Chachimbiro Geothermal area, Northern Ecuador – A new magnetic exploration.

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Abstract

Geophysical surveys are efficient ways to obtain information on areas that are promising for geothermal energy. One of the geophysical techniques commonly used is the magnetic method, which is useful to detect shallow structures and changes in magnetization due to processes related to geothermal activity, such as faulting and hydrothermal alterations. Despite the richness of available geothermal resources in South America and Ecuador, the use of these resources for electricity production is very limited. Chachimbiro, in northern Ecuador, is one of the potential sites for developing a geothermal power plant. Our objective is to provide complementary magnetometry data to improve the existing model of the geothermal area. We performed high resolution ground magnetometry survey of ˜30 m spacing around the prospective drilling area in order to better understand the shallow structures above the reservoir. We also performed two additional survey lines with ˜5 m spacing across possible fault locations. After necessary data reductions the magnetic anomaly map was compared with a digital elevation model and a geological map of the area. This helped to understand the distribution of the anomalies and their relation with the presence of high magnetic susceptibility materials, hydrothermal alterations and topography. Major anomalies observed in the magnetic profiles were compared with forward fault models, allowing us to distinguish topographic from fault effects. We then compared our new magnetometry results with previous geophysical models of the Chachimbiro geothermal system. The large long-wavelength negative anomaly on the Northeast side of the survey area seems to coincide with the suggested location of the clay cap, and can therefore be used to improve the existing models. The new magnetic exploration of Chachimbiro therefore shows the usefulness of this method to locate magnetic anomalies related to faulting and hydrothermal alterations.

CHACHIMBIRO GEOTHERMAL AREA, NORTHERN ECUADOR – A NEW MAGNETIC EXPLORATION.

Javier Pauta, Ph.D Elisa Piispa, Ph.D Celine Mandon,
and Mst. Matilde Urguizo

December 15th, 2021

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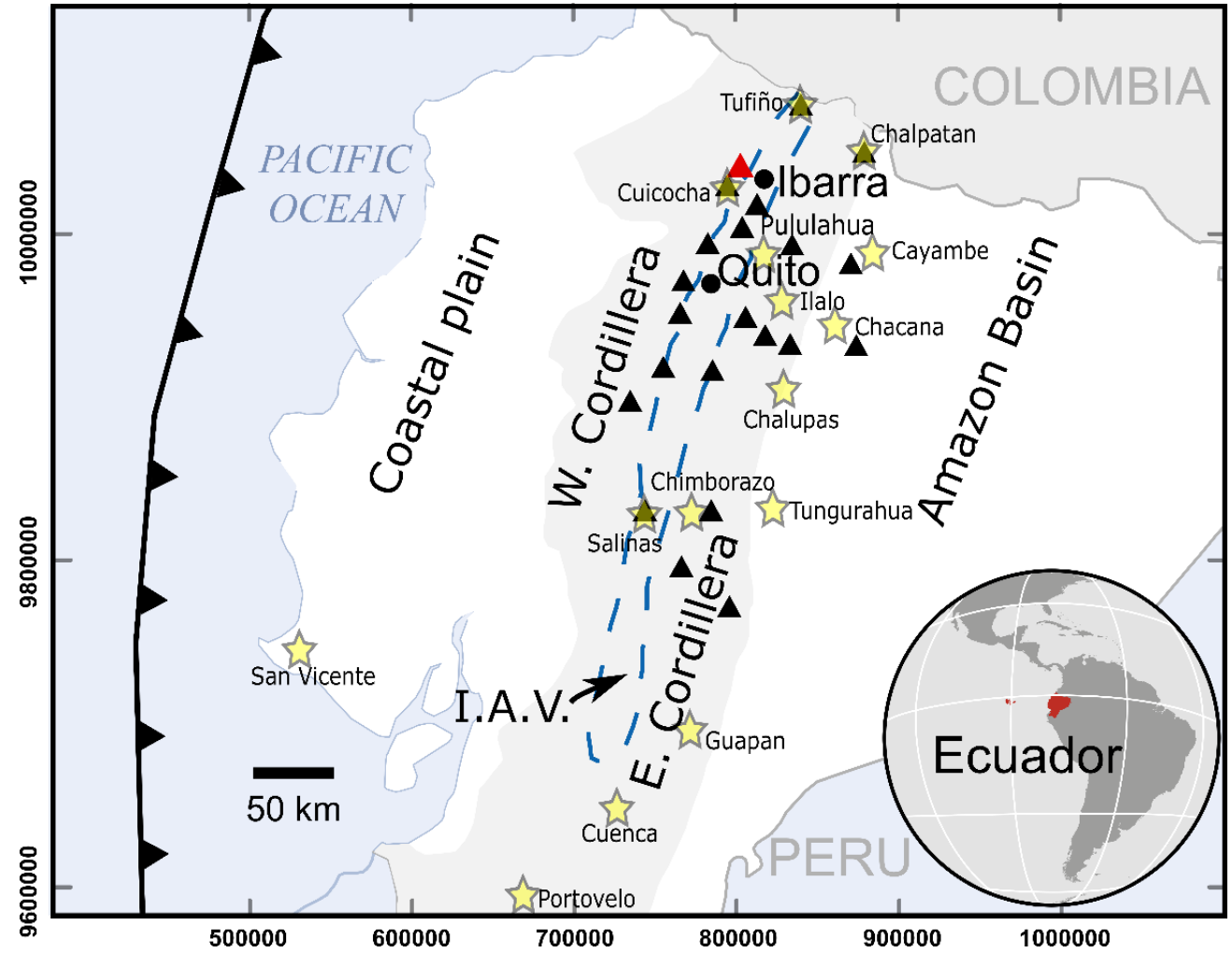
IMPORTANCE/MOTIVATION



Legend: I.A.V. = Inter Andean Valley

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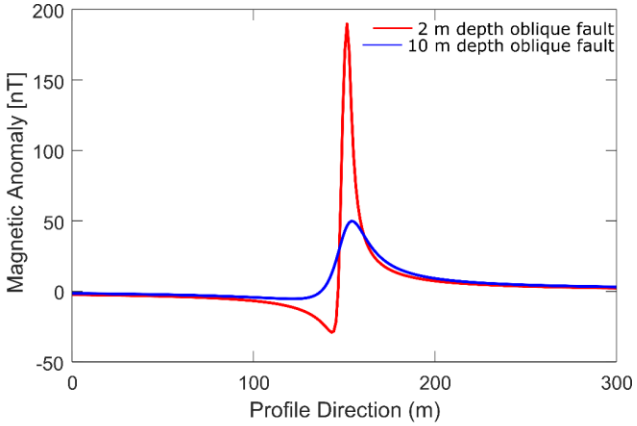
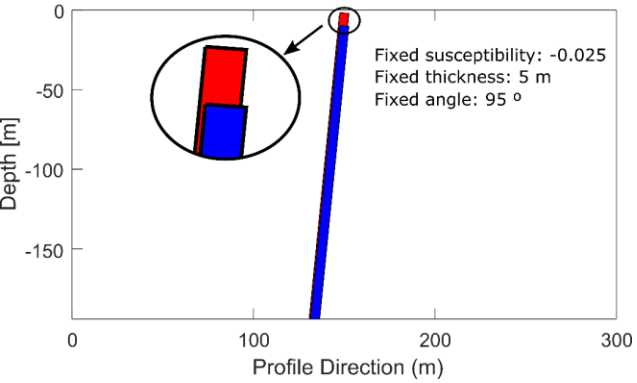
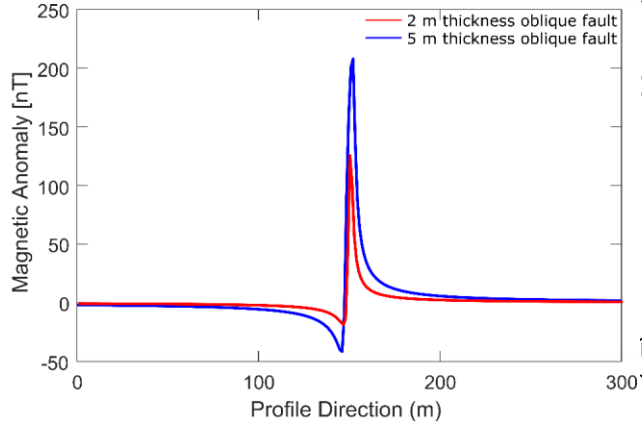
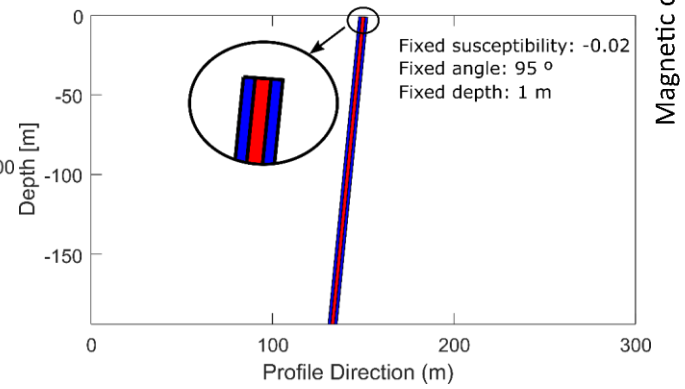
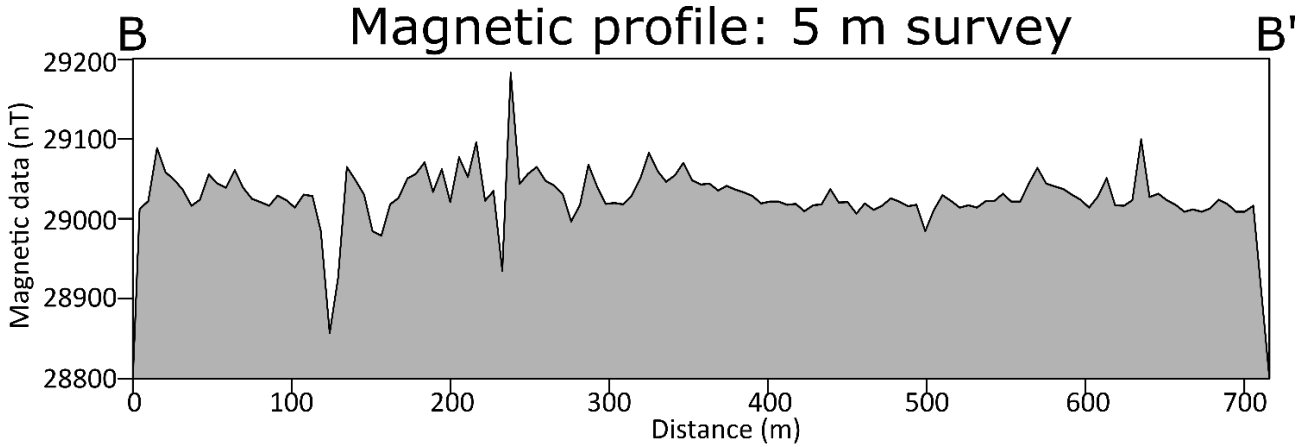
RESULTS

