

June
2018



FIRE:
**WP2 Morphostructural
evolution of Fogo Island**

José Madeira

AL1: Work produced

Field work concluded in two field campaigns:

January 28 - February 10, 2017; June 19 - 30, 2017

Participants:

J. Madeira, R. Ramalho, M. Moreira, P. Silva and A. Brum da Silveira.

Objectives:

- a) Retrieve structural and geologic data – Identification and characterization of planar intrusions around the Caldera.
- b) Sample the dike system exposed on the Caldera wall for morpho-structural analysis and AMS (Anisotropy of Magnetic Susceptibility);
- c) Sample historic lava flows from Chã das Caldeiras and eastern flank of the island to refine global reference geomagnetic secular variation (SV) curve models and use the curve to date historical and pre-historical flows of unknown age.

AL1: Work produced

Location of the dikes (red) and lava flows (blue) sampled

20 sampled lavas inside Caldera
40 sampled lavas, mostly in the east and southeast flank.

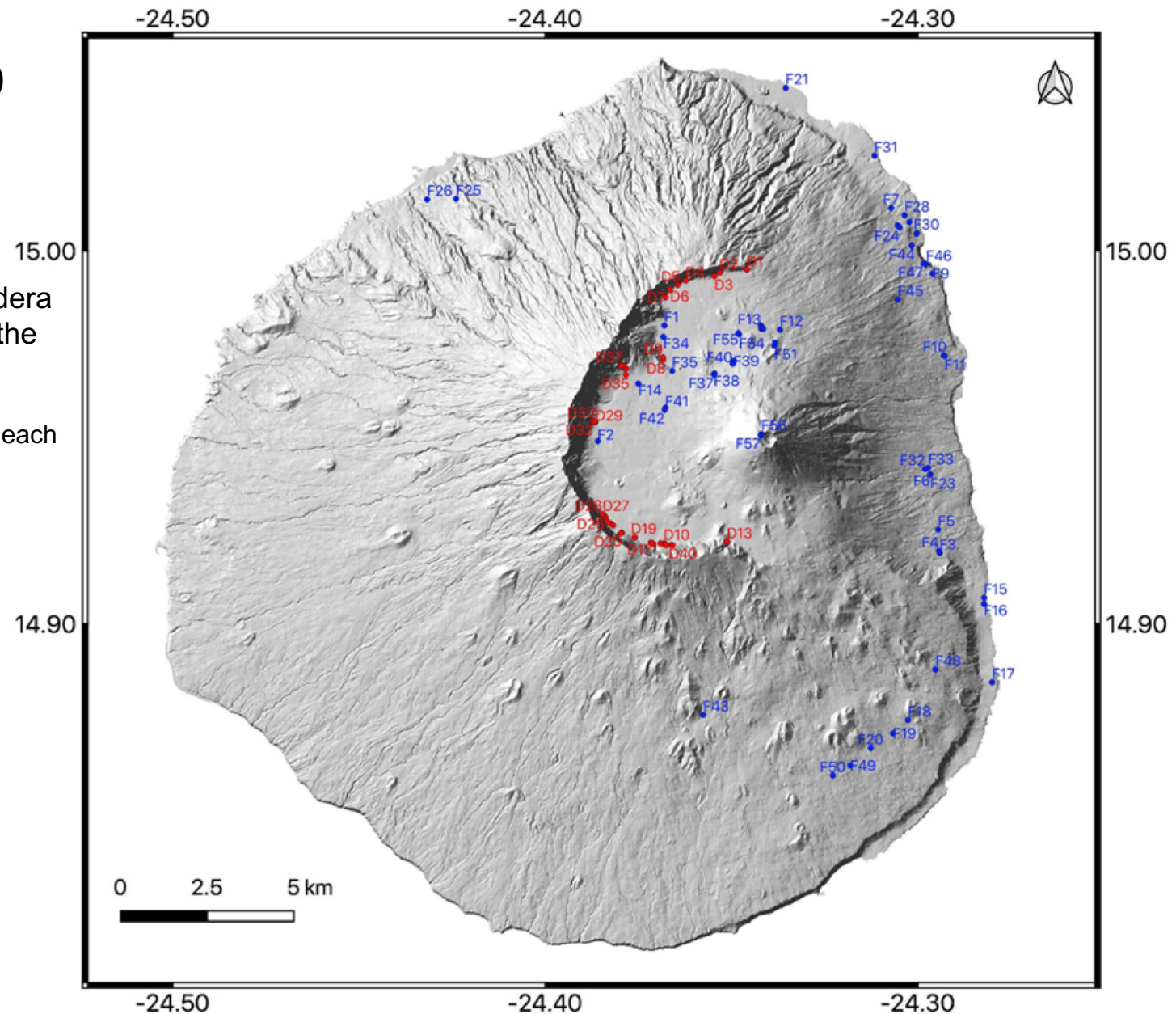
Around 15 to 25 oriented cores on each lava.

250 samples thermal and AF demagnetized

40 dikes sampled for magnetic studies – AMS

14 to 20 oriented cores for each dike
Around 750 oriented cores

15 dikes studied



AL1: Work produced (field work)



