2021 survey and helicopter survey 1965

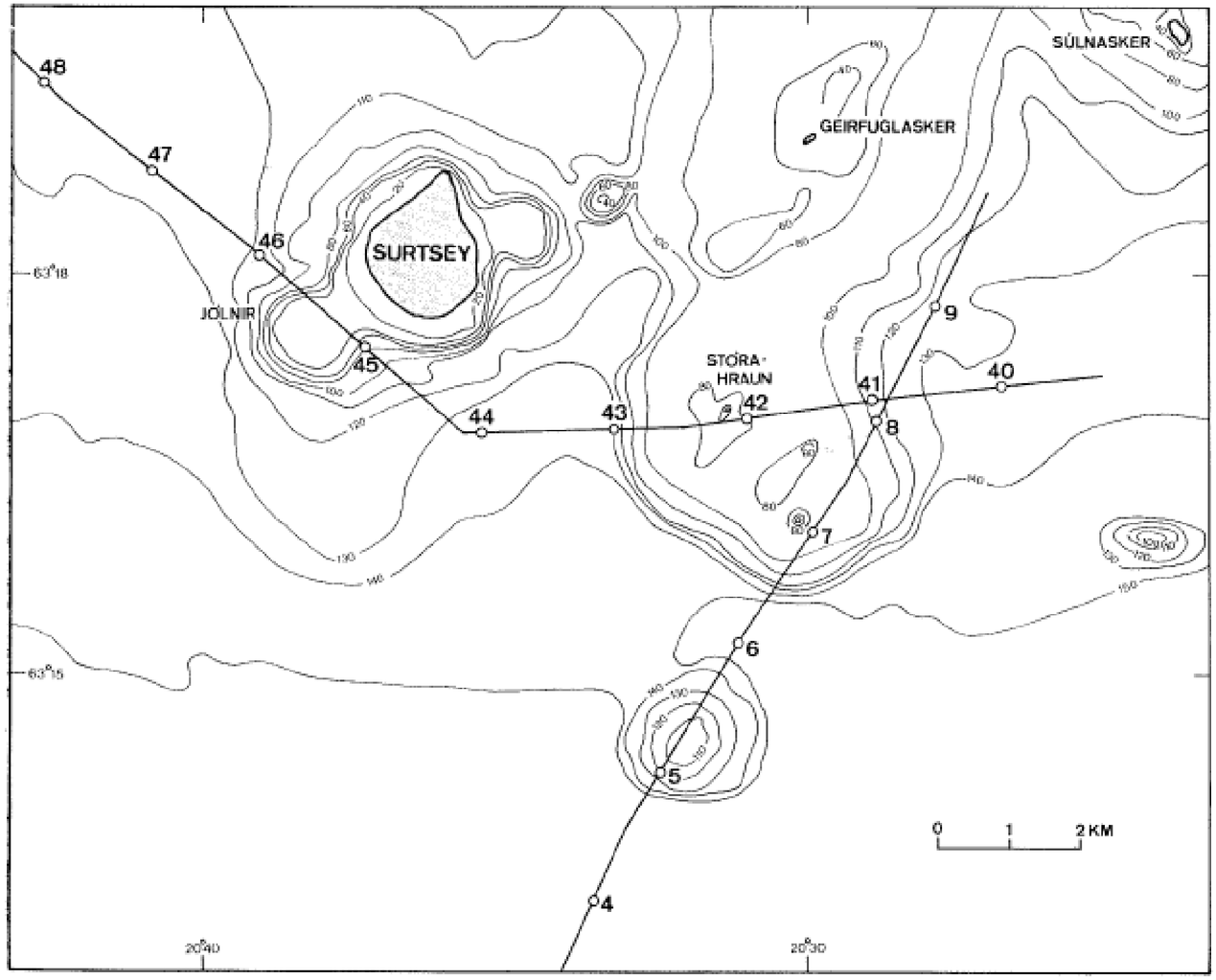
Differential map of 2021 survey and 1965 survey