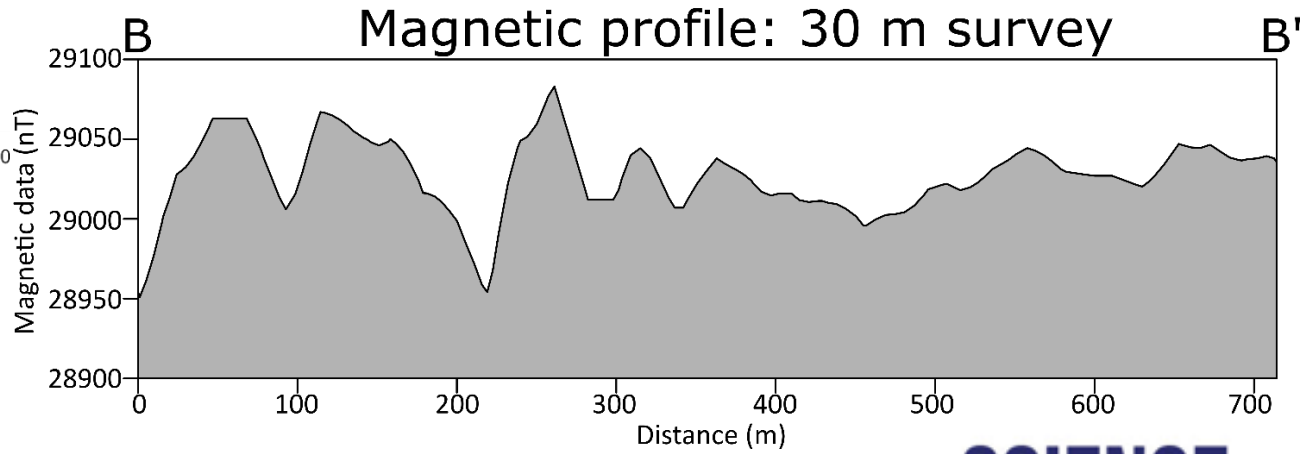












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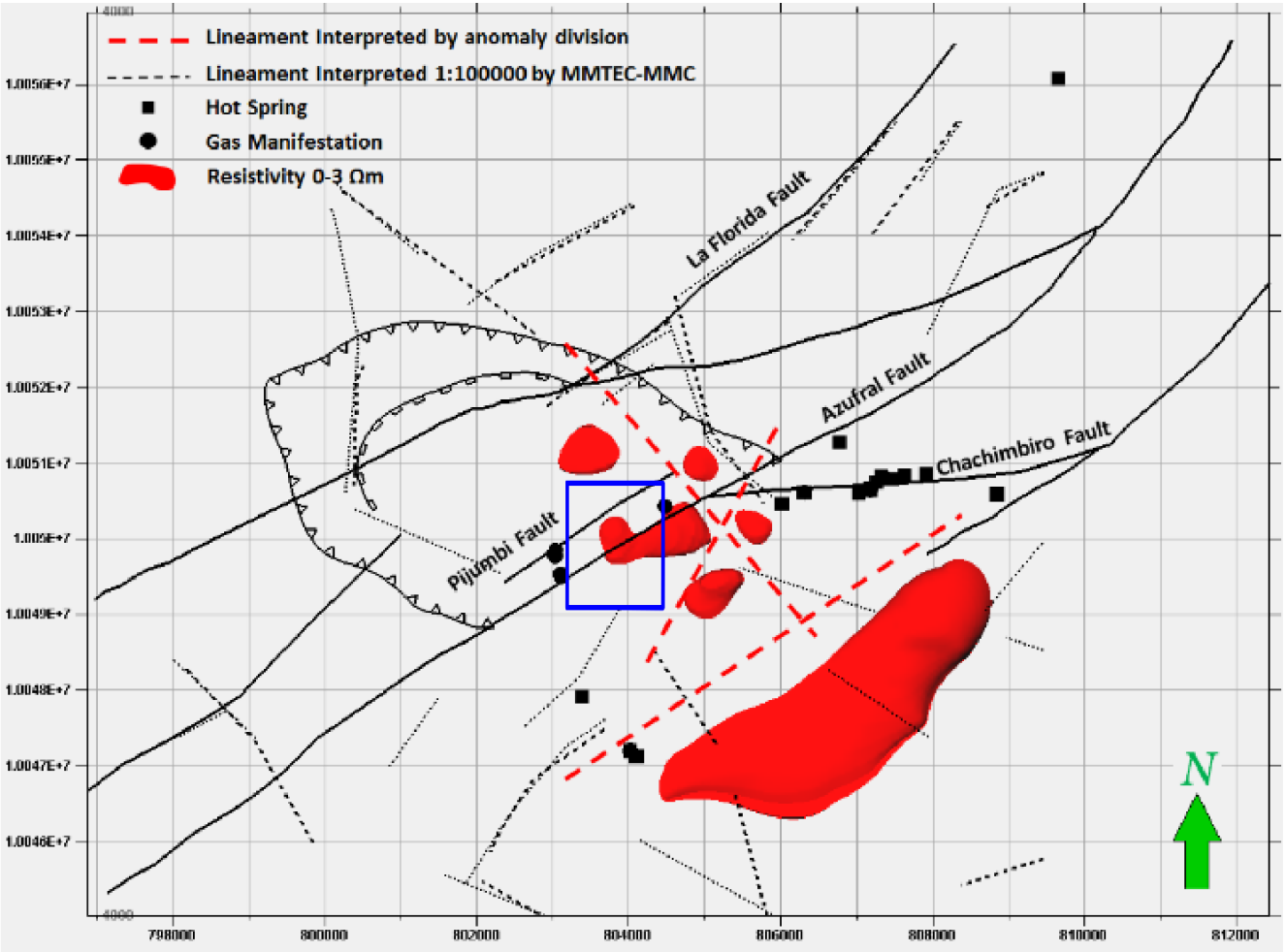

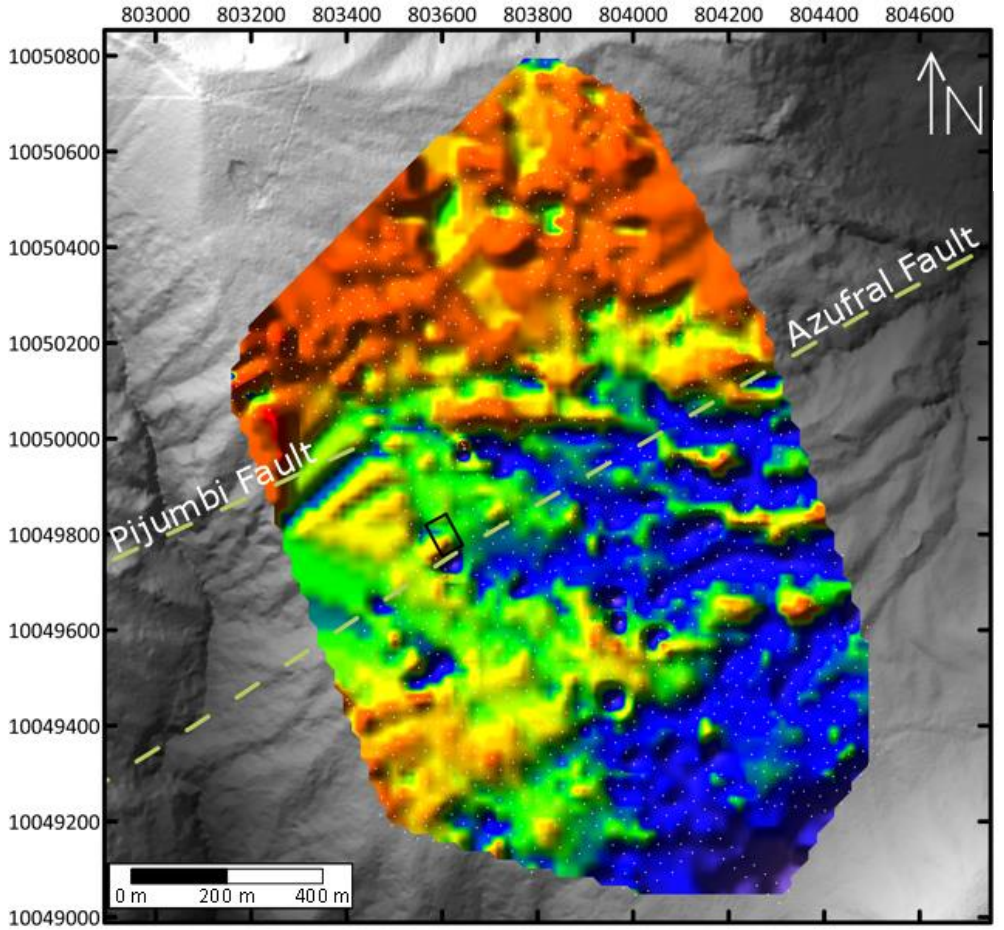

Pilicita, (2016).

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THANK YOU

Questions, suggestions and comments are welcome!

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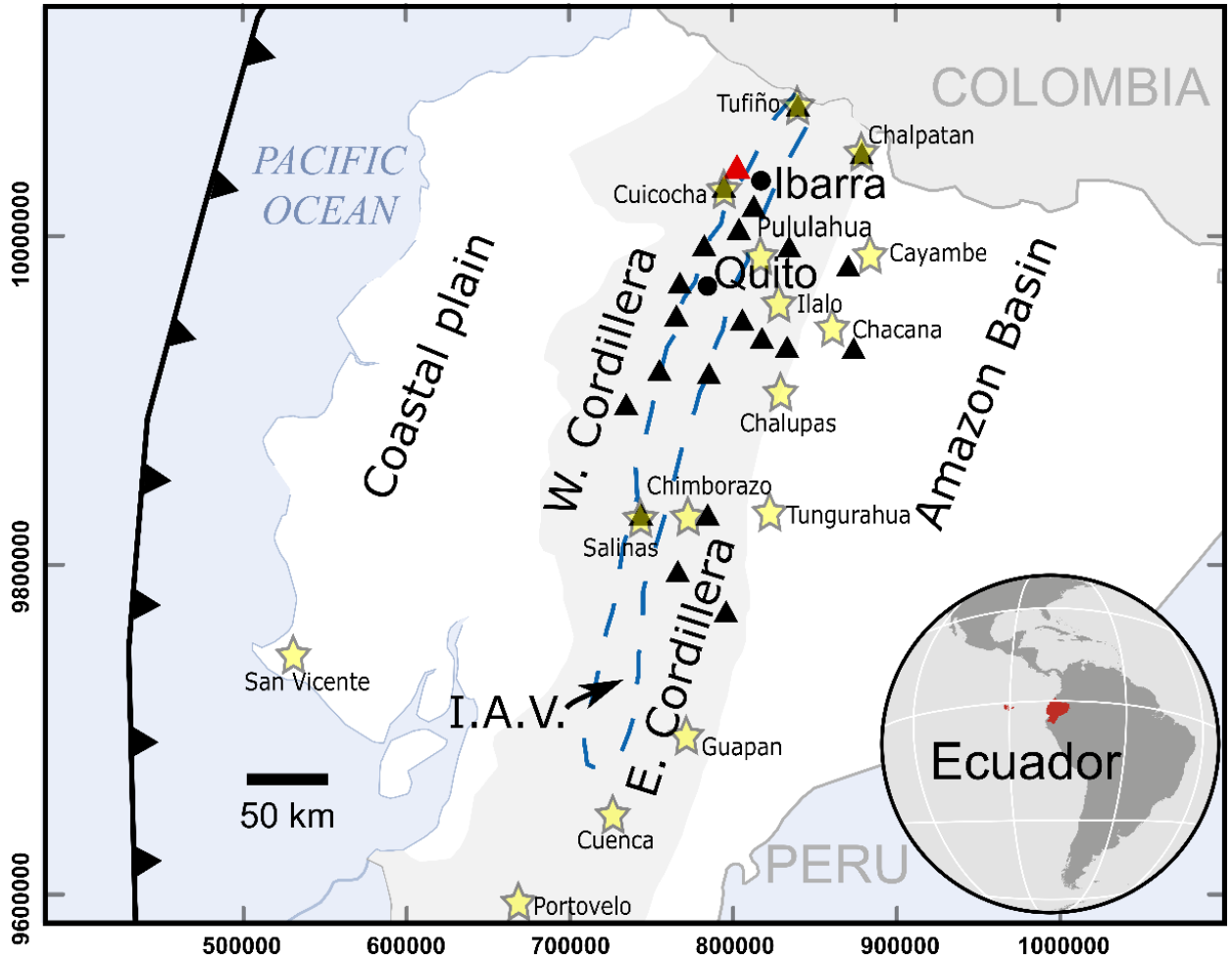
GEOLOGICAL SETTING



Legend: I.A.V. = Inter Andean Valley

- Plates interaction
- Andean Cordillera
- Several geothermal prospects
- Chachimbiro