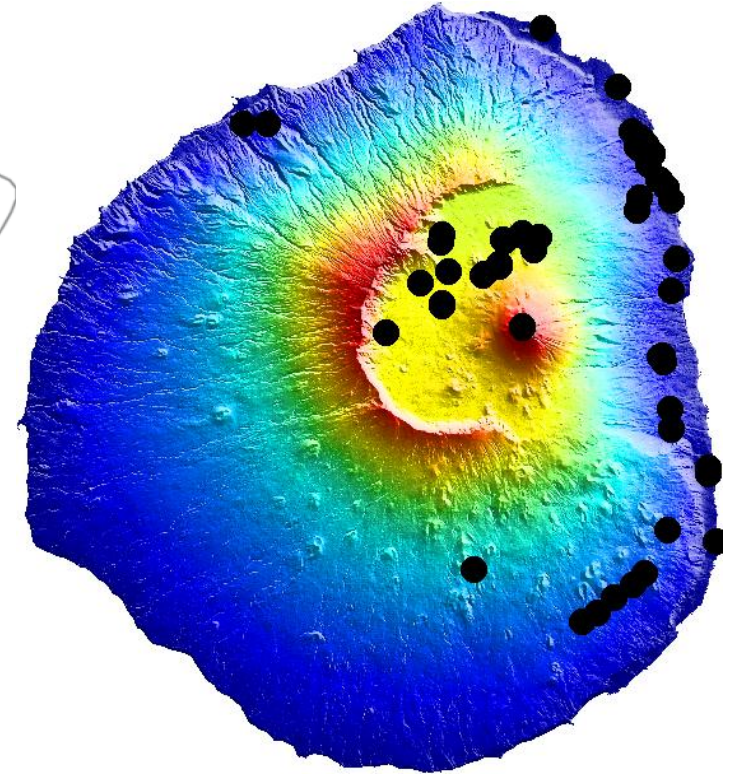
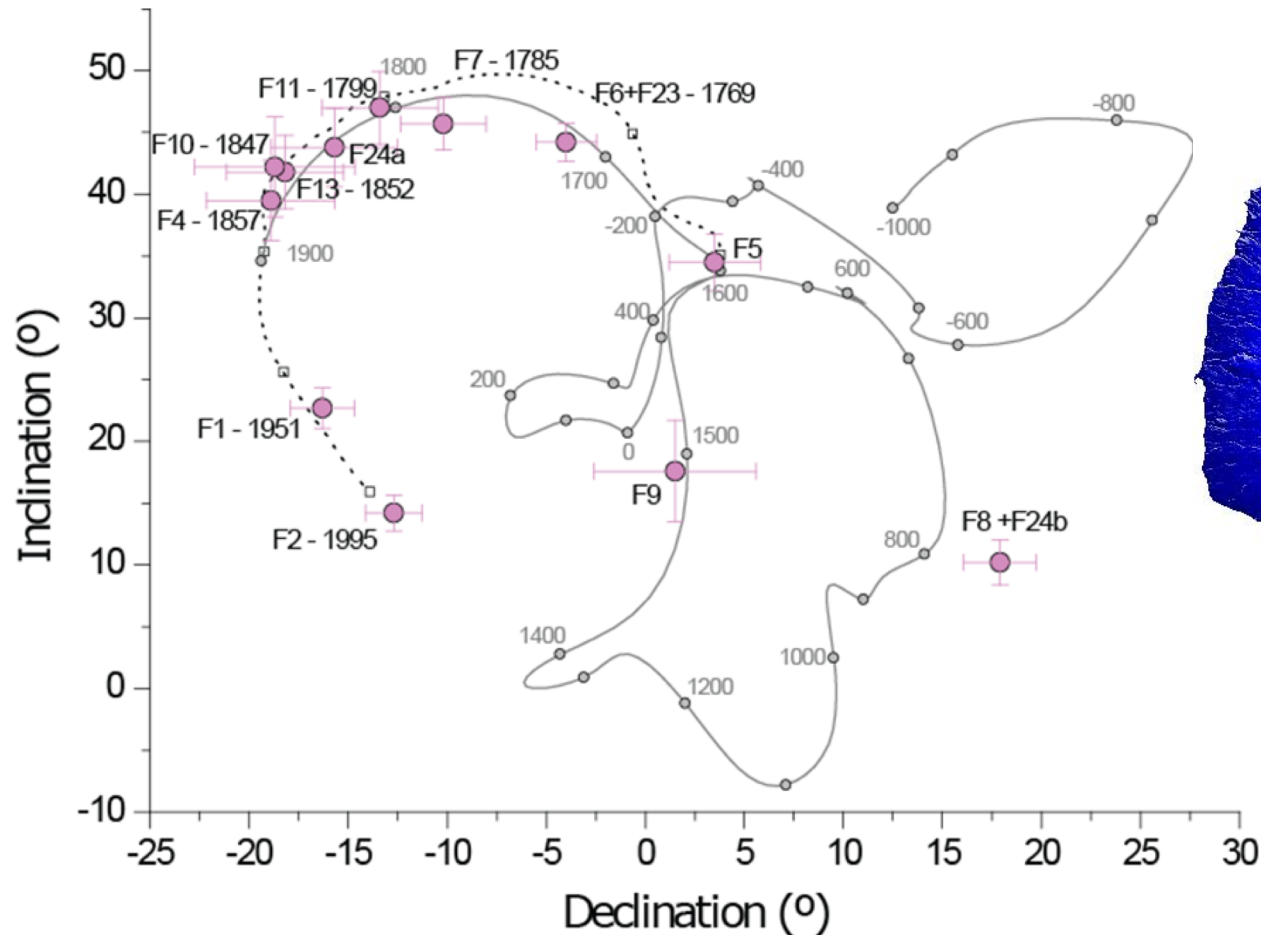
Sampling

On top of Pico do Fogo

Flow in east flank of Fogo

A detail of a dike (ring dike) sampled in both margins

AL2: Magnetostratigraphy



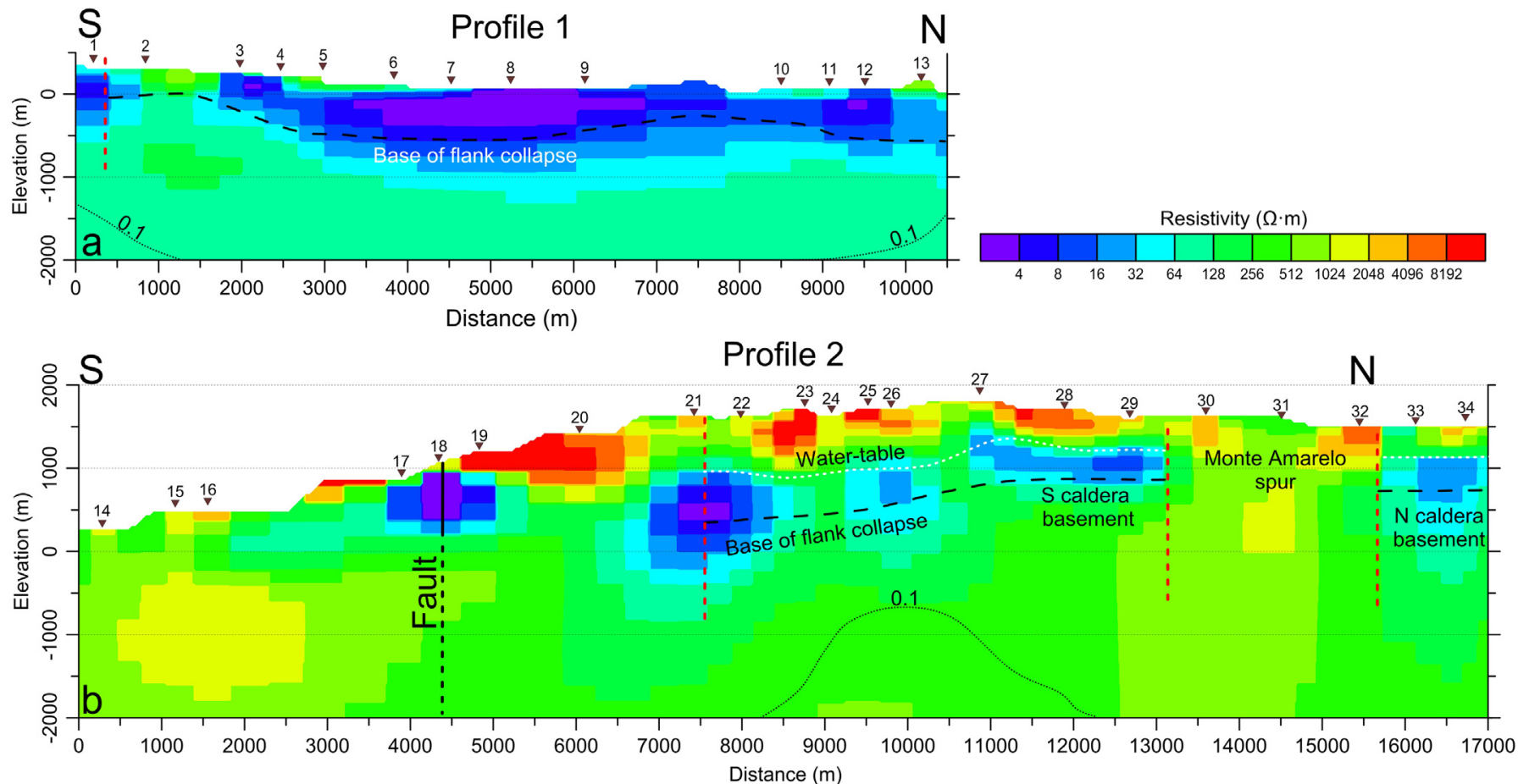
Around 15 to 25 oriented cores were sampled on each lava.