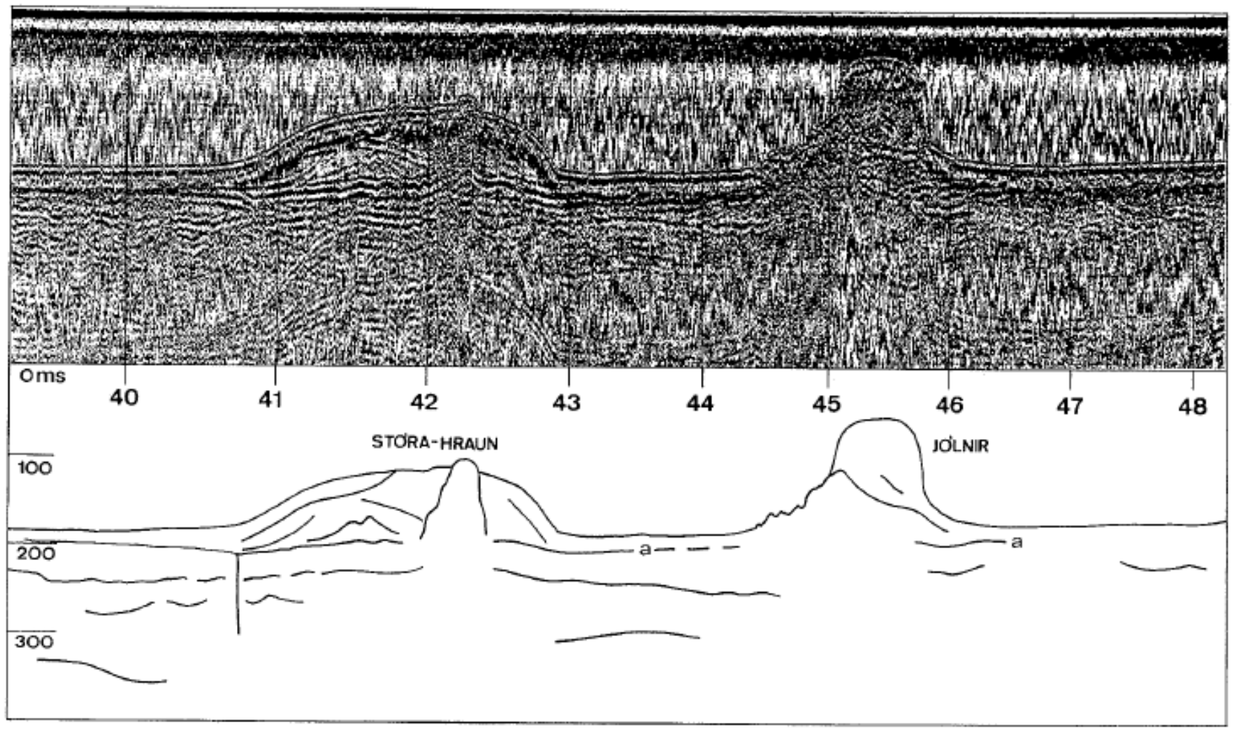


1965 helicopter survey

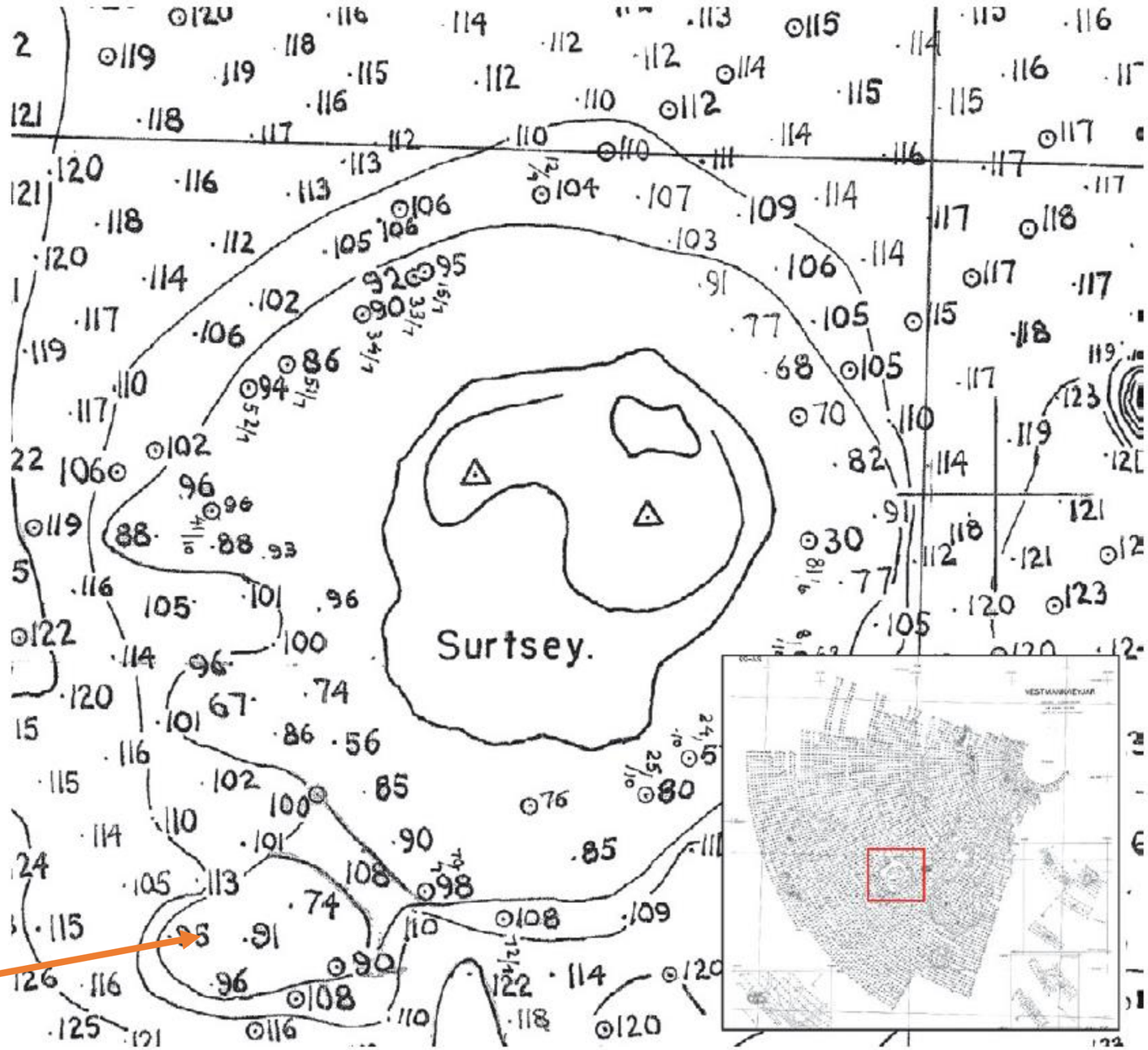


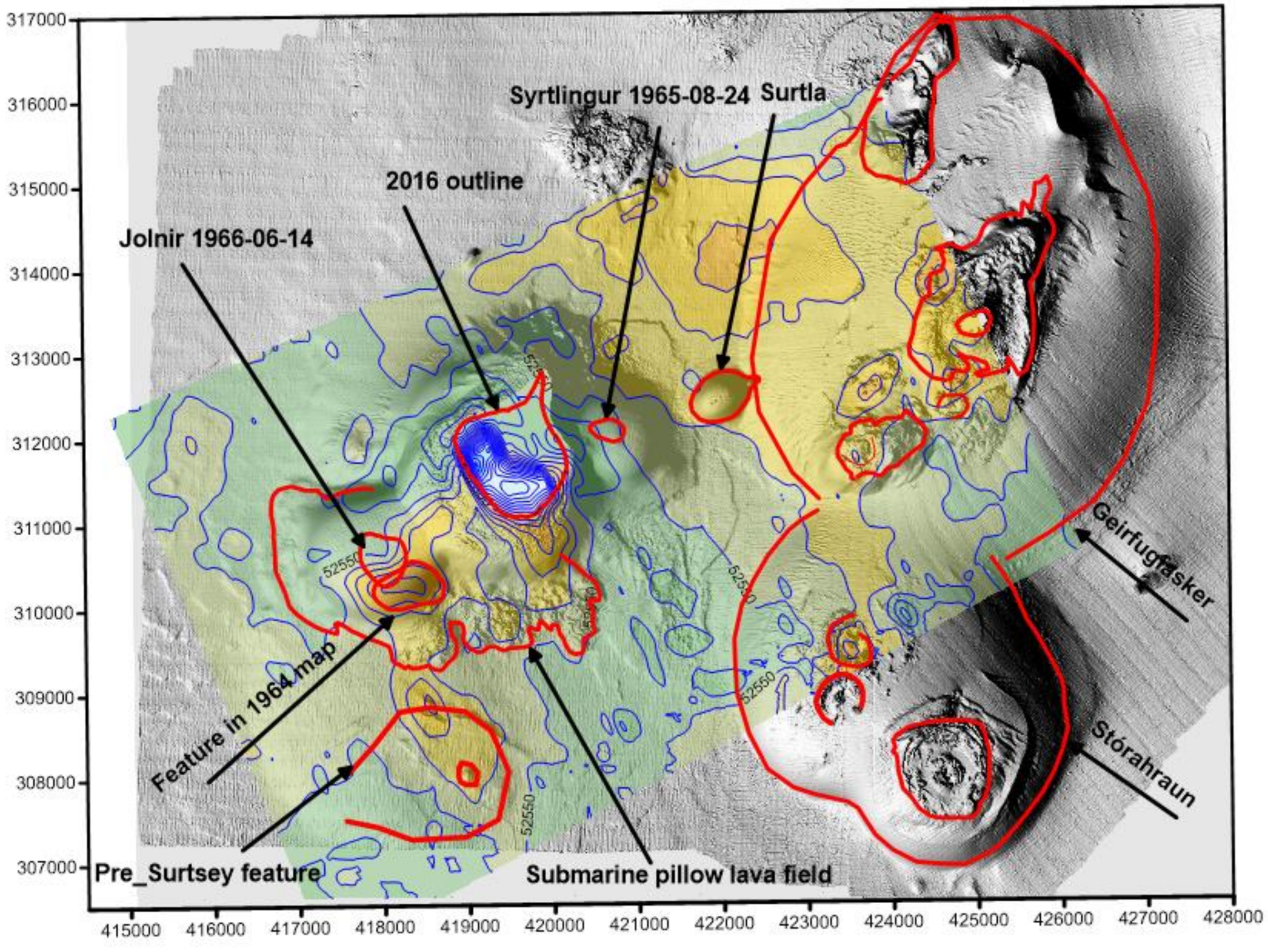