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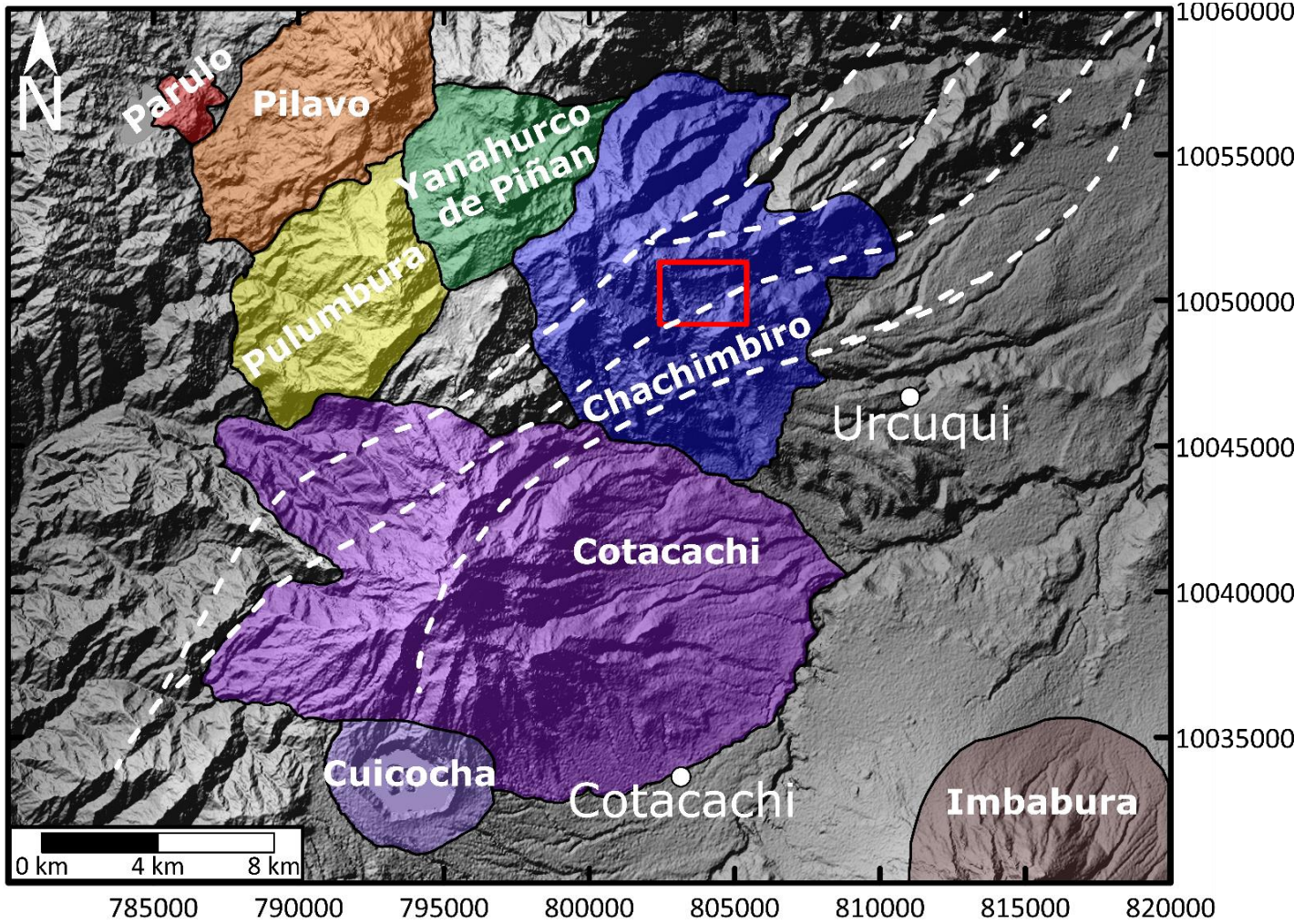
GEOLOGICAL SETTING



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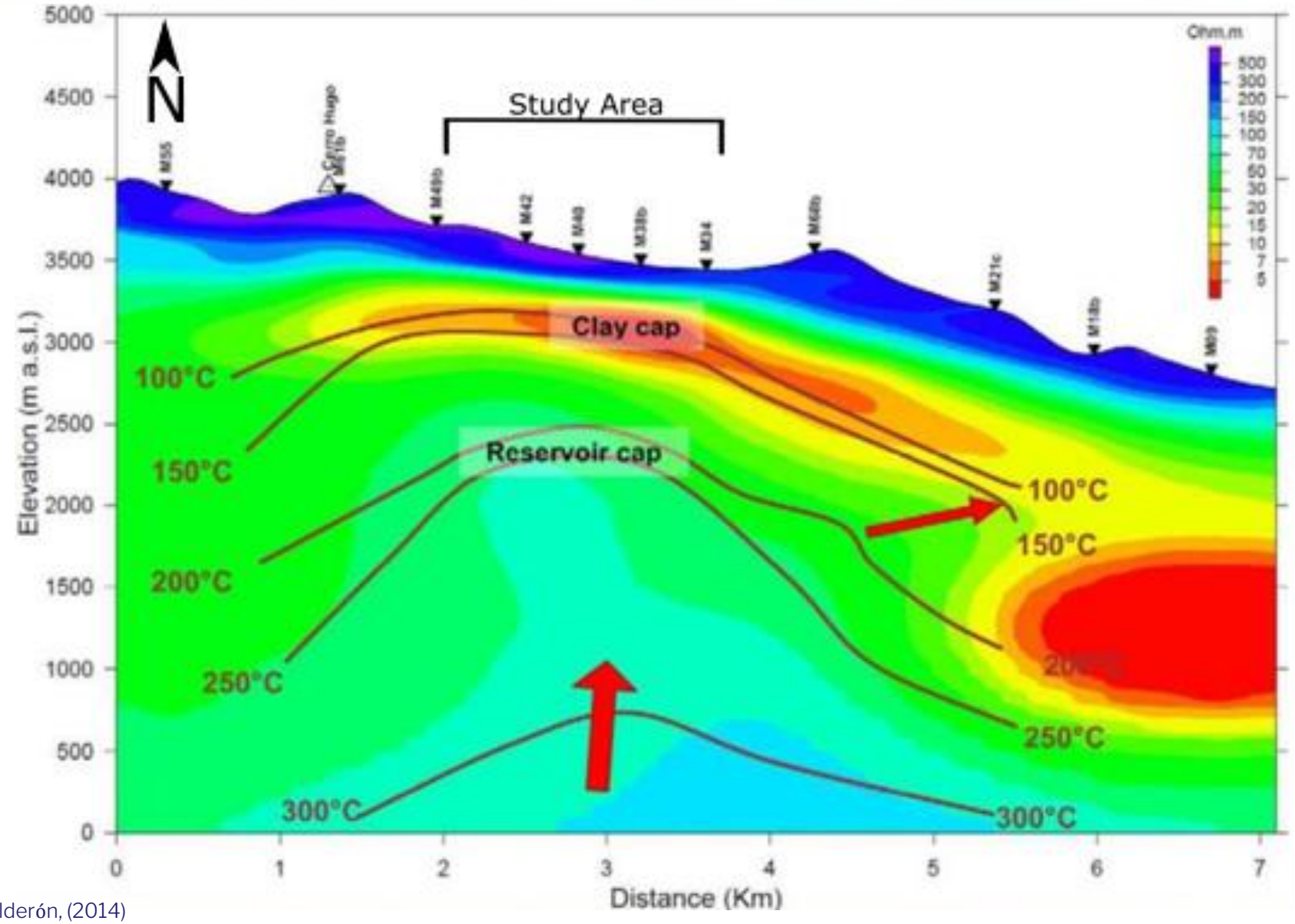

Modified after Torres Calderón, (2014)

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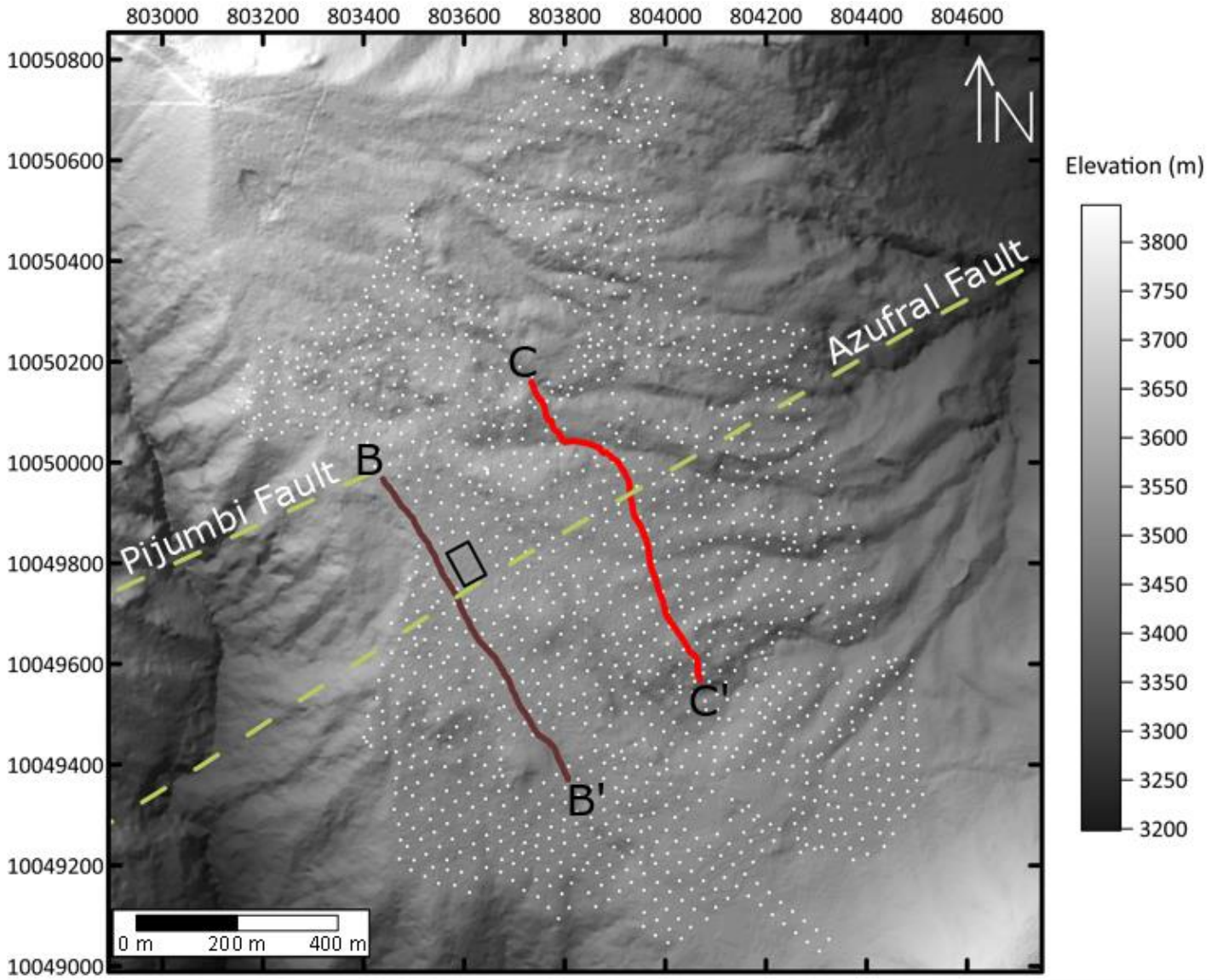
METHODOLOGY



- ~1.3 km width and ~1.8 km length
- ~27 to ~35 m distancing between points.
- In total, 1614 points were measured.
- B-B' and C-C' survey lines, points every 5 m.
- Base station measurement every 1 to 2 hours.

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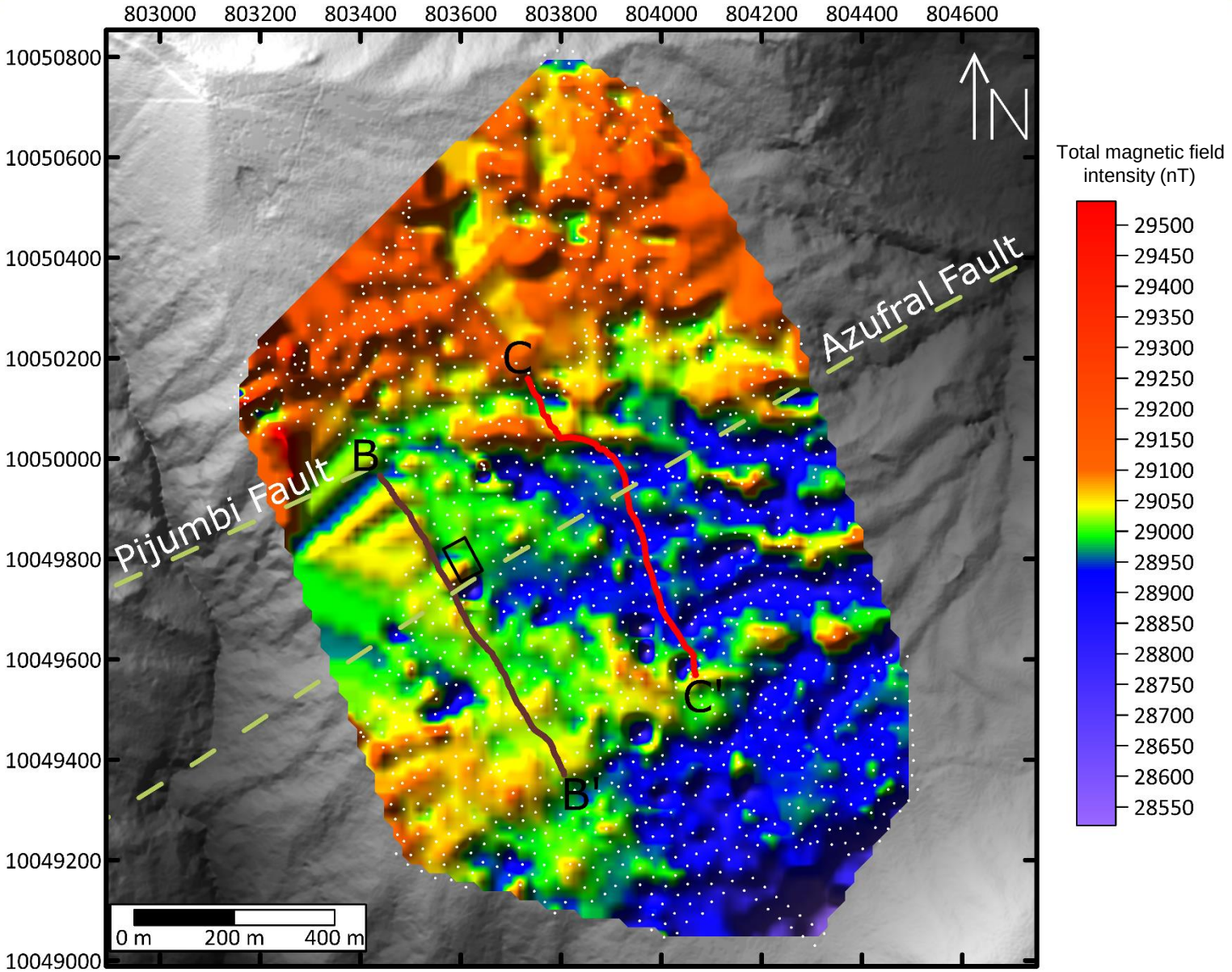
RESULTS