Plot of paleomagnetic directions of historical lavas (pink dots, this work) with uncertainty represented by error bars. Paleomagnetic models are GUFM1 (Jackson et al., 2000 - dashed line) and SHA.DIF.14k model (Pavón-Carrasco et al., 2014 - solid line)

AL3: Volcanic structure

The interpretation of the collapse structures from Fogo was addressed in a JVGR paper:

Martínez-Moreno, F.J.; Monteiro-Santos, F.A.; Madeira, J.; Pous, J.; Bernardo, I.; Soares, A.; Esteves, M.; Adão, F.; Ribeiro, J.; Brum da Silveira, A. & Mata, J. (2018) Investigating the collapse structures of Fogo Island (Cape Verde) by a magnetotelluric survey. *JVGR* 357: 152-162.

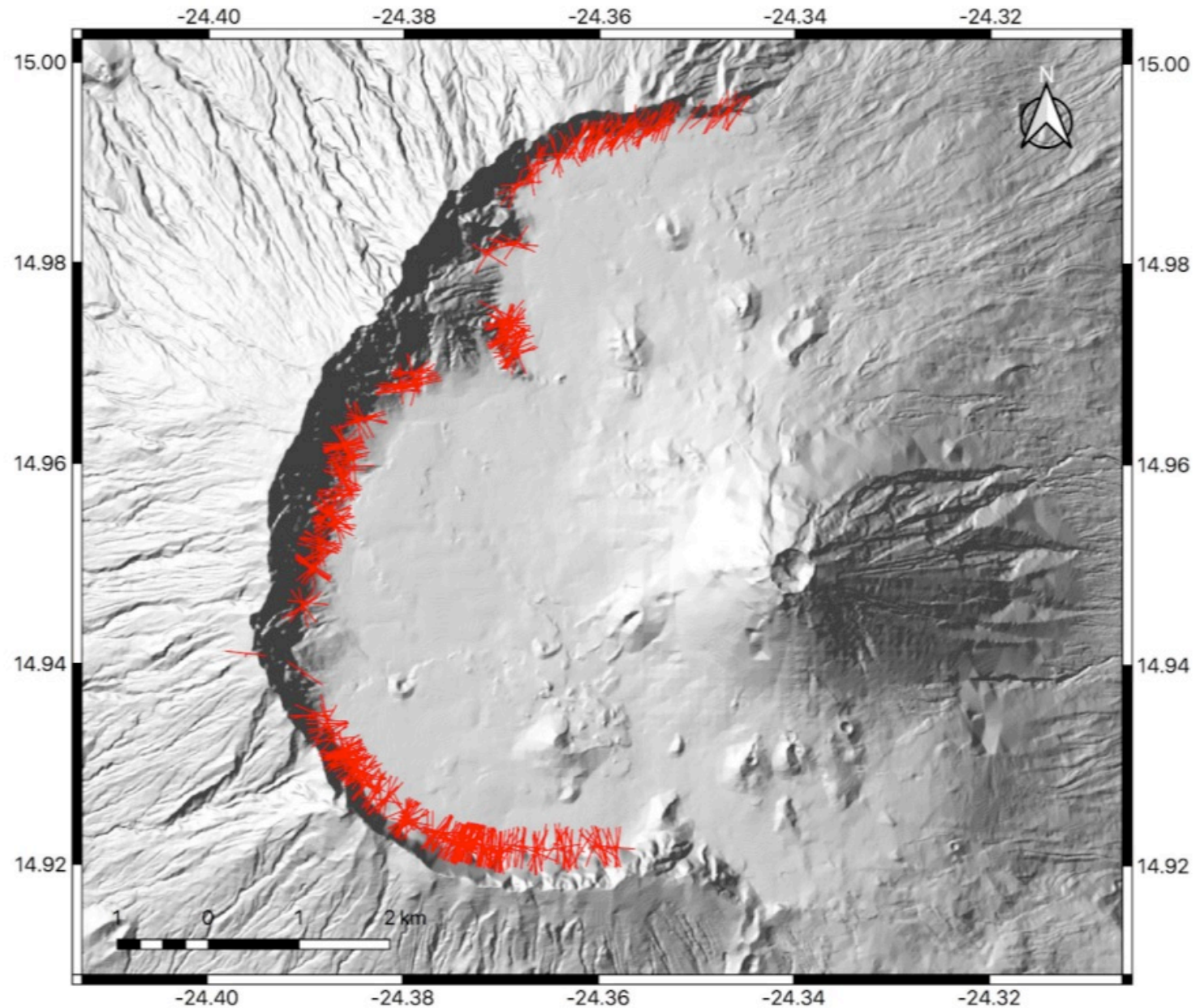


AL3: Volcanic structure

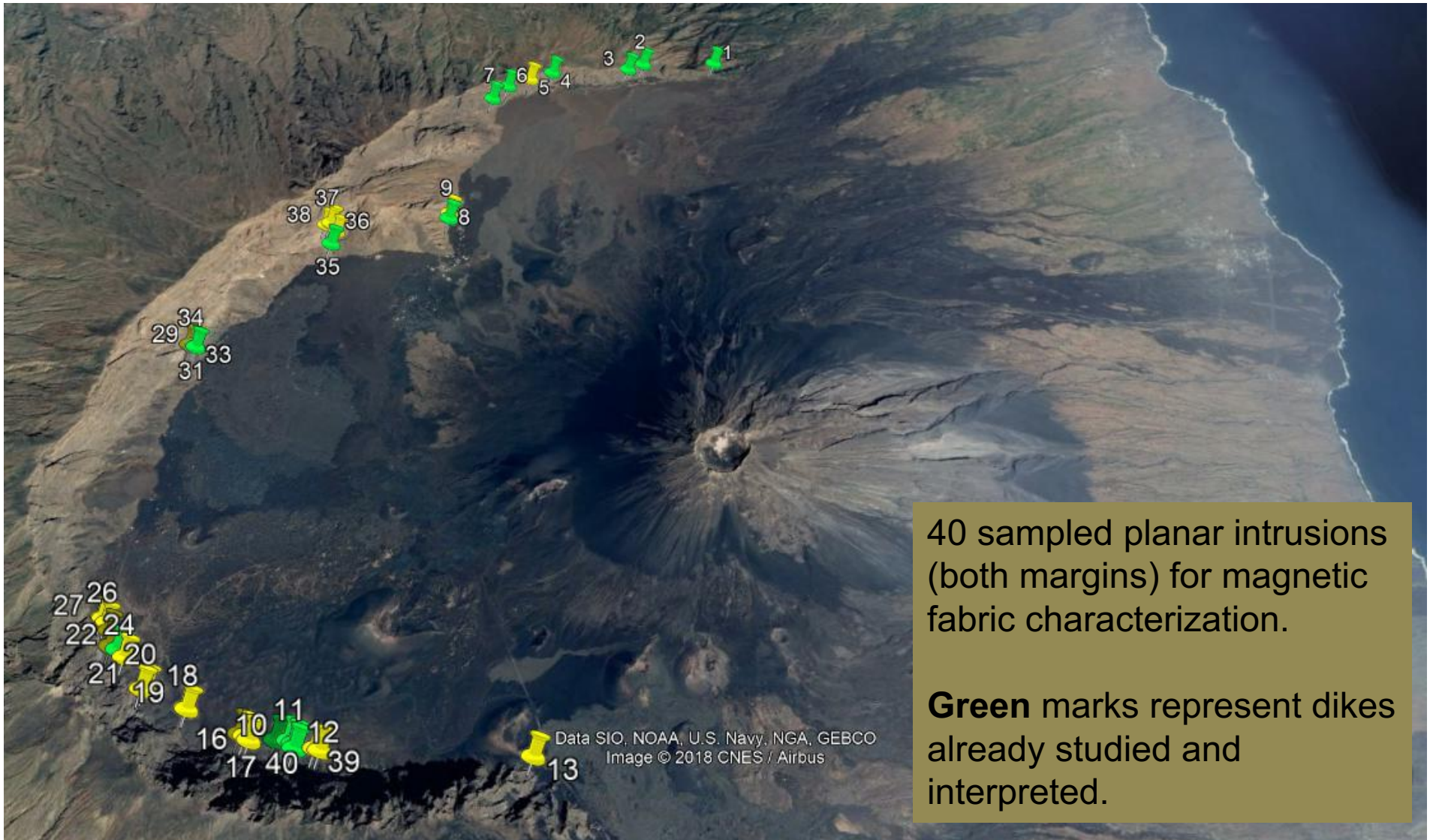
Dikes cropping out at the base of the Caldera wall were measured for (ongoing) structural analysis.

504 dike measurements

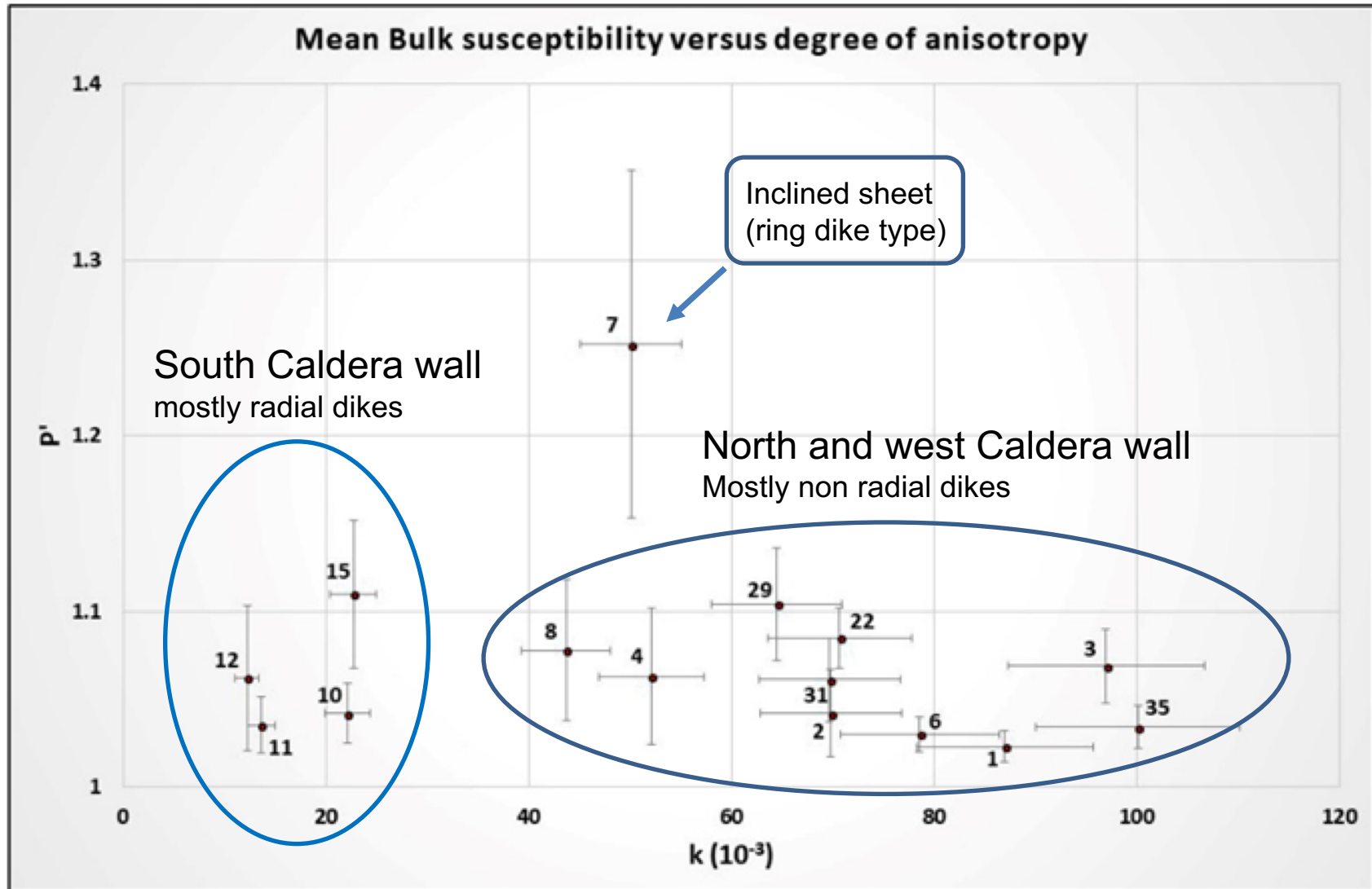
40 dikes sampled for magnetic studies - AMS



