Magnetic fabric of Lamas de Olo Pluton: AMS and AARM fabrics comparison

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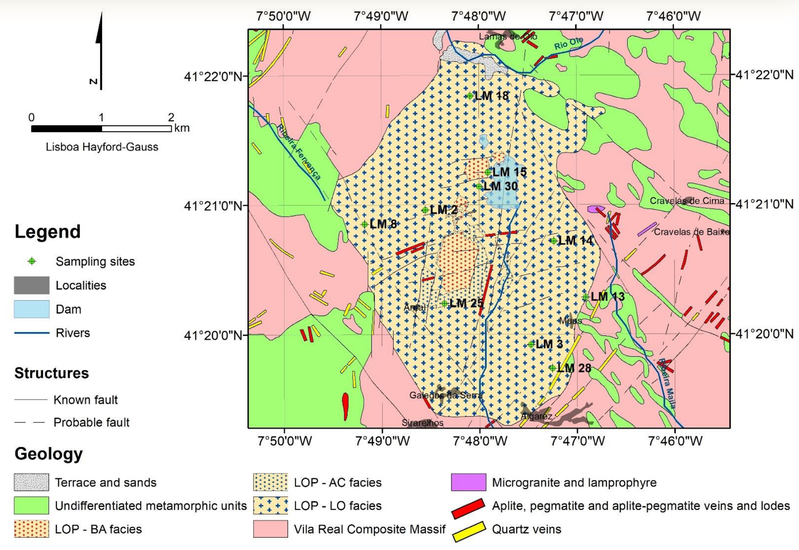
1 Introduction

Geological setting

- The Lamas de Olo Pluton (LOP) is:
  - A small outcrop located in the Northern part of Central Iberian Zone from the Iberian Variscan belt;
  - A post-tectonic (*ca.* 297.19 ± 0.73 Ma) pluton composed of granites: Lamas de Olo (LO), Alto dos Cabeços (AC), and Barragem (BA);
  - Intrusive in granites from the Vila Real Massif, Armorican Quartzite Formation, schists, and Desejosa Formation (***fig. 1***).



Main goal

- Characterization of the magnetic fabric by anisotropy of magnetic susceptibility (AMS) and anhysteretic remanent magnetization (AARM);
- Correlation between AMS and AARM tensor for comparison of both fabrics.

Figure 1. Simplified geological map of the Lamas de Olo Pluton (modified [1]; [2]).

2 Sampling & Methodologies

Sampling

- 10 representative sampling sites were been selected: 7 in the set of granites with high K_m values ($K_m \geq 1000$ µSI) + 3 in set of granites with low K_m values ($K_m < 1000$ µSI) [3] (***fig. 1***).

AMS versus AARM

- Both techniques are based on the magnetic properties of rock minerals, where:
- The magnetic fabric are characterized by:
  - Magnetic lineation → // K_{max} or $AARM_{max}$
  - Magnetic foliation → ⊥ K_{min} or $AARM_{min}$

AMS → consider the contribution of all rock minerals (paramagnetic, diamagnetic and ferromagnetic *s.l.*);

AARM → the fabric is exclusively given by the ferromagnetic *s.l.* minerals.

3 AMS & AARM fabric

Global magnetic fabric for all samples from all the granite set (10 sampling sites)

- Magnetic foliations: AMS: N166°, 82°NE // AARM: N166°, 83°NE
- Magnetic lineations: AMS: 23°→N166° // AARM: 68°→N163°

Magnetic fabric in magnetite-type granite (7 sampling sites)

- Magnetic lineations and foliations given by both tensors are coaxial (***fig. 2***).

Magnetic fabric in ilmenite-type granite (3 sampling sites)

- The AMS and AARM foliations are parallel **&** the AMS and AARM lineations are not coaxial (***fig. 2***).