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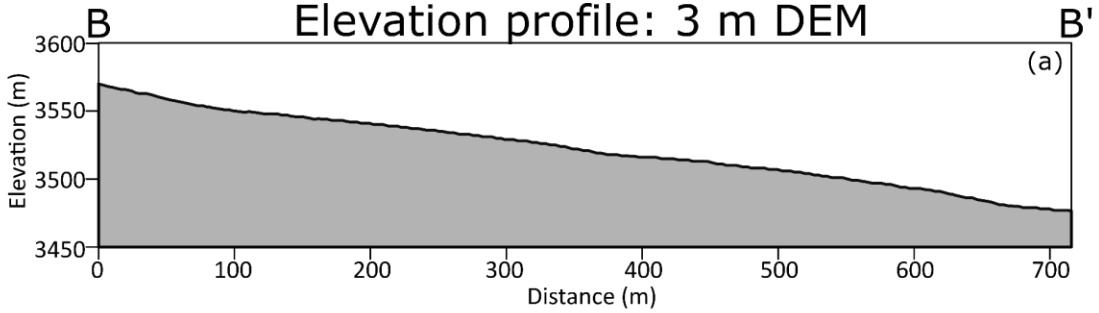

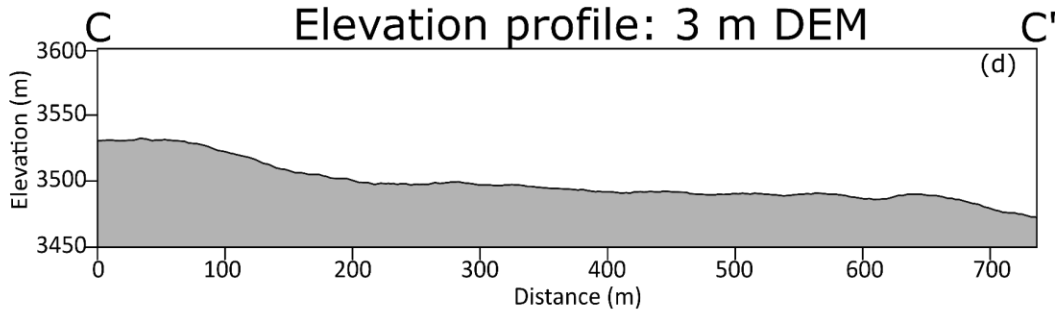

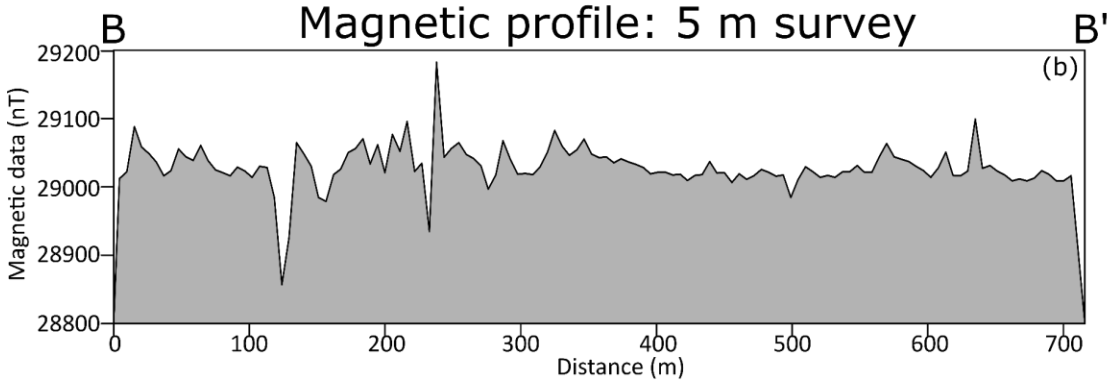

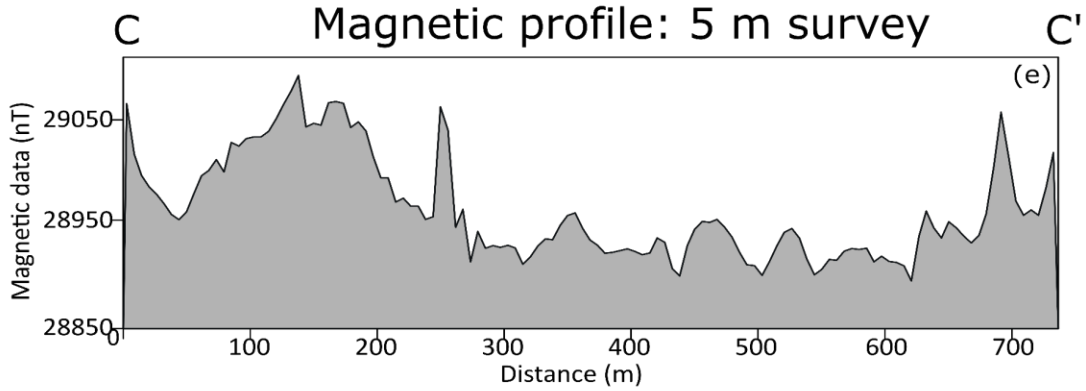

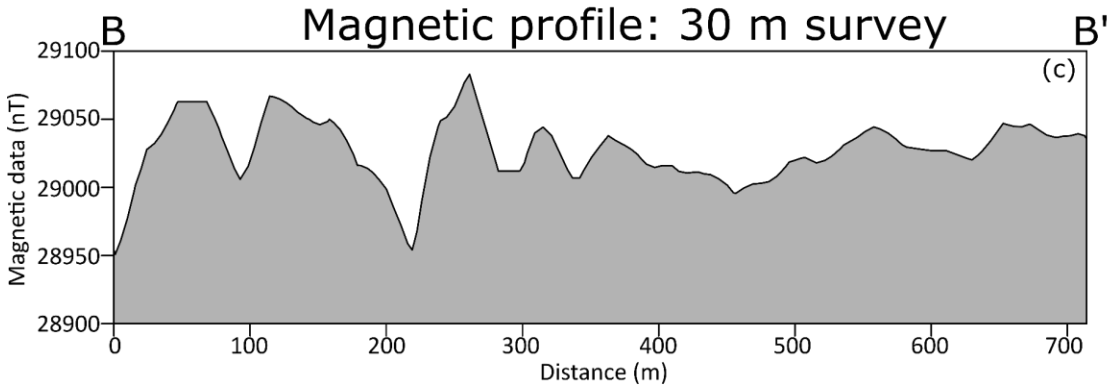

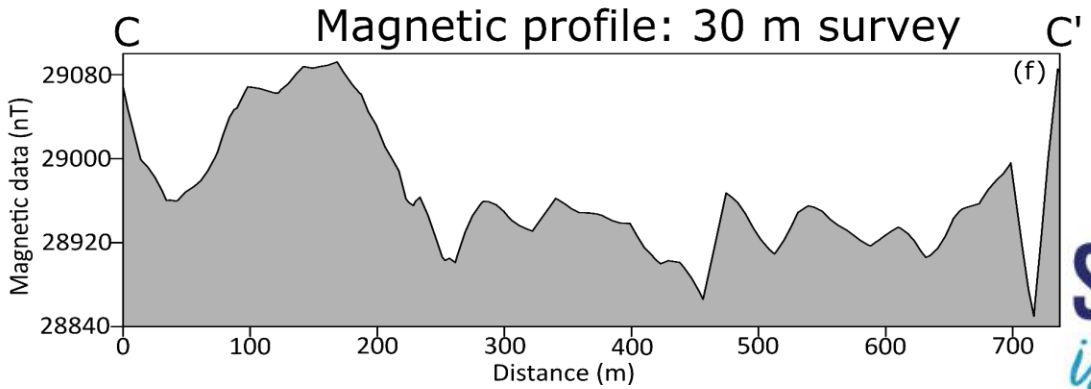

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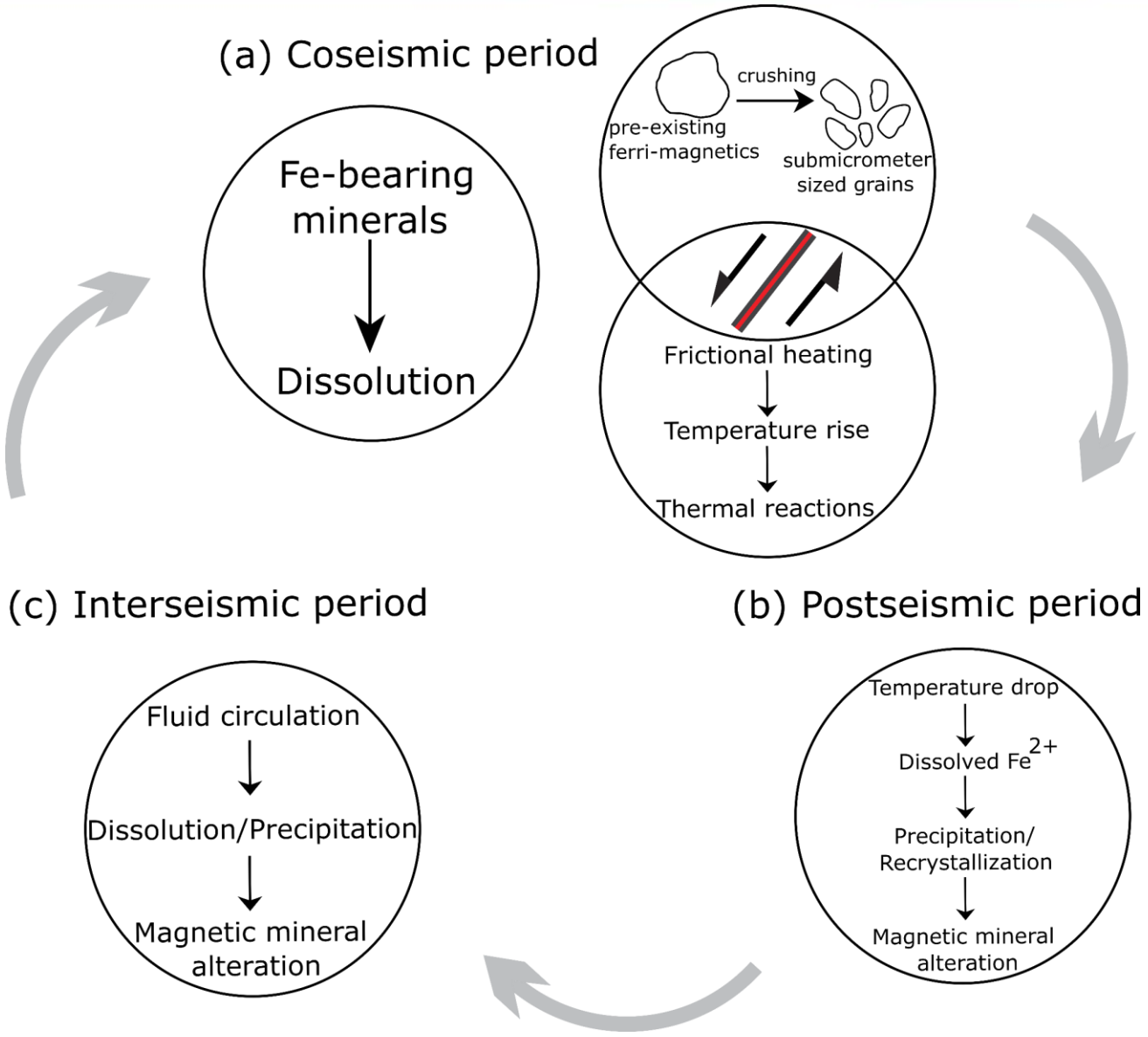
DISCUSSION

