



Geophysical Analysis of The Three Sisters Outcrop in El Paso, TX



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Objective

In order to gain an understanding of the underlying rock composition of the Three Sisters outcrop located west of the Franklin Mountains in El Paso, Texas, magnetic surveys were conducted. During the process of data interpretation, the magnetic readings across a portion of the hills that were previously mapped as andesite were not consistent with expectations, which led to the incorporation of other geophysical and geological studies into this research project.

Hypotheses

What is causing the observed changes in the magnetic field?

1. There may be mineralogic changes within the andesite
2. The andesite intrusion could have variations in thickness
3. There could be a completely different rock unit incorrectly mapped as andesite

Background

- The Three Sisters outcrop originated from the same magmatic body as the other intrusive bodies found within the El Paso, Texas and Juarez, Mexico area
- Eocene aged magma intruded Cretaceous aged strata during a time of compressional, mountain-building events

- Never formed volcanoes
- Magma cooled below the crust
- Erosional forces exposed pluton
- Three Sisters outcrop: stage 5

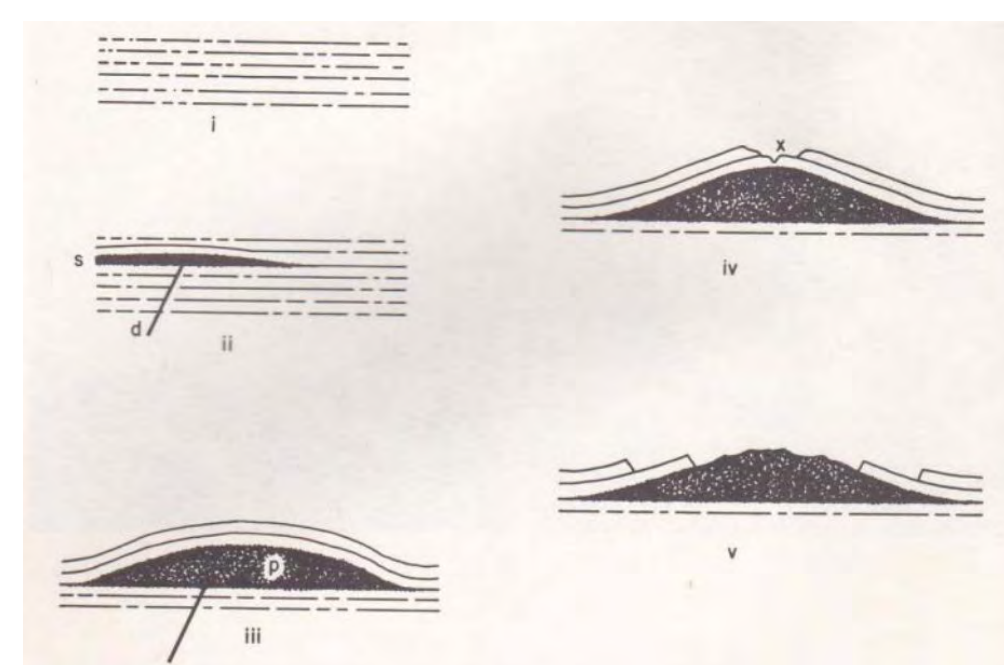


Figure 1. Process of origination of magmatic bodies, from West Texas Regional overview, pg. 5

Location of Study



Figure 2 Location of El Paso within Texas



Figure 3.1 and 3.2 Labeling the Location of the the Three Sister Hills within El Paso, TX



Methods

- **Previous work**
 - 3 magnetic survey lines (1-3) collected summer 2017
 - 1 magnetic survey line (8) collected fall 2017
- **Overview**
 - 2 field days for the 2018 data collection (lines 4-7)
 - 100 meter lines, with readings taken at 1 meter intervals
 - The location of the magnetic base station remained constant so as to accurately account for magnetic drift
 - 2017 data has been adjusted to the base station recordings of 2018

- **Proton Precession Magnetometer:** magnetic field strength
- **Conductivity:** measures electromagnetic fields
- **EM-31**



- **Magnetic Susceptibility:** ability to be magnetic
- 5 meter intervals
- **Mineralogic Analyses of Andesite:** thin sections

