Variation of the paleomagnetic and rock magnetic properties across a ~20 m thick andesitic lava flow (Tungurahua Volcano, Ecuador): implications for paleointensity

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Abstract

Data of the Earth's magnetic field strength is diversely applicable from dating archeological artefacts or lava flows to understanding early earth evolution and the mechanisms of the geodynamo. Lava flows are commonly used as a means to obtain records of this paleointensity. Understanding the underlying paleomagnetic and rock magnetic properties and how they vary across a flow is crucial to ensure collection of good quality samples for analysis. In fact, the success of paleointensity as well as paleomagnetic analysis is strongly dependent on the rock-magnetic properties of the samples, and large variations may exist between samples even of the same unit, related mainly to varying cooling rates. The active Tungurahua volcano is one of the most prominent features in the Ecuadorian Eastern Cordillera with numerous basaltic andesite and andesitic lava flows exposed along its flanks. To appraise the relation between volcanic emplacement processes and rock-magnetic properties, we sampled a vertical transect in a ~20 m thick lava flow at Tungurahua volcano. A total of 55 oriented in situ sample from six sites distributed across Ulba Cascada lava flow were collected for this purpose. We will present petrographical analysis of each sample as a function of the depth within the lava flow, with an emphasis on the textural and structural characteristics of magnetic minerals as observed with transmitted, reflected light and scanning electron microscopes. Moreover, a detailed analysis of rock-magnetic properties such as magnetic susceptibility, hysteresis (remanent magnetization, saturation remanent magnetization, coercivity and back-field coercivity), accompanied with detailed stepwise alternating field and thermal demagnetizations will allow us to determine the direction of the magnetic field and assess the variations of magnetic properties with respect to the position within a lava flow. We will also discuss the correlations that may exist between grain size, oxidation state of the magnetic minerals and the emplacement processes of a lava flow, as well as the implications of all these results to paleointensity determinations.