Faulting and hydrothermal alteration effects on magnetization



Modified from Yang, (2020)

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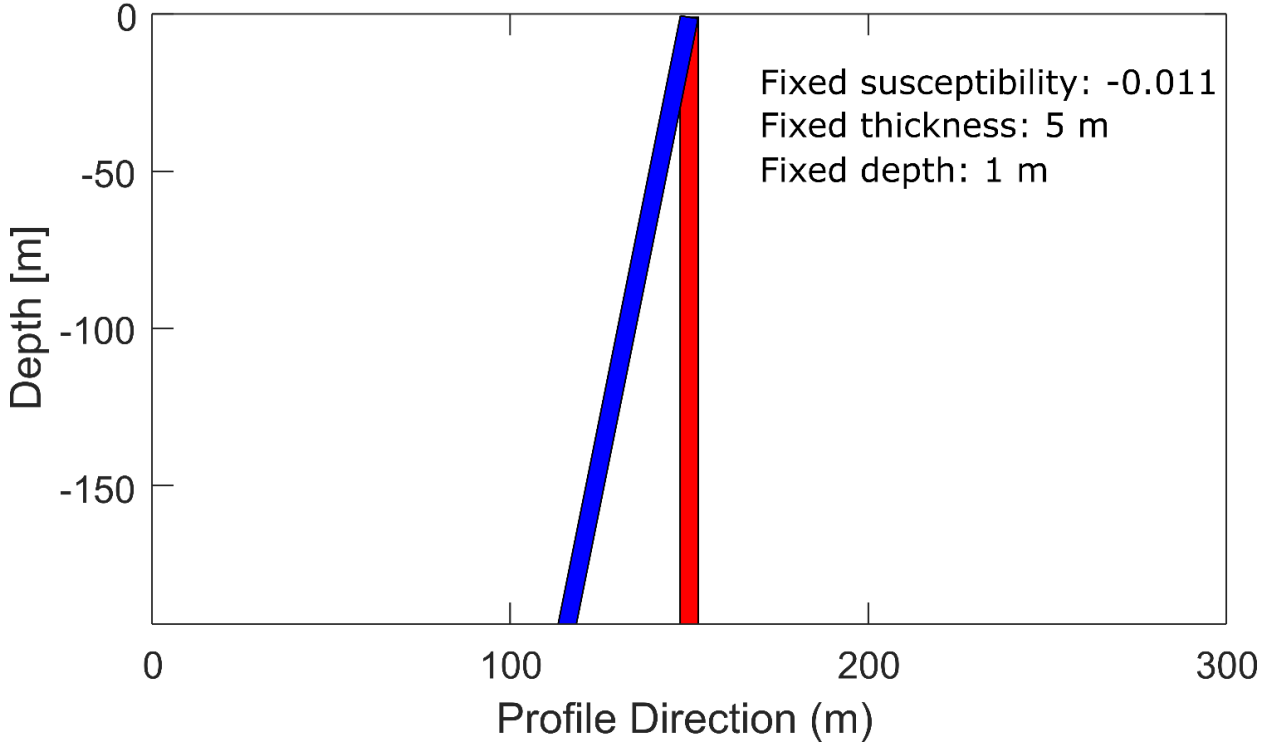
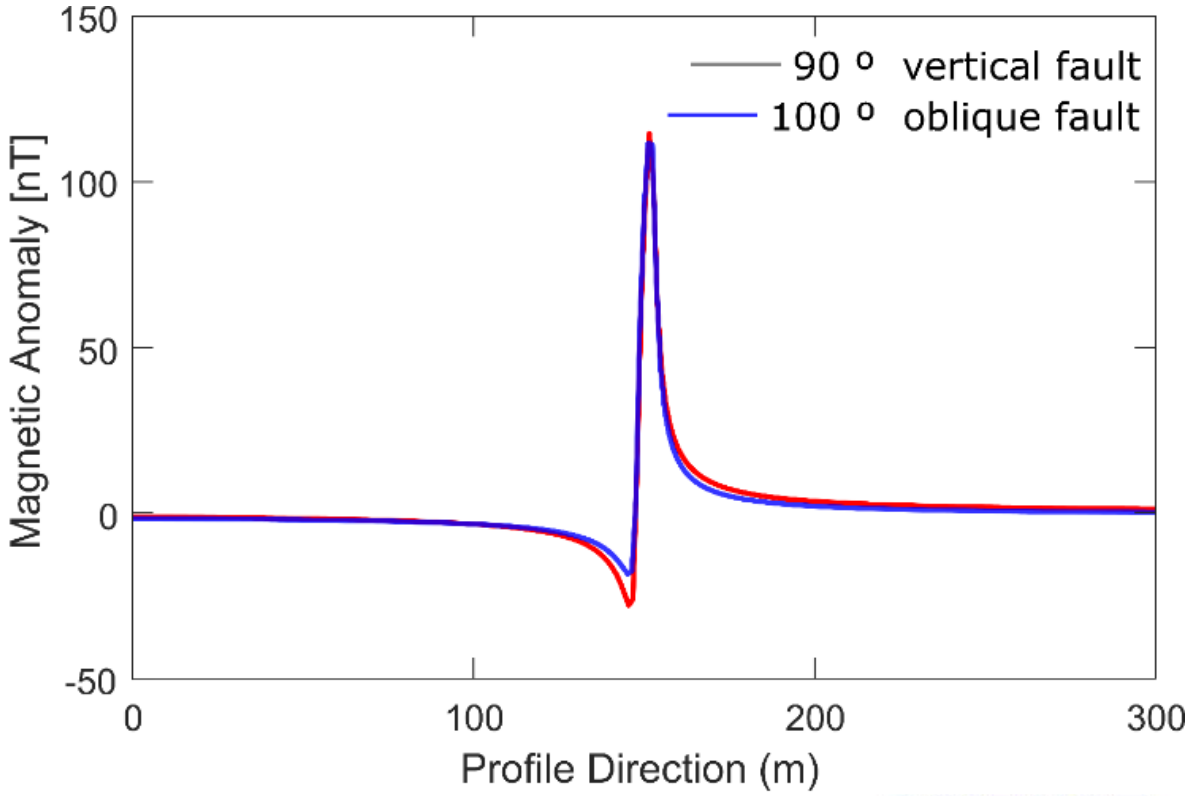
DISCUSSION

Schematic of fault orientation



Resulting magnetic anomaly



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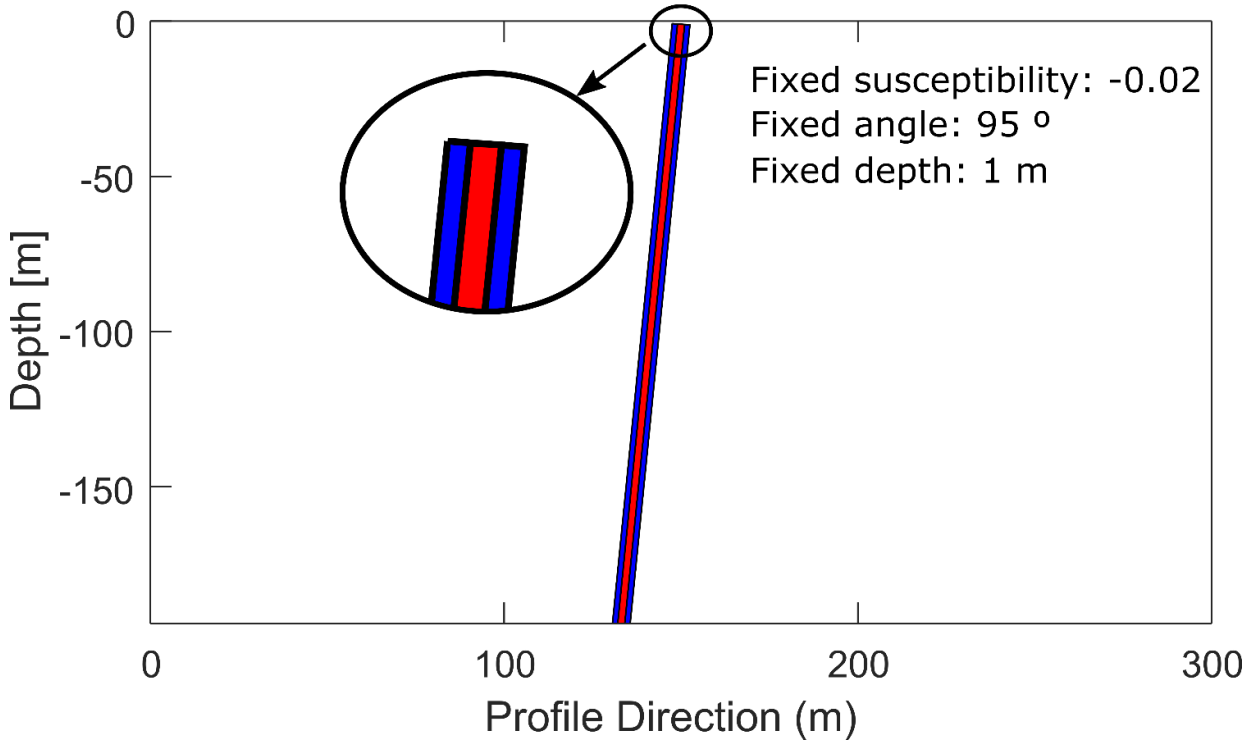
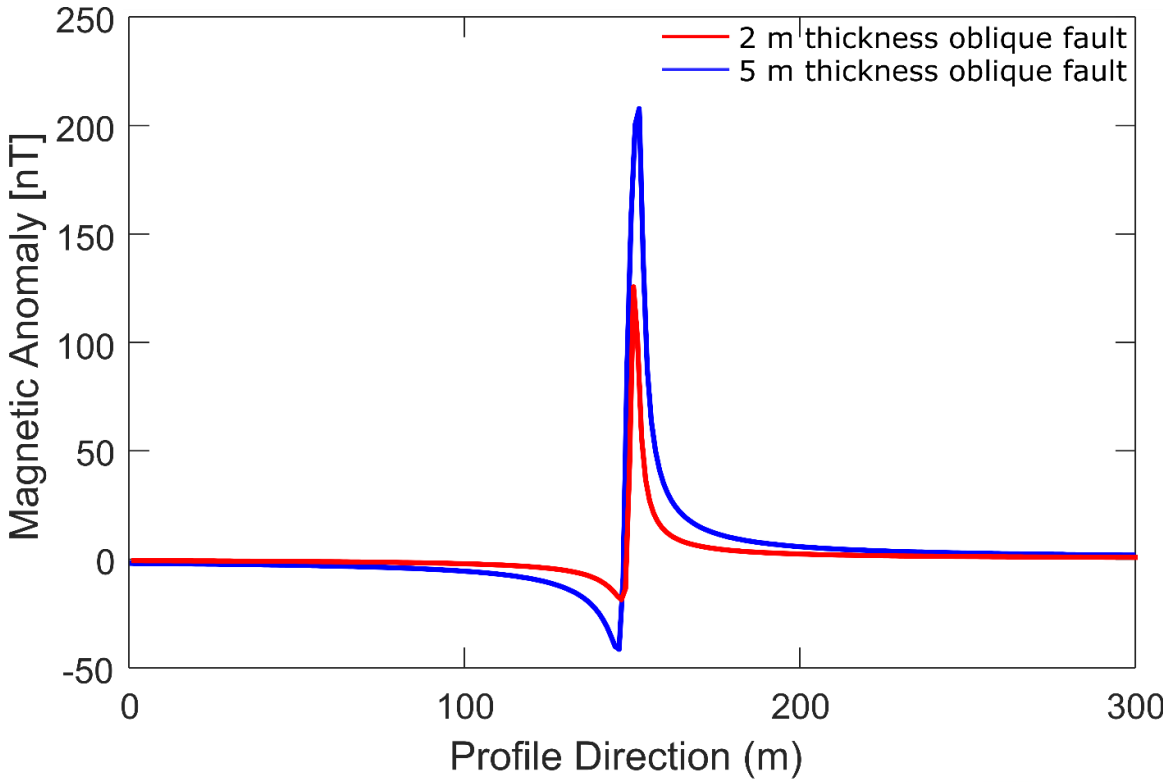
Schematic of fault thickness