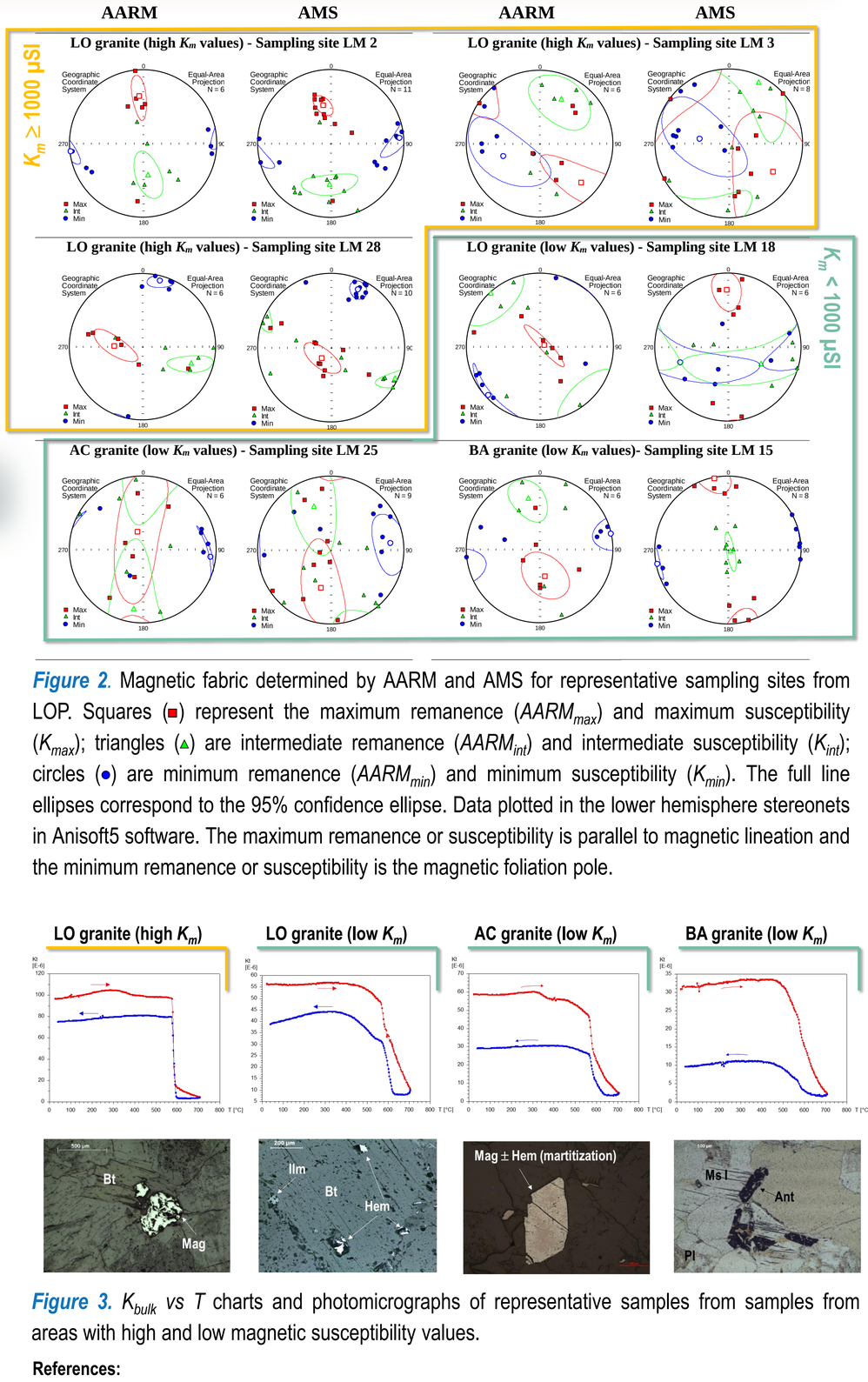


Figure 2. Magnetic fabric determined by AARM and AMS for representative sampling sites from LOP. Squares (■) represent the maximum remanence ($AARM_{max}$) and maximum susceptibility (K_{max}); triangles (▲) are intermediate remanence ($AARM_{int}$) and intermediate susceptibility (K_{int}); circles (●) are minimum remanence ($AARM_{min}$) and minimum susceptibility (K_{min}). The full line ellipses correspond to the 95% confidence ellipse. Data plotted in the lower hemisphere stereonets in Anisoft5 software. The maximum remanence or susceptibility is parallel to magnetic lineation and the minimum remanence or susceptibility is the magnetic foliation pole.

4 Conclusions

Global magnetic fabric for all samples from all the granite set

- Their coaxiality, means that the AMS can be safely used in heterogeneous and complex magnetite-type plutons with both high and low magnetic susceptibility values.

Magnetic fabric in granite set with high K_m

- The coaxial AMS and AARM magnetic foliations are due to magnetite grains imitating the fabrics of paramagnetic phases, through preferred collage, or crystallization of magnetite along grain boundaries, or exsolutions of magnetite along biotite cleavage planes;
- The magnetite and paramagnetic (or diamagnetic) minerals have the same orientation.

Magnetic fabric in granite set with low K_m

- The partial coaxiality ~ AMS and AARM foliations are parallel but the AMS and AARM lineations are not coaxial ~ may due to the neoformation minerals;
- Previous magnetic mineralogy studies (*e.g.* thermomagnetic experiments and isothermal remanent magnetization [4]) pointed out the presence of magnetite/ Ti-poor magnetite in all LOP granites, even in areas with low K_m values, but in different proportions (***fig. 3***);
- The petrographic observations showed that, in areas with low K_m values, the magnetite is often oxidized to hematite – martite - which justify the non-coaxility of the llinear fabrics.

Figure 3. K_{bulk} *vs T* charts and photomicrographs of representative samples from samples from areas with high and low magnetic susceptibility values.

References:

[1] Pereira (1989), Serviços Geológicos de Portugal, 53 pp.; [2] Helal (1992), PhD thesis (published), 508 pp.; [3] Ishihara, S. (1977), Mining Geology, 27: 292-305; || [4] Cruz et al. (2020), Geologica Acta, 18.5, 1-20.

Acknowledgments:

The first author was financially supported by SFRH/BD/109693/2015 (FCT Portugal). The authors acknowledge funding from COMPETE 2020 through the ICT (Institute of Earth Sciences) project (UIDB//04683/2020) with reference POCI-01-0145-FEDER-007690 and from ESMIMET, an Interreg Spain-Portugal POCTEP project..