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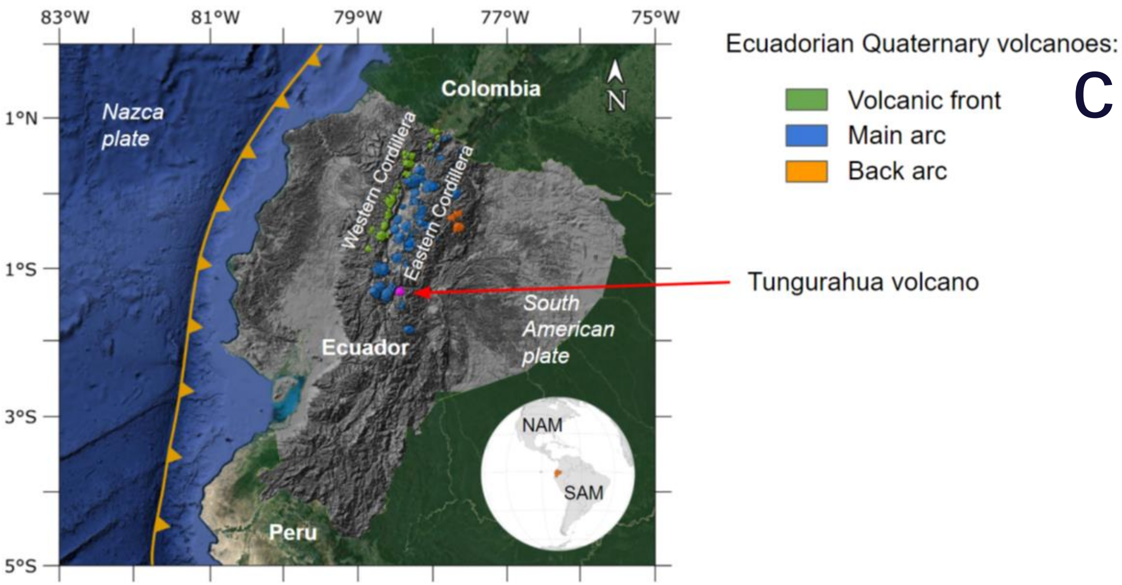
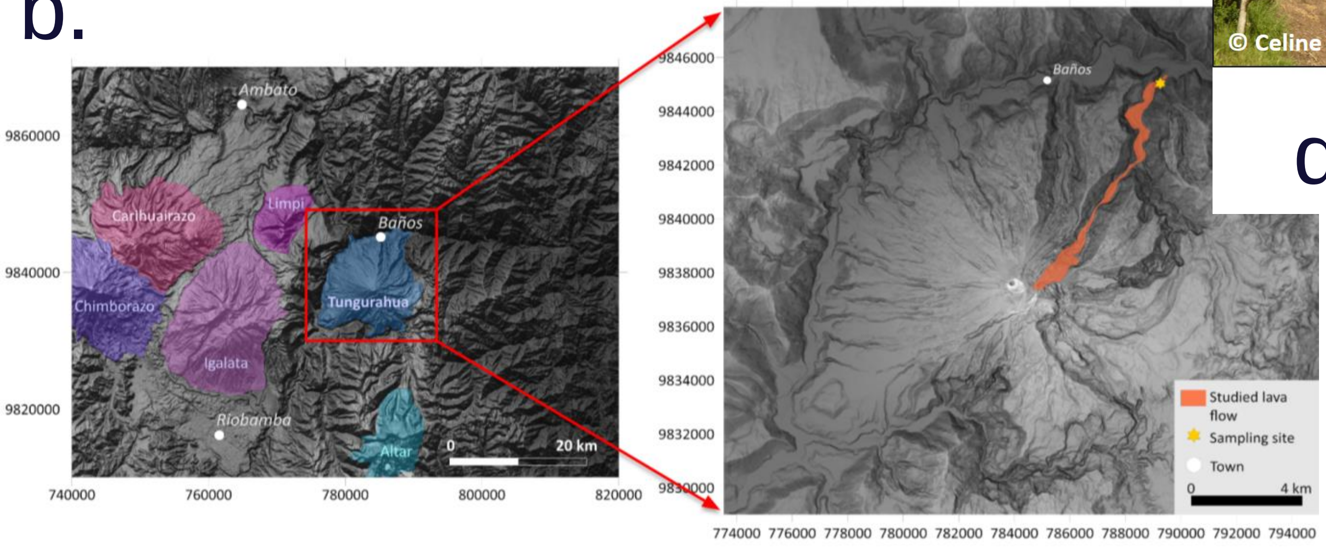
a.