Resulting magnetic anomaly



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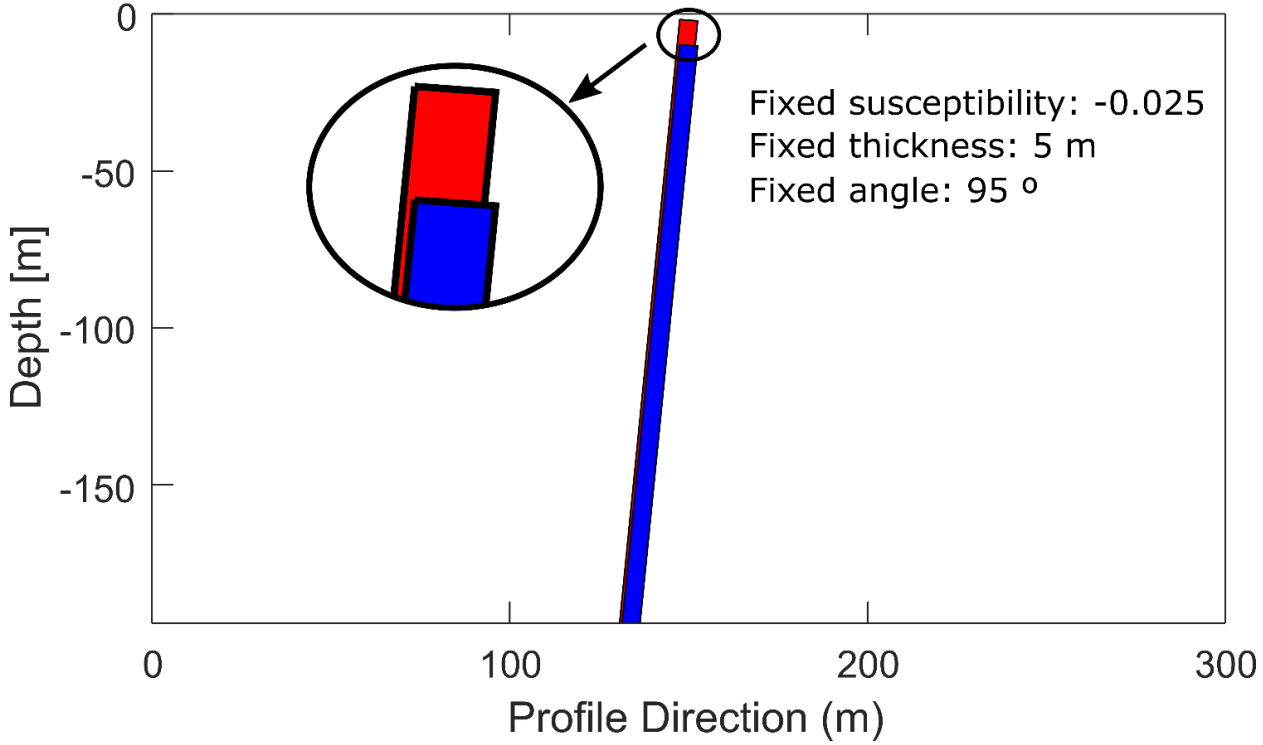
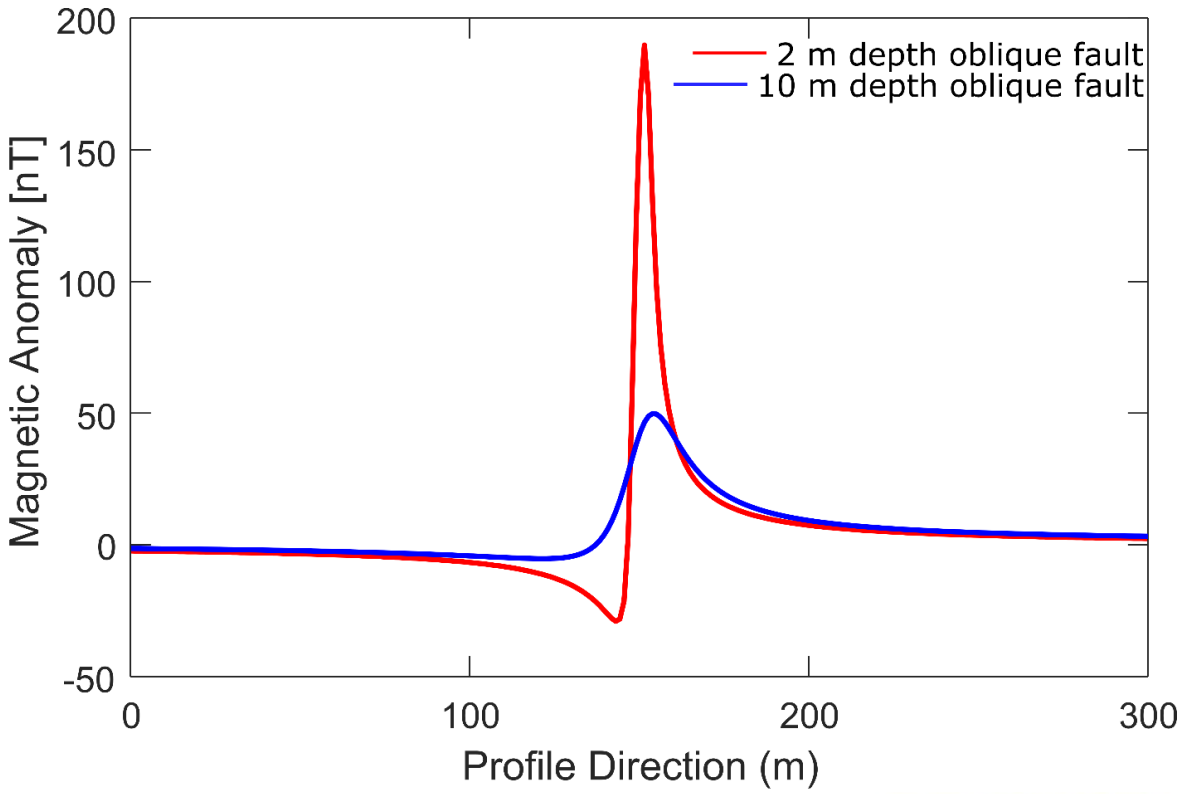
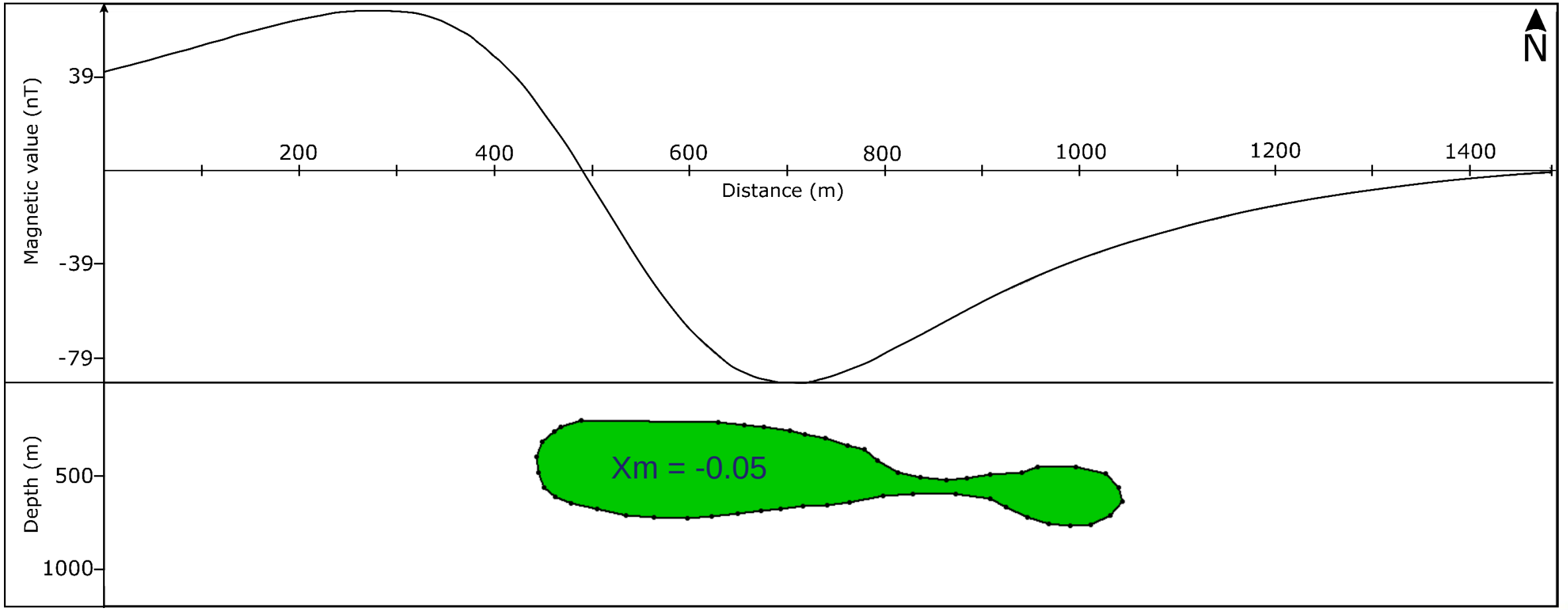
Schematic of fault depth