AL3: Volcanic structure



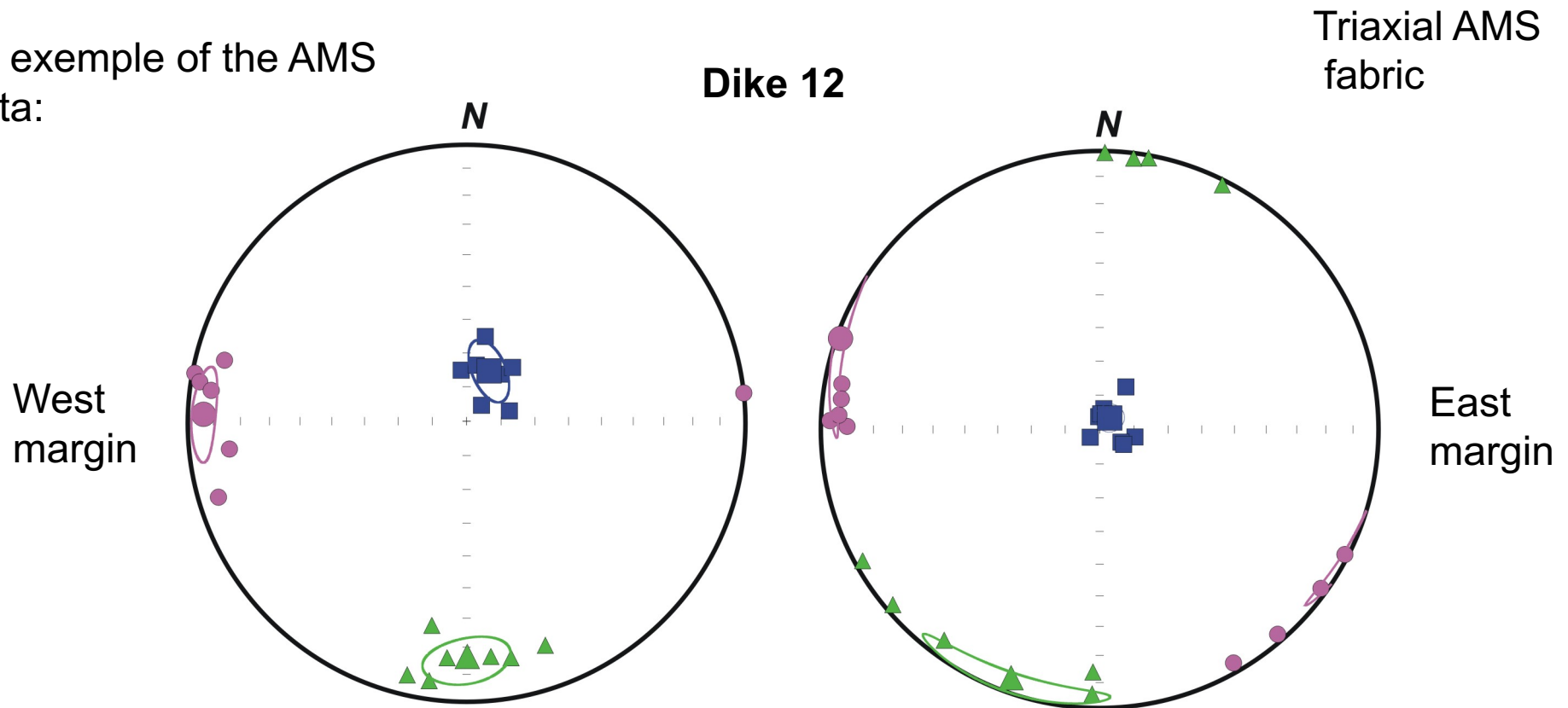
AL3: Volcanic structure



Scalar and shape parameter: plot of the mean bulk magnetic susceptibility k versus mean degree of anisotropy \bar{P}' for the 15 dikes studied. Error bars represent the range of values of susceptibility and anisotropy for each dike.

AL3: Volcanic structure

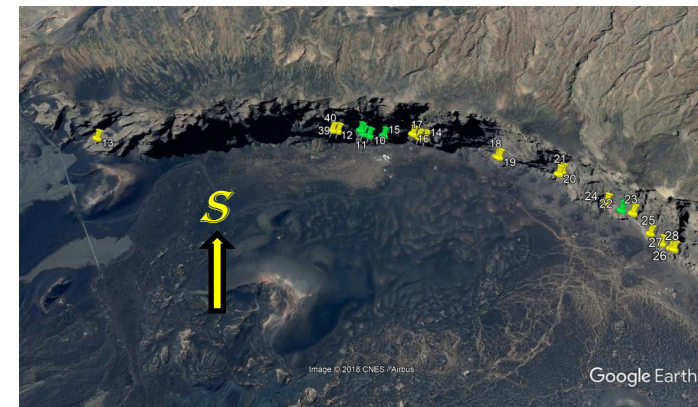
an exemple of the AMS
data:



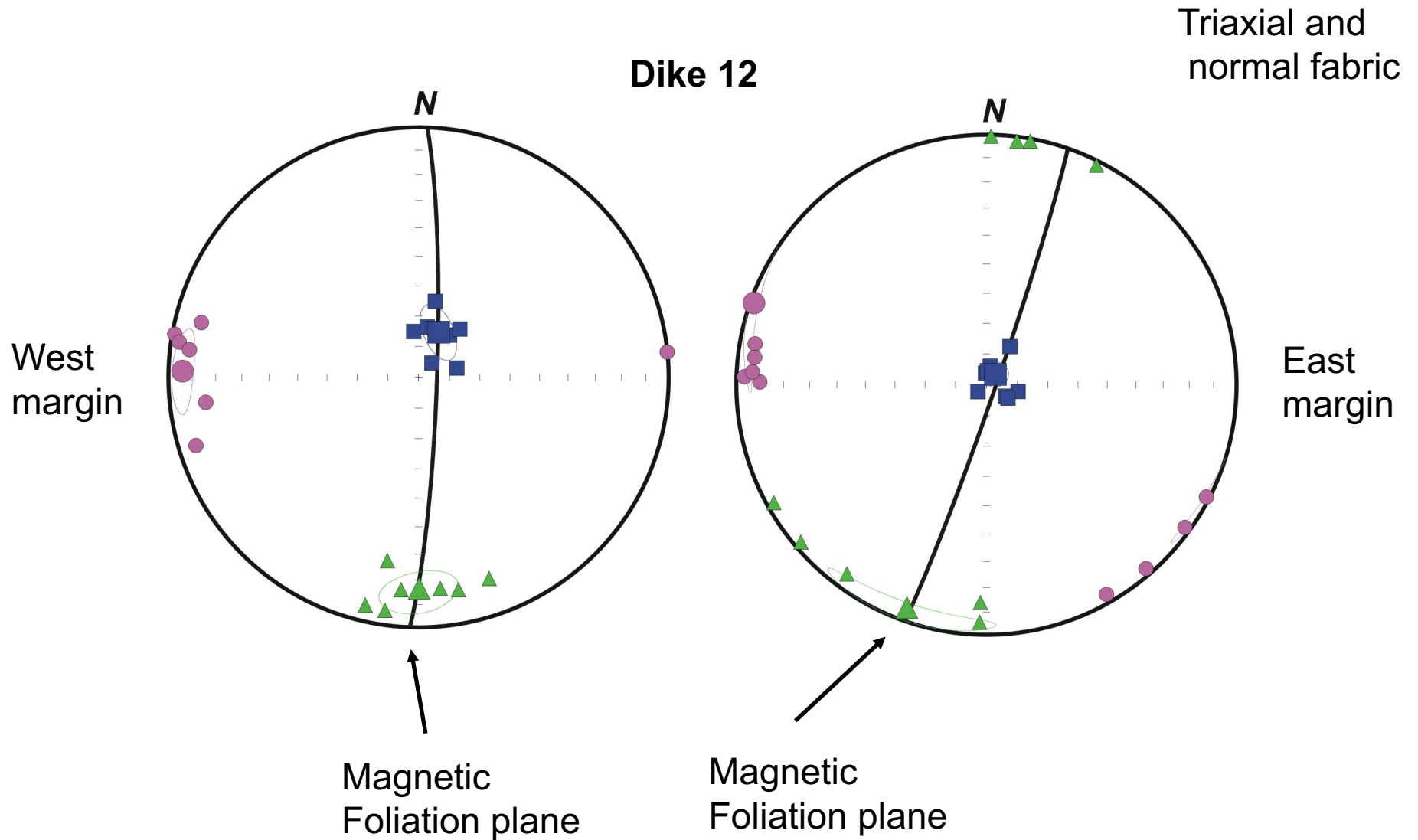
Dike 12, southern Caldera wall. Vertical and radial dike.