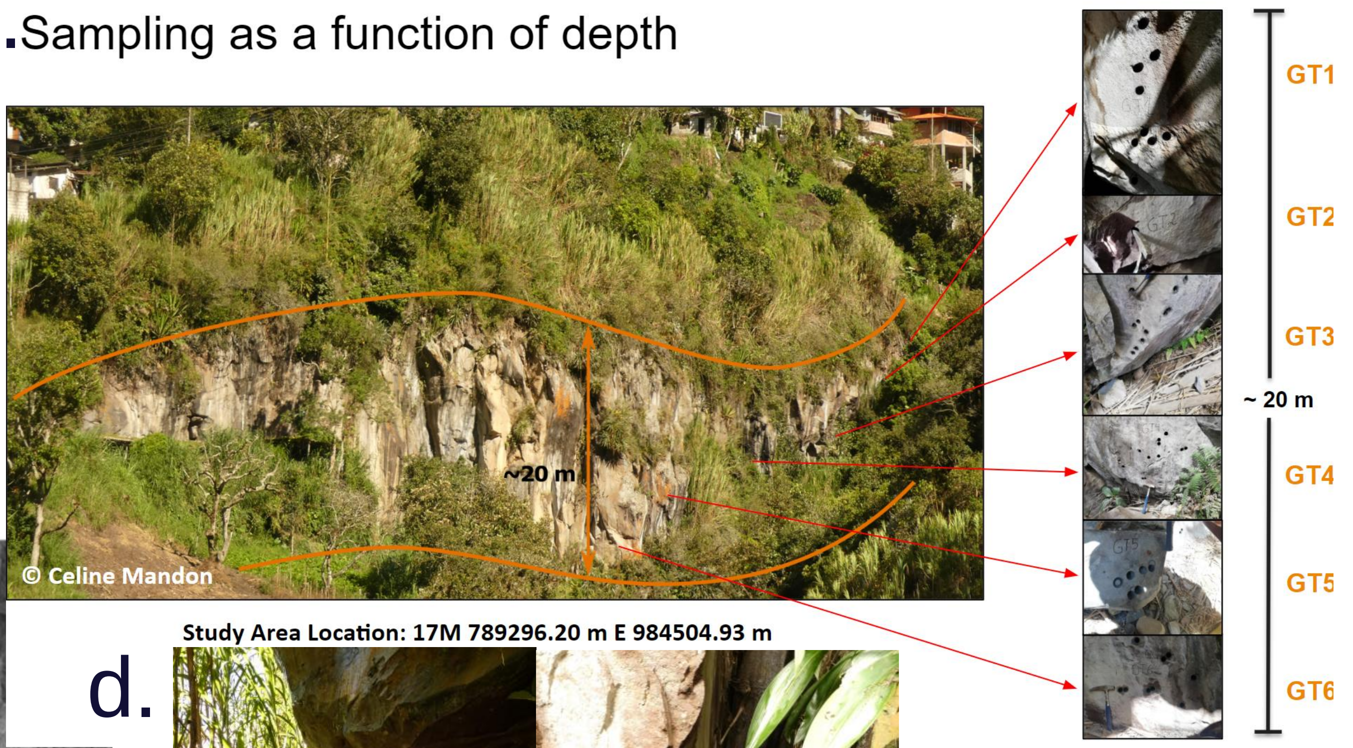


b.



Age estimate of lava flow 0 ±9 ka (Bablon, 2018)

c. Sampling as a function of depth



Study Area Location: 17M 789296.20 m E 984504.93 m

d.