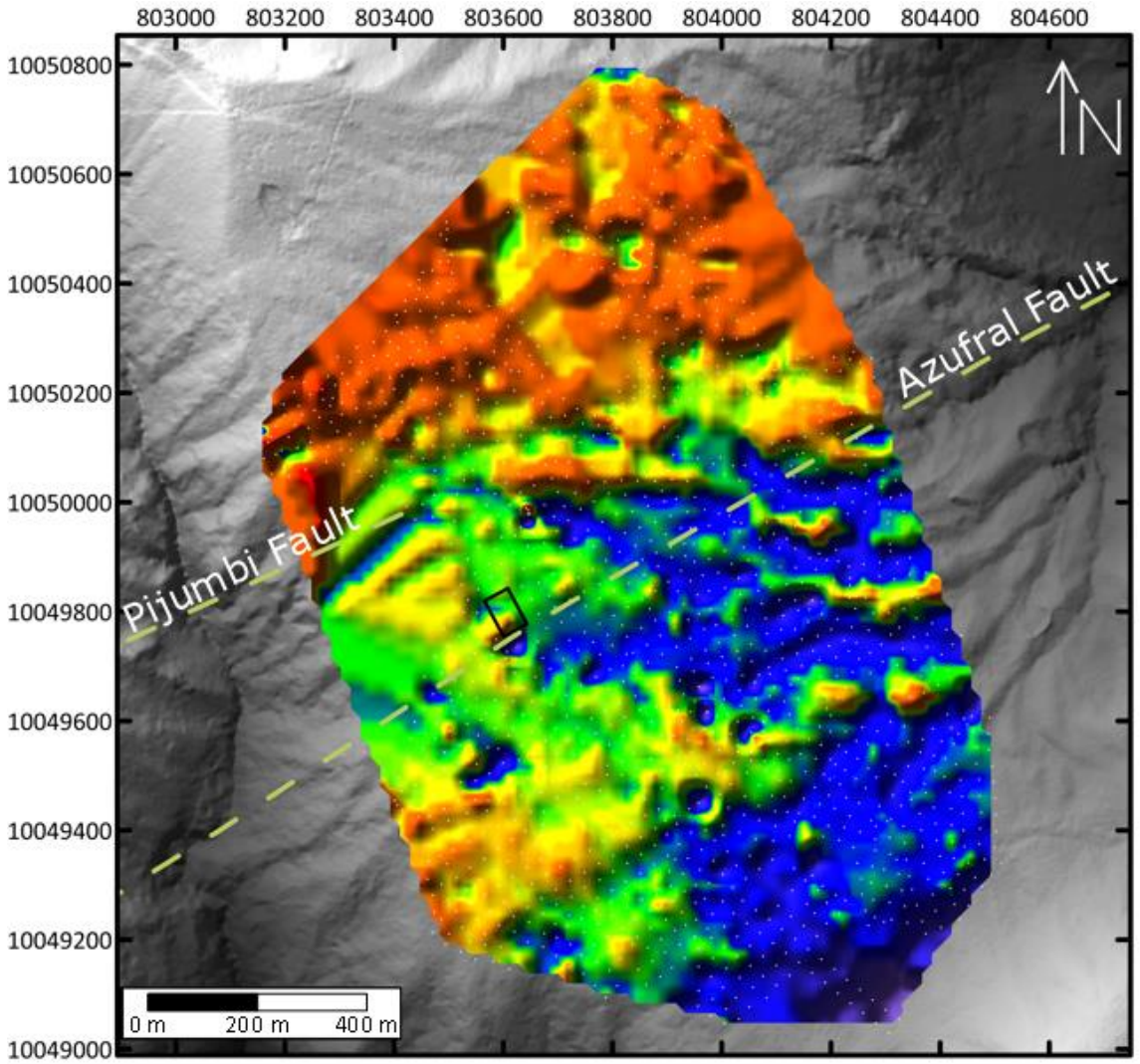


Resulting magnetic anomaly

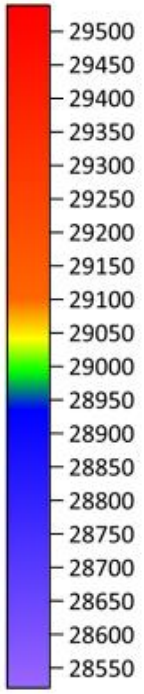


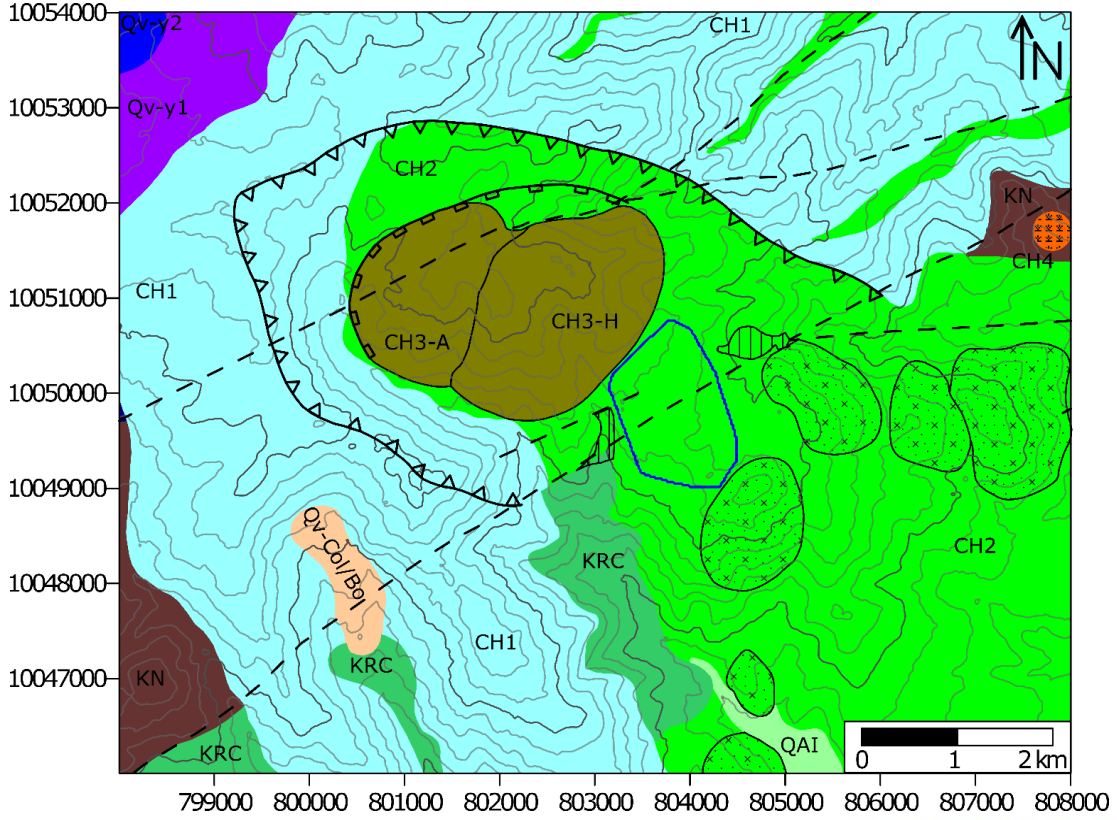
Potential effect of clay cap





Total magnetic field intensity (nT)





Modified after SYR, (2012)

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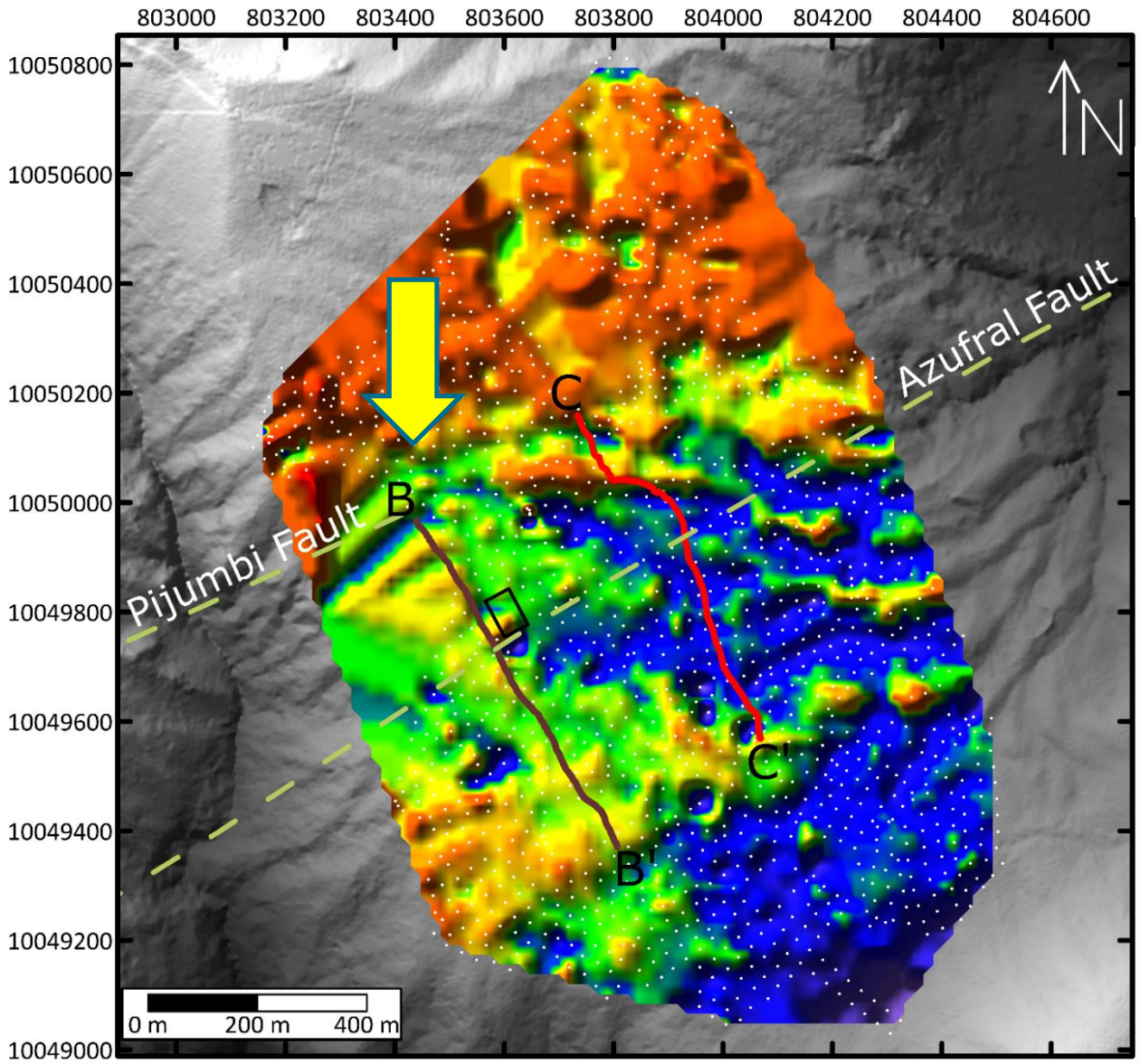

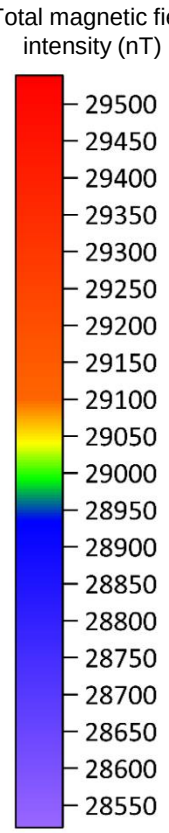

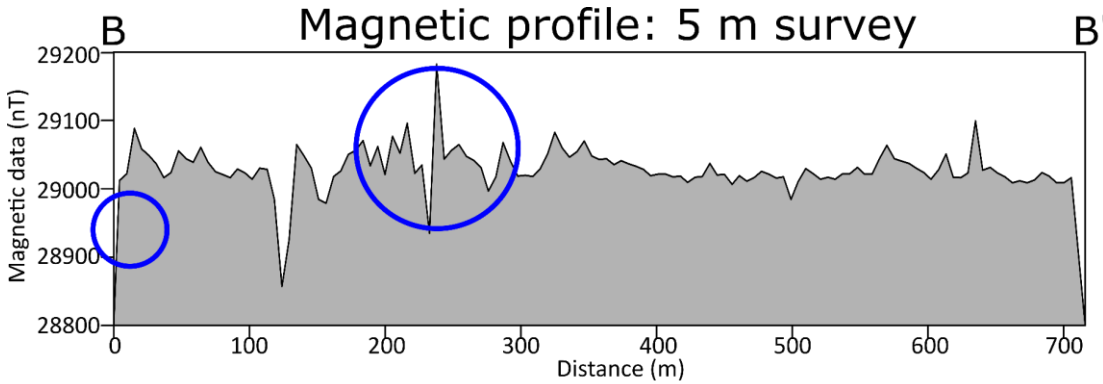

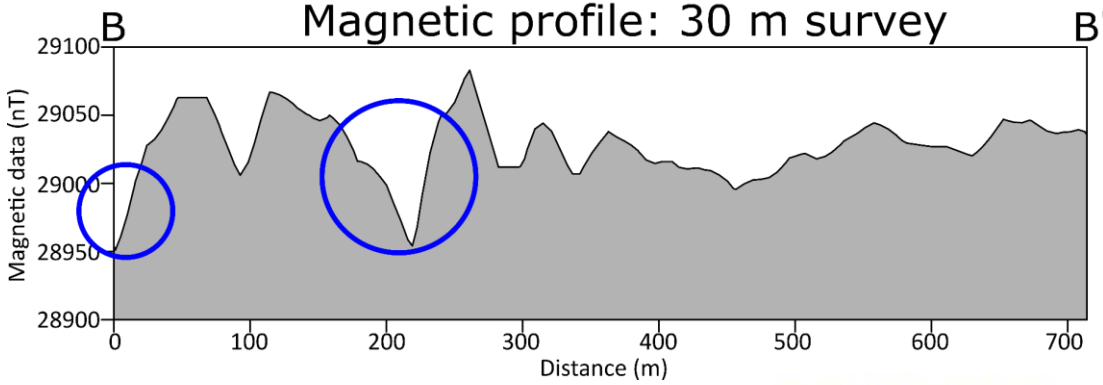

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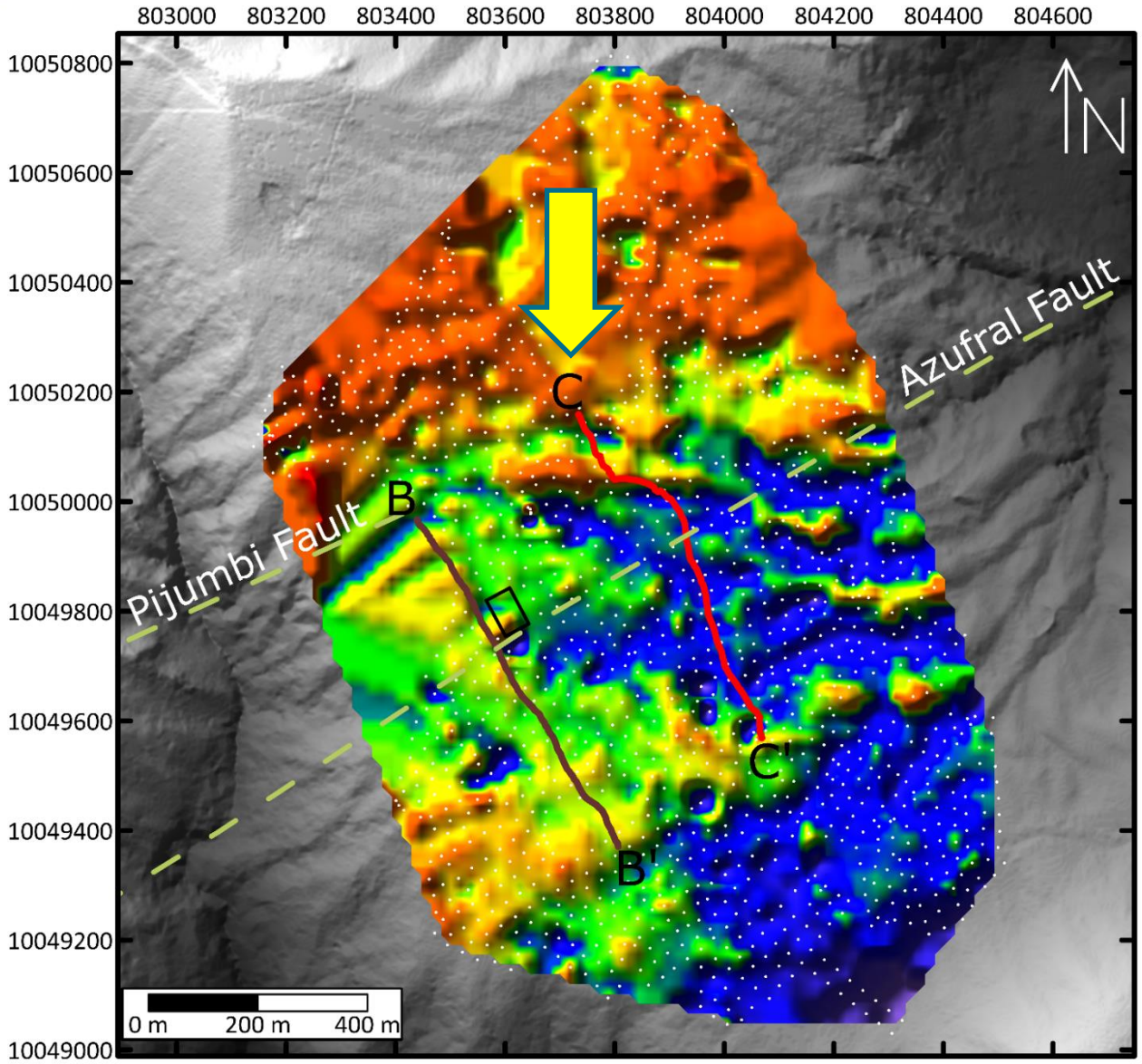