Stereographic plot (equal area, lower hemisphere) of principal magnetic axes k_1 , k_2 and k_3 of AMS from a representative example: the west and east margins of dike 12.

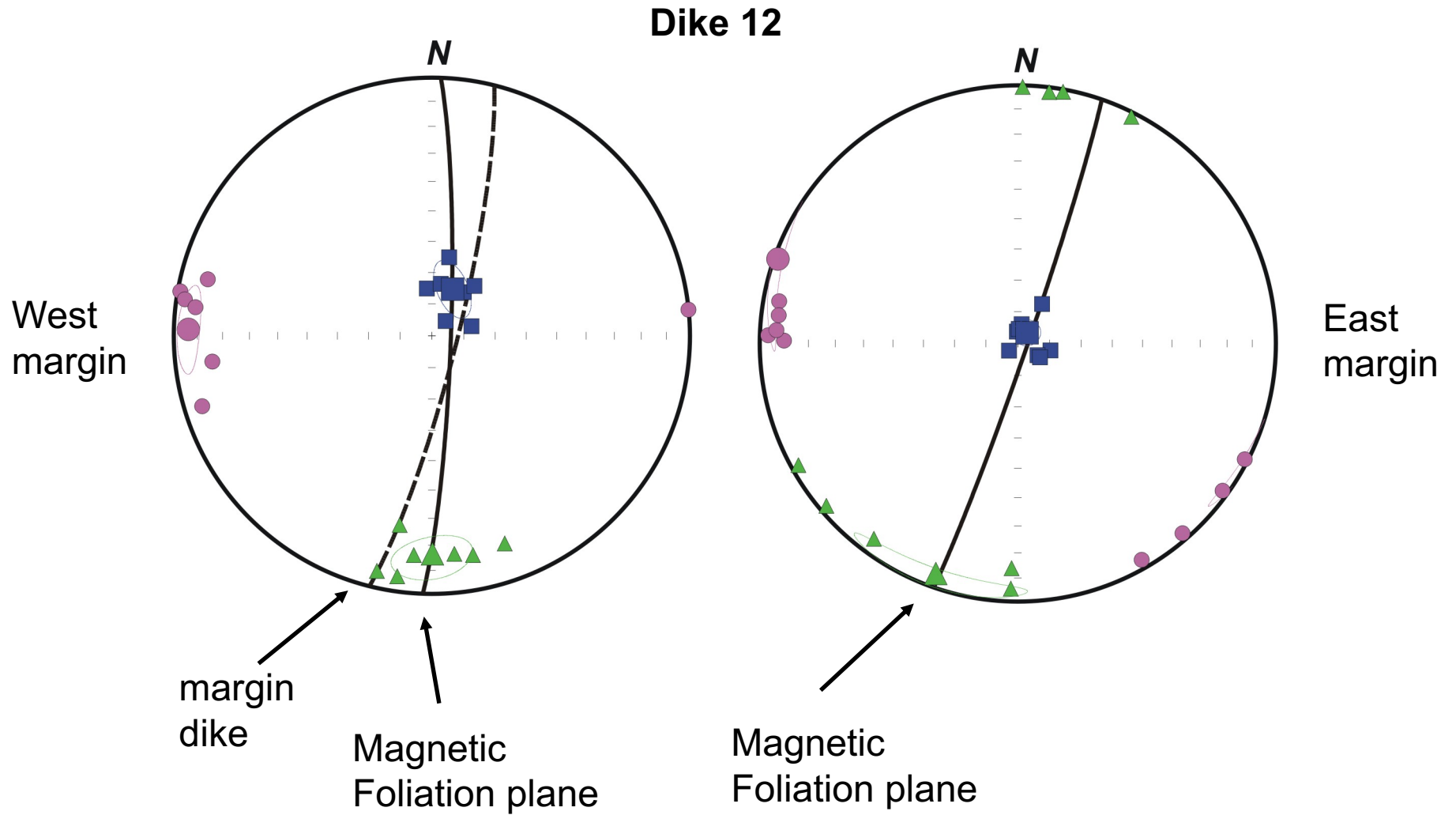
Confidence areas from Jelinek statistics.