Seismic profiles from 1980 (Kjartan Thors)





Pre eruption of Jolnir Bathymetry map of July 1964




Syrtlingur 1965-08-24
Surtla
2016 outline
Jolnir 1966-06-14
Geirfuglasker
Feature in 1964 map
Stórahraun
Pre_Surtsey feature
Submarine pillow lava field
317000
316000
315000
314000
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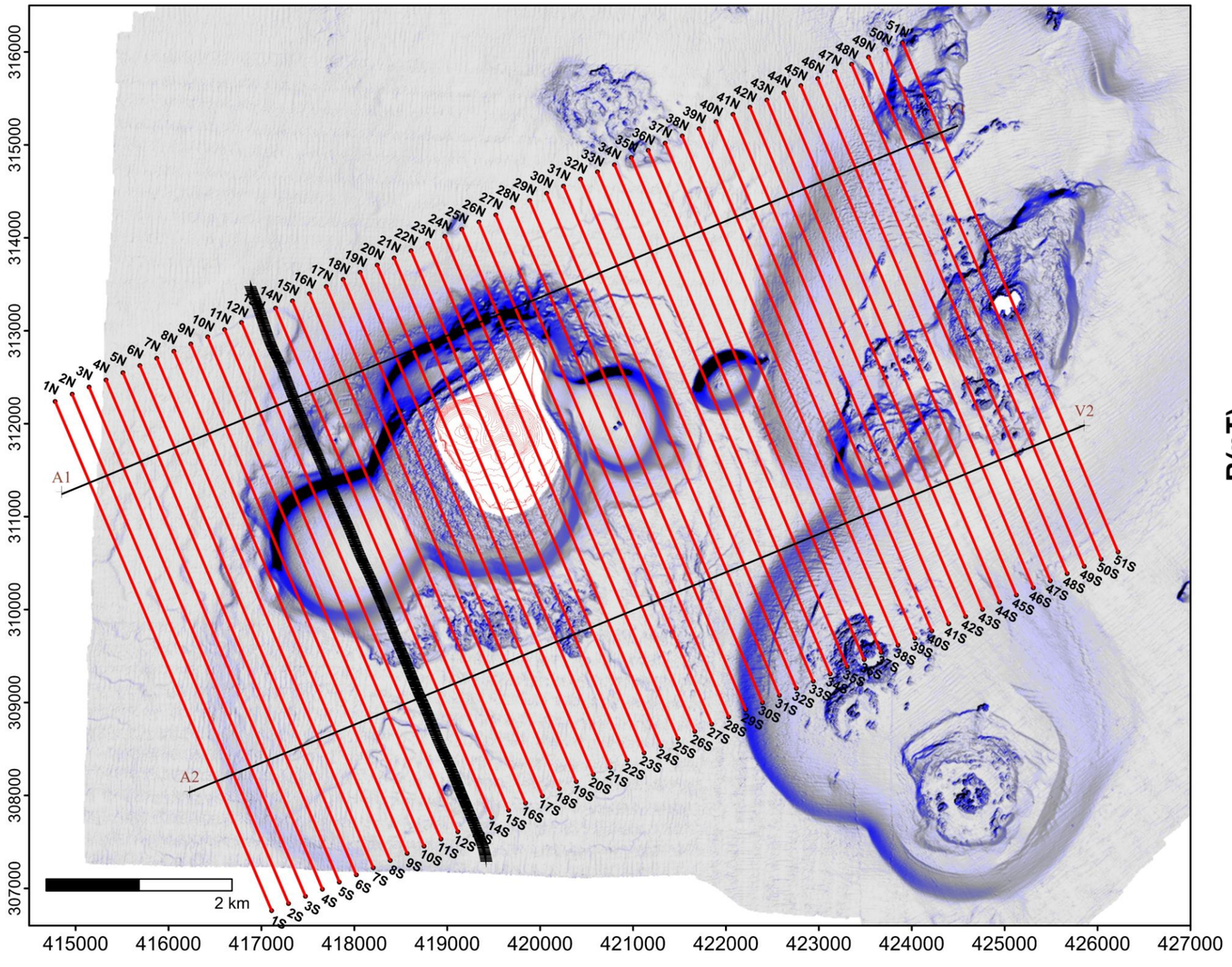
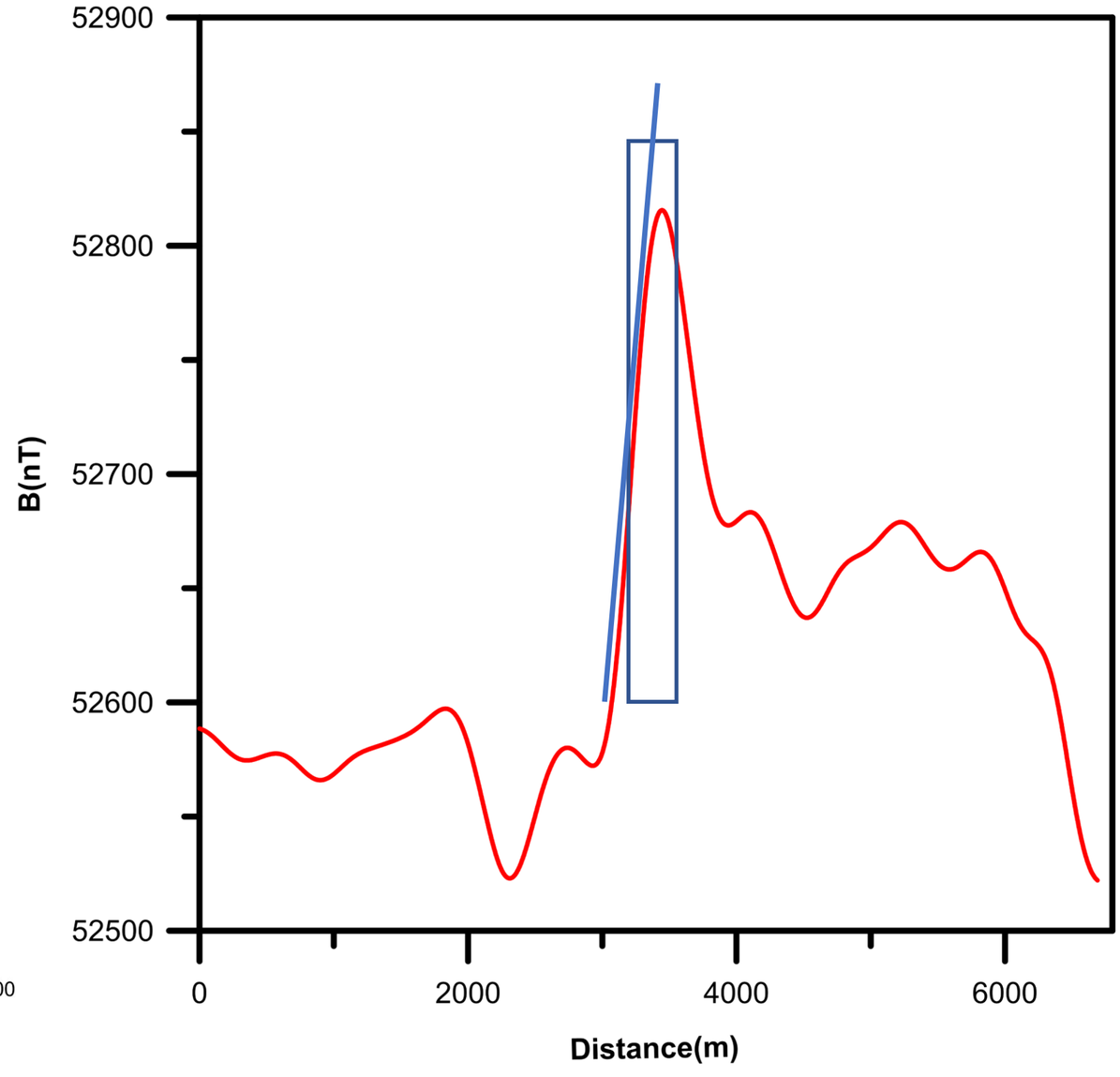
428000

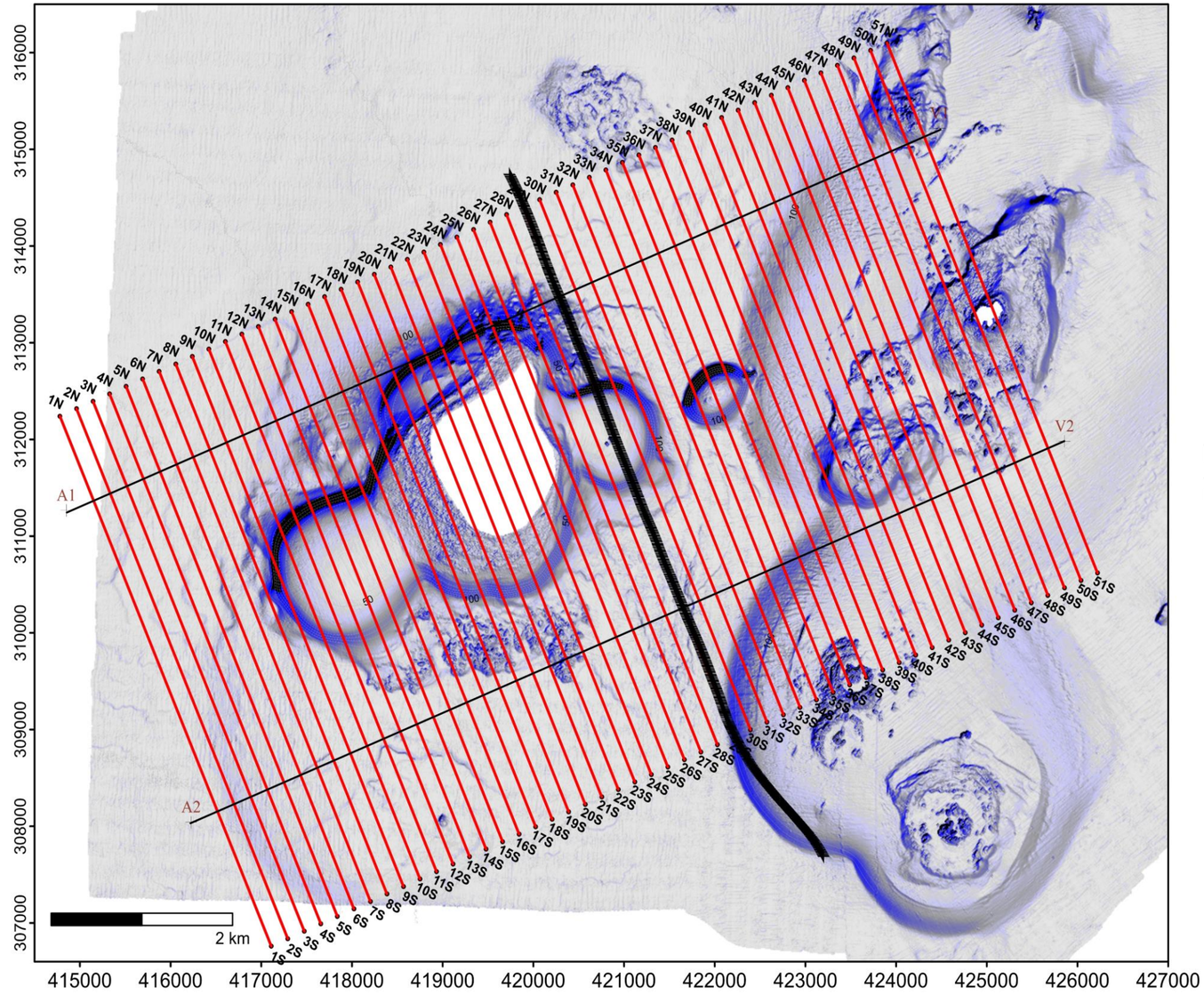