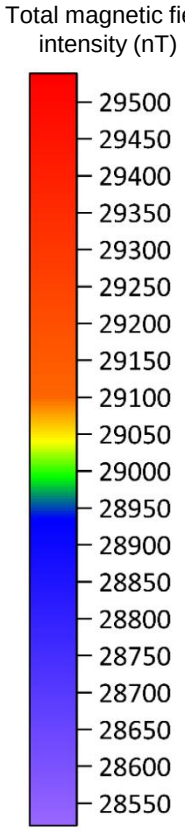

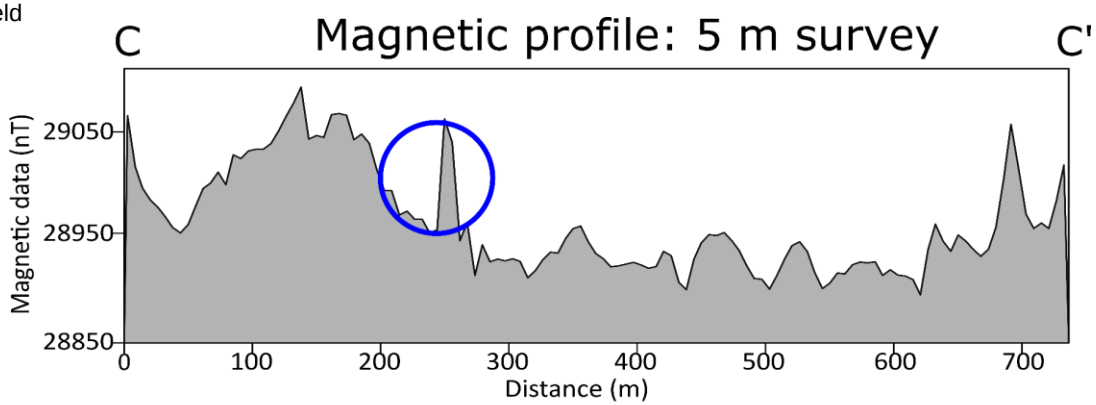

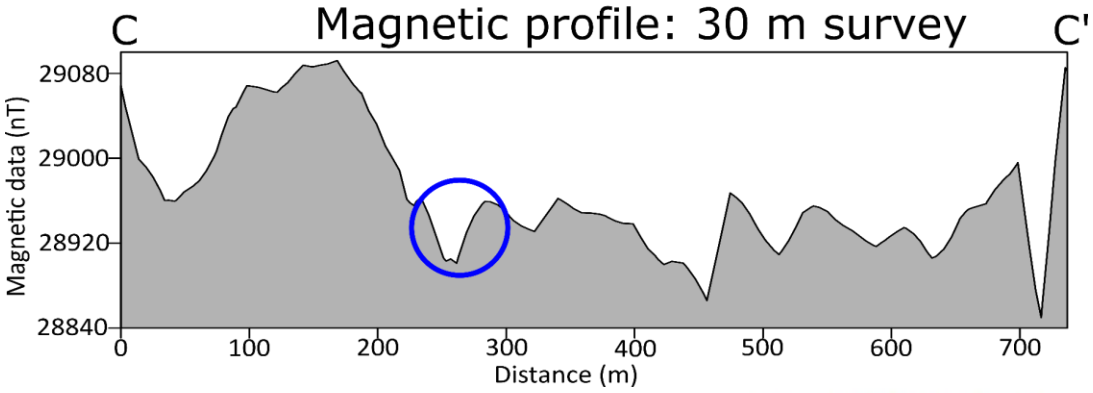

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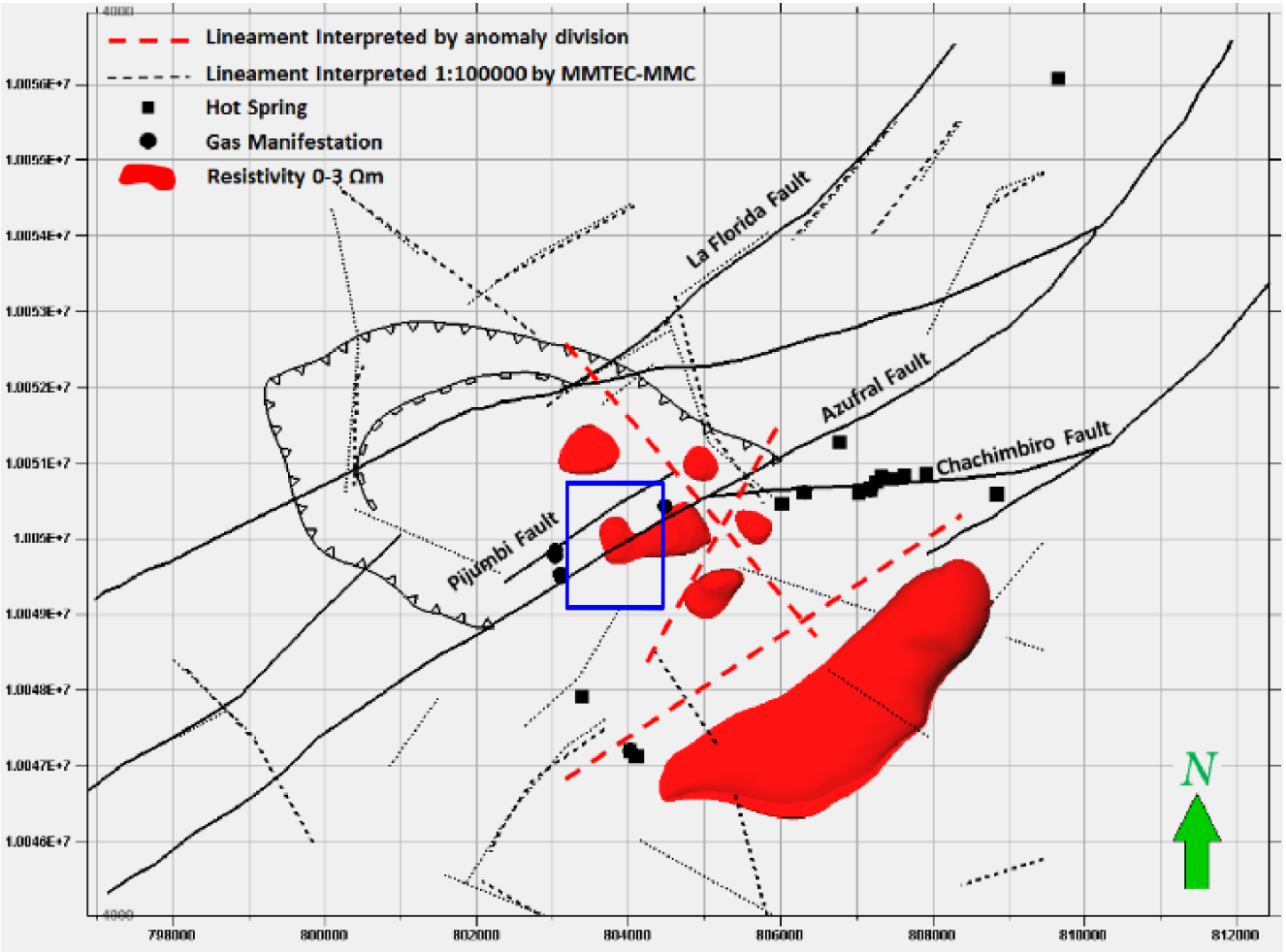

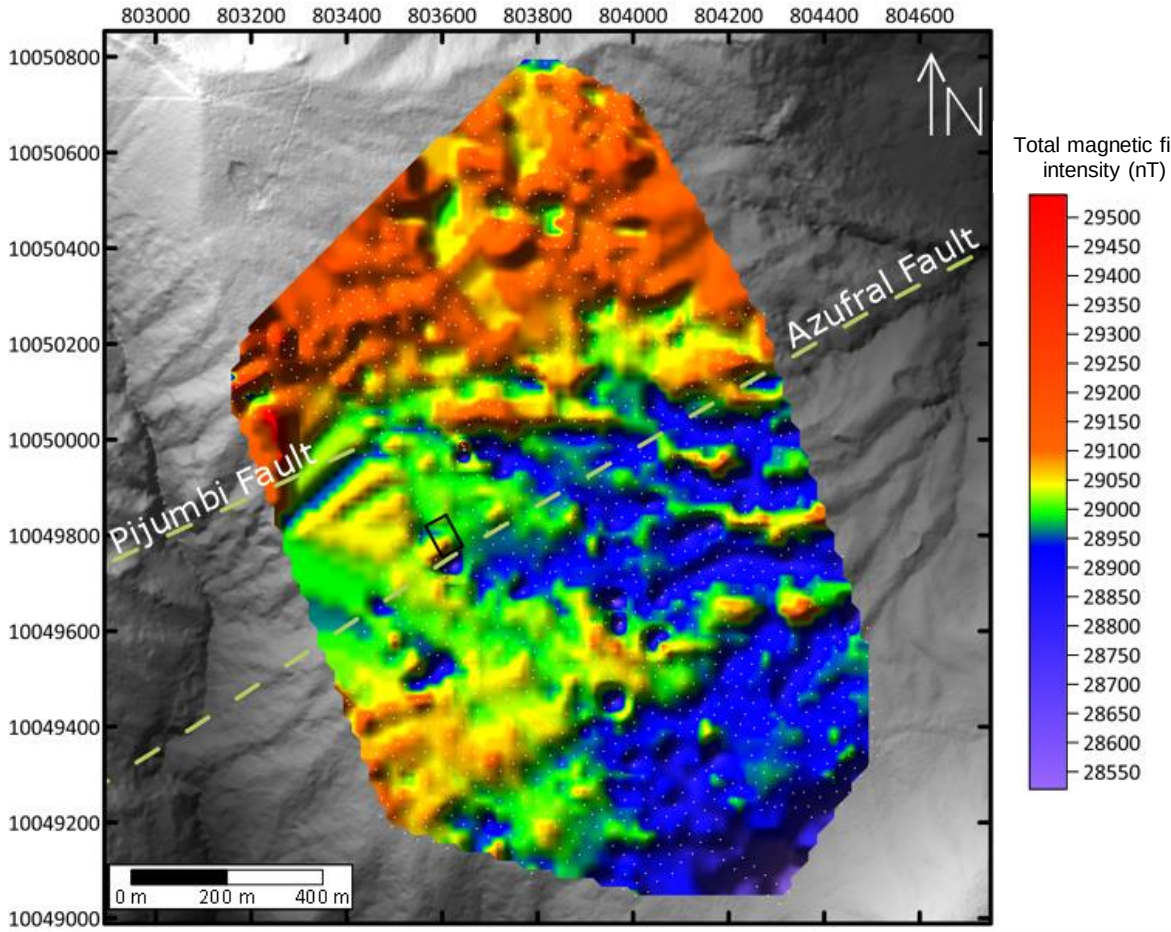

Pilicita, (2016).

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CONCLUSIONS

The study shows that the magnetic method is useful in geothermal prospection in Ecuador dominated by andesitic/dacitic rocks.

- Faults where the magnetization surrounding them has been altered to a less magnetic form show up in both high resolution and 30 m grid surveys, suggesting that the fault zone is fairly wide ~5m and close to the surface.
- It is always necessary to compare the magnetic results with topography and geological map in order to be able to interpret the results with higher confidence.
- The large low magnetic anomaly corresponds with the location of the clay cap when compared with the previous model of the geothermal system.

THANK YOU

Questions, suggestions and comments are welcome!

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