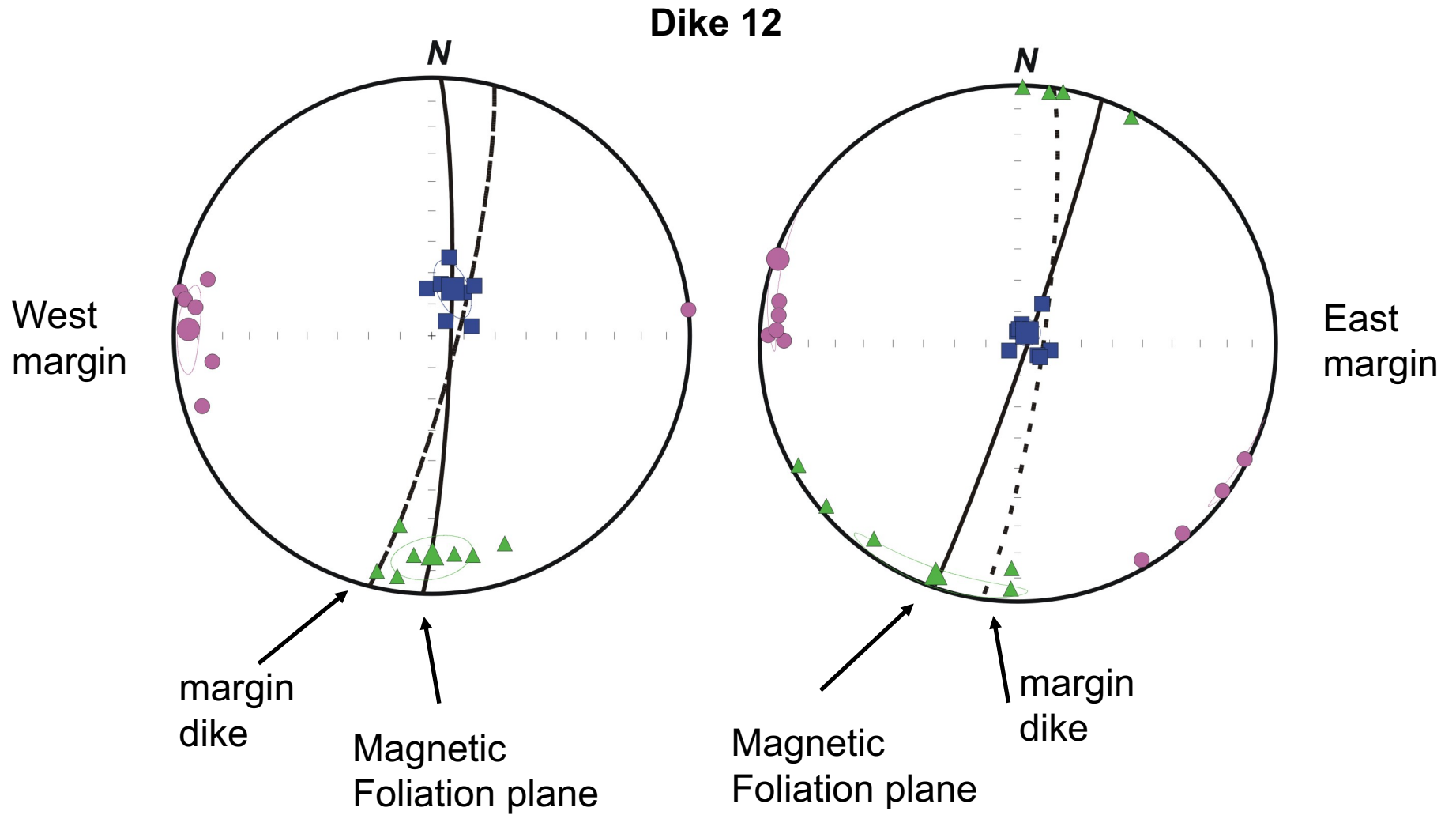
AL3: Volcanic structure



AL3: Volcanic structure

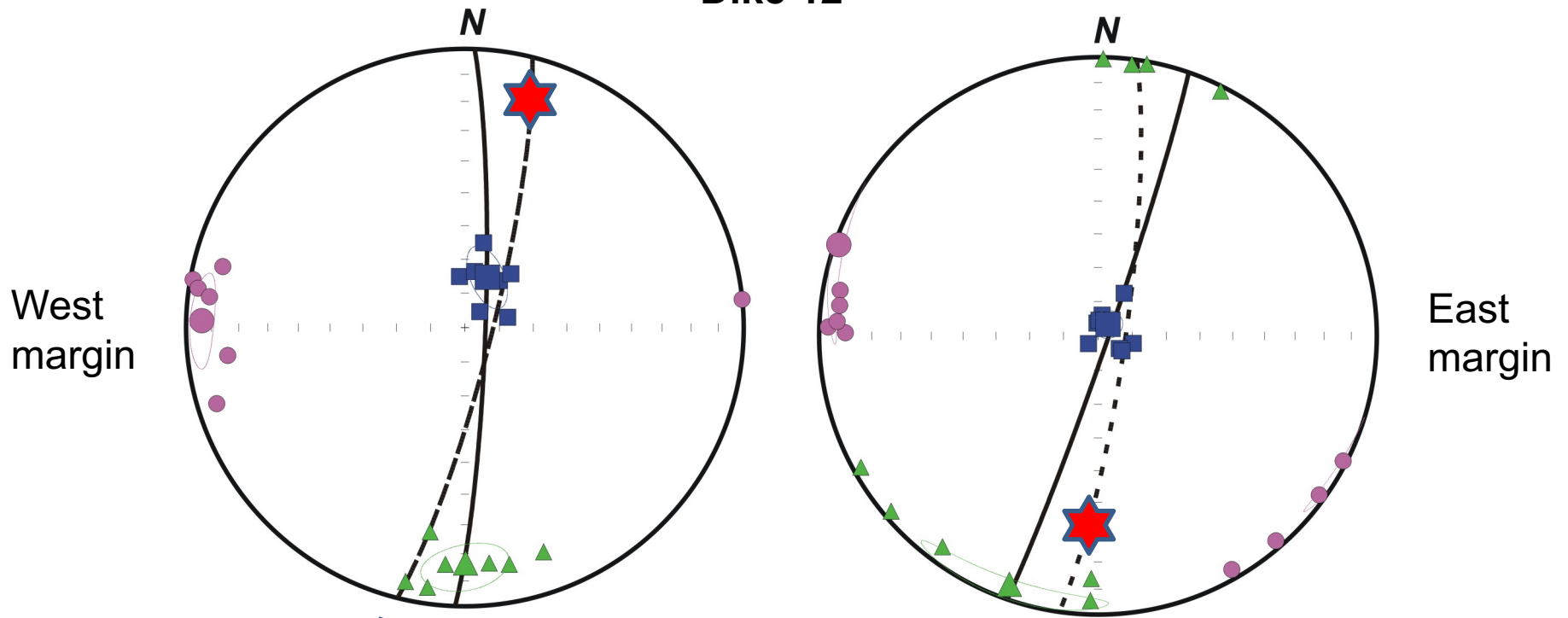


AL3: Volcanic structure



AL3: Volcanic structure

Dike 12



West margin

East margin



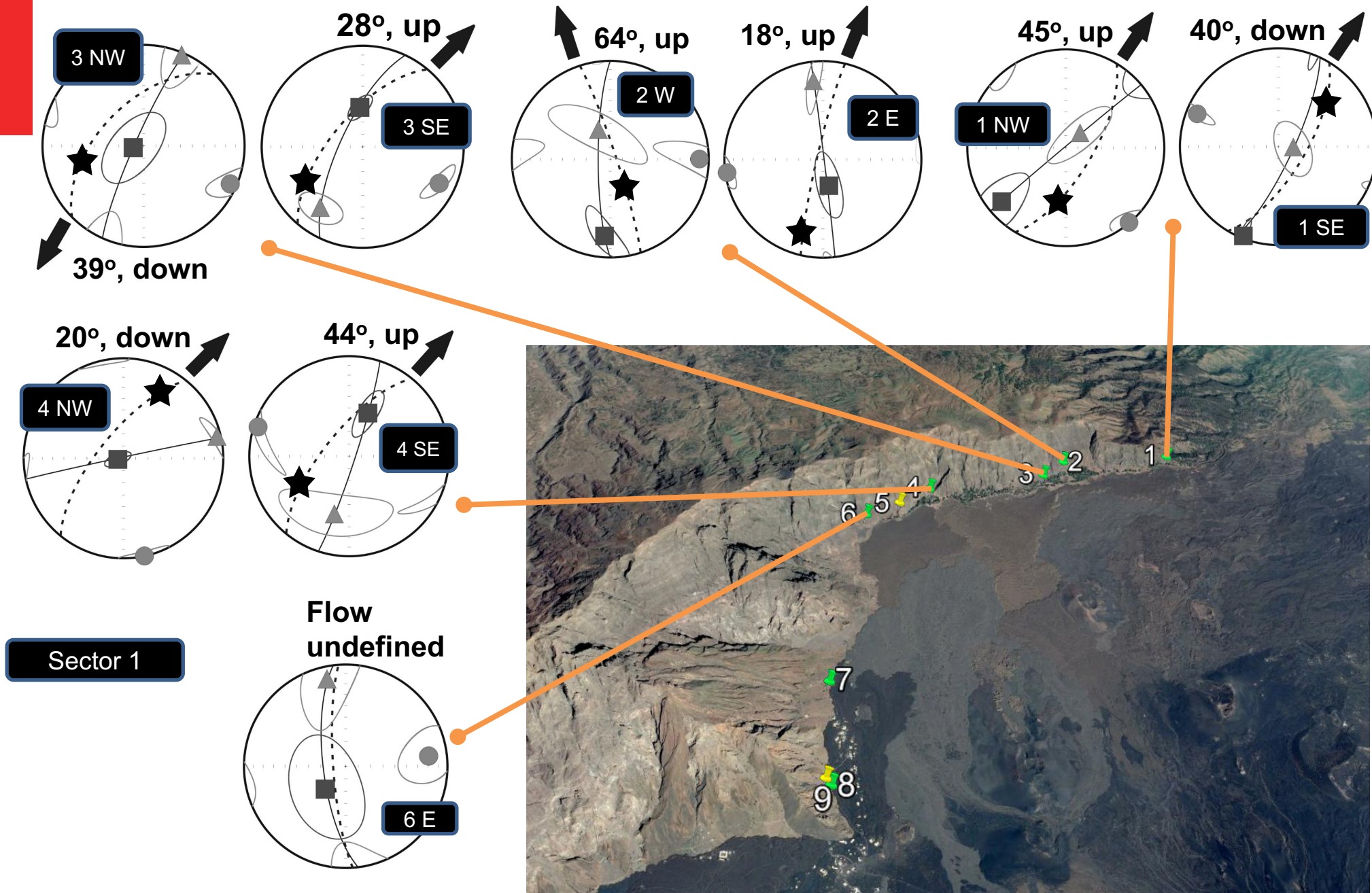
Az: 15°
Inc: 9°
Flow SSW, up

Az: 185°
Inc: 24°
Flow SSW, down

Inferring magmatic flow vector from the relationship between the MFP and the dike margin, for each margin.

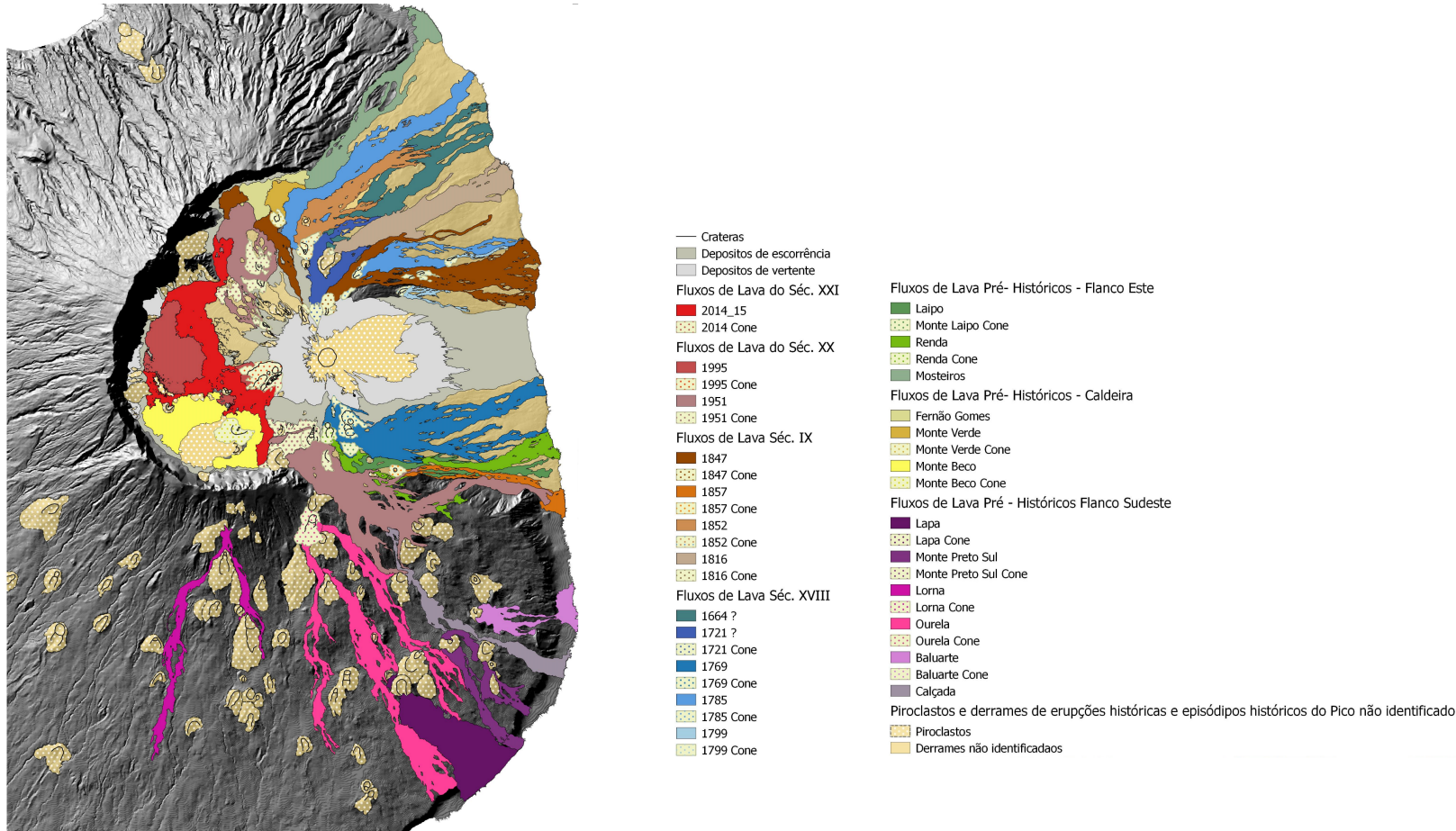
Normal fabric, and symmetrical angle → coherent flow vector.

Radial and near horizontal, lateral, magma flow



North sector: centrifugal flow vector with intermediate dips in vertical (but not radial) dikes

AL4: Strategies for risk mitigation



Preparation of a refined Geological Map of historical and recent eruptions that will contribute to volcanic hazard assessment.

General prediction (volumes; recurrence intervals) are essential for hazard assessment. Mapping the flows and confirming their ages is a key data to develop risk mitigation strategies



Challenges/issues encountered/anticipated

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Plans for coming months

- Prepare a final version of the Geological Map.
- Lab measurements of AMS of dikes and lava samples. Analytical procedures for determination of magmatic flow vectors in the dikes.
- Lab measurements of NRM, (thermal and AF field demagnetization) for paleomag.
- Magnetic mineralogy (Curie temperatures, unmixing of coercivities) for identification of magnetic carriers and their alterations.
- Prepare paper on a revised geomagnetic secular variation curve (GSVC) and sheet intrusions of the Fogo volcano.
- Refine the volcano-stratigraphy of recent eruptions based on the GSVC model
- Analyze and interpret the dikes attitude data, with the inferred magmatic flow direction and their relation with the surface expression of the feeder system.



Dissemination

Number of papers:

- in prep. : 3
- submitted: 0
- published: 1

Martínez-Moreno, F.J.; Monteiro-Santos, F.A.; Madeira, J.; Pous, J.; Bernardo, I.; Soares, A.; Esteves, M.; Adão, F.; Ribeiro, J.; Brum da Silveira, A. & Mata, J. (2018) Investigating the collapse structures of Fogo Island (Cape Verde) by a magnetotelluric survey. *JVGR* 357: 152-162.

Number of communications (national and international):

- planned: 2
- done: 0

Number of outreach: 0



Other