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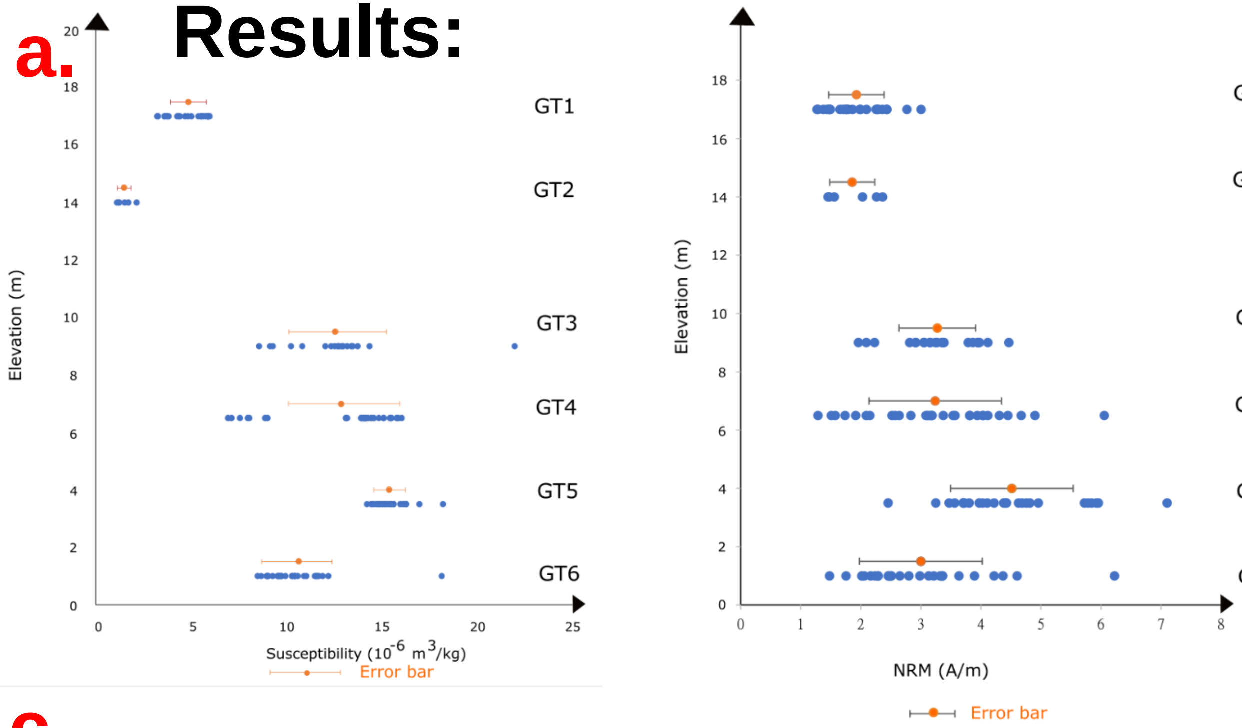
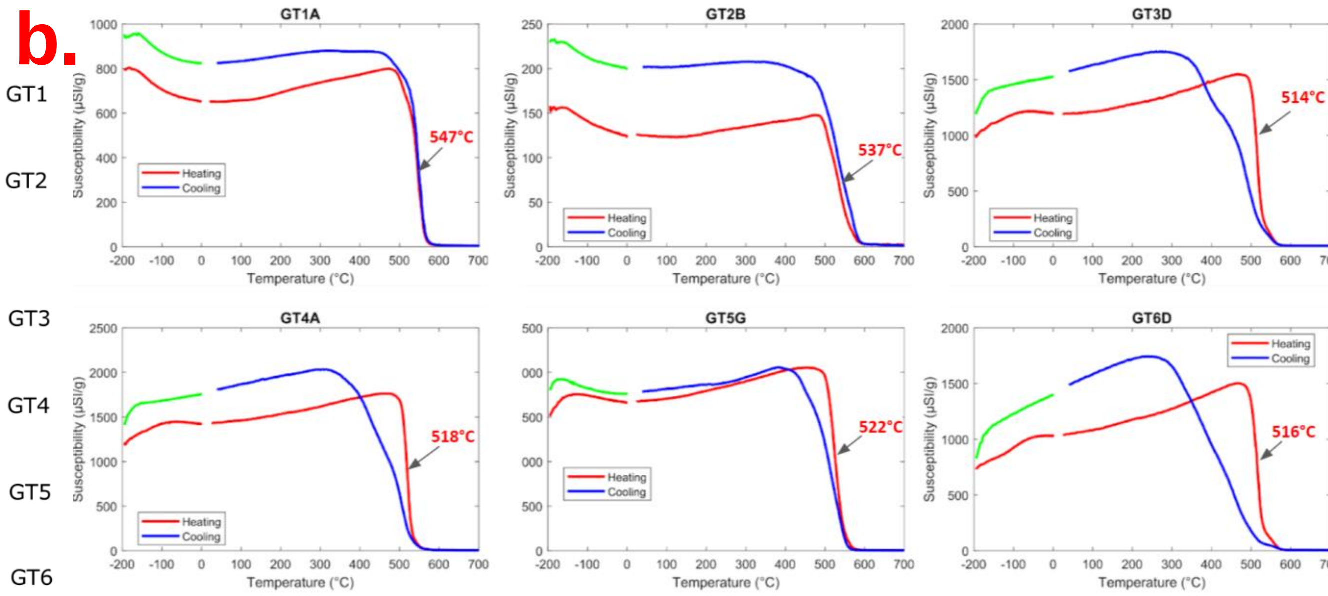
Results:

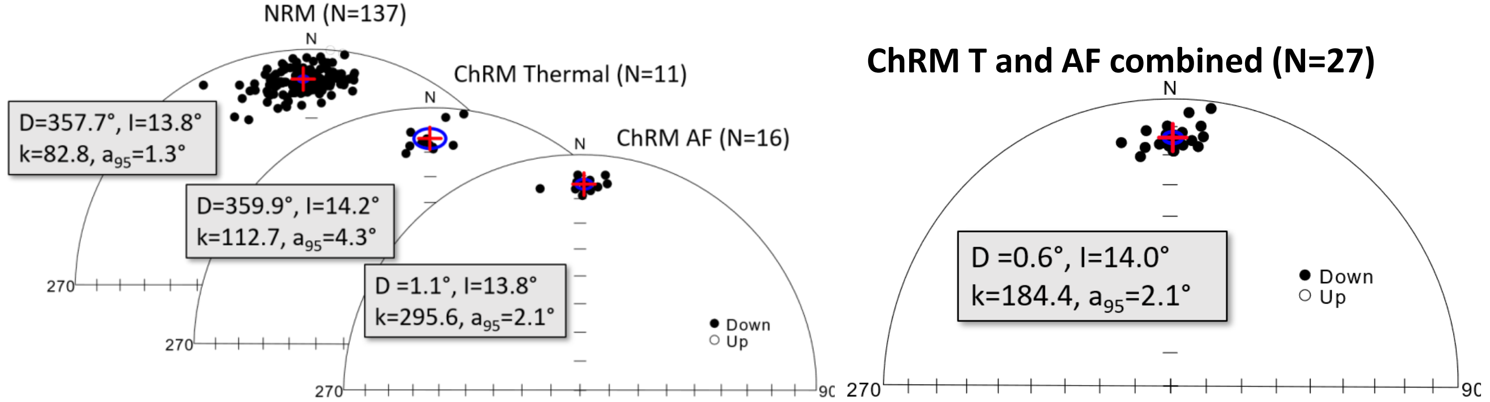
a.



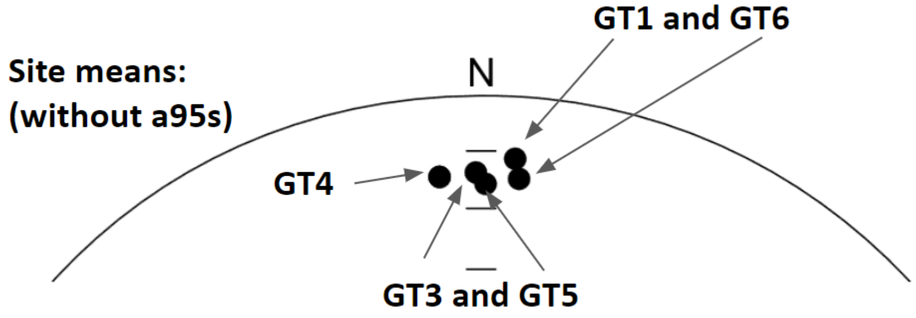
b.



c.



d.



NRM = Natural Remanent Magnetization

ChRM = Characteristic Remanent Magnetization

AF = Alternating field demagnetization

T = Thermal demagnetization

N = Number of samples

D = Declination, I = Inclination, k = precision parameter

a_{95} = Alpha95, the 95 % confidence cone around the mean direction

Present Earth Field:

D=-4°, I=18°

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Conclusions and future work

- The rock magnetic and paleomagnetic properties show considerable variation throughout the 20 m thick andesitic lava flow.

- Top- and bottom most sites show the easternmost declinations and the center of the lava flow westernmost. This behavior is not removed with thermal or AF cleaning. Most likely an unremoved viscous overprint, either due to a lightning strike or present earth field affecting the MD dominated center more.

- Comparison with global reference curve will be done in order to try to pinpoint the age of the lava flow.

- There is a lot of future work still left, including FORCs and paleointensity.

THANK YOU

Tungurahua Volcano (2021)

If you are interested in this topic, come to Oral Presentation GP42A-03

Thursday, 16 December 2021, 9:45-11:00 am (Central)

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