Depth estimation over area of Jolnir (on going work)

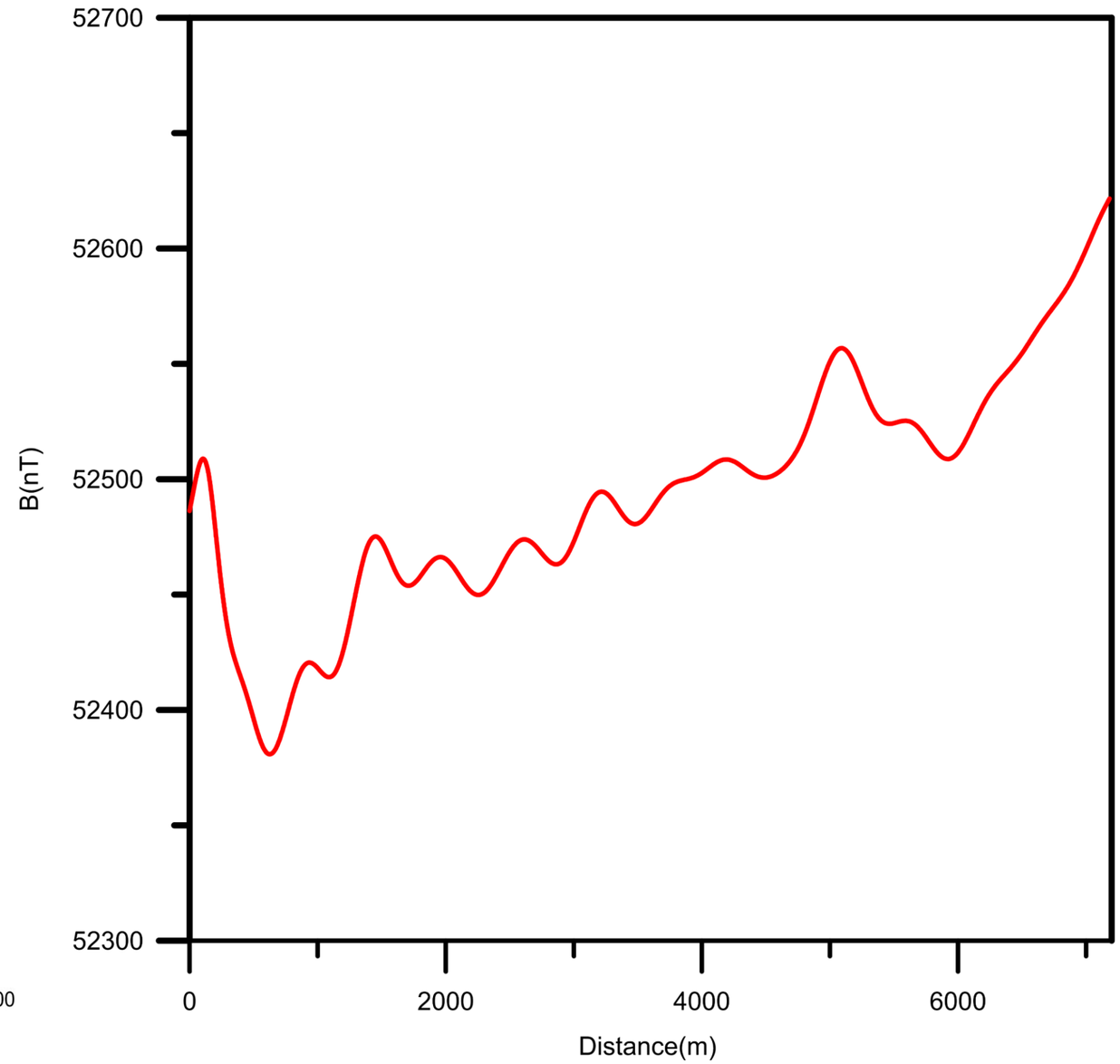




Simple Peter’s rule show an approximate 125 depth for anomaly

Depth estimation over area of Syrtlinmgur (on going work)





Conclusion

- **Subaerial lava: signs of source magnetic anomaly**
- **Indication of pillow lava on SE of Surtsey**
- **Satellite islands of surtsey: Magnetic or not**

Ongoing work : Depth estimation and modeling of magnetic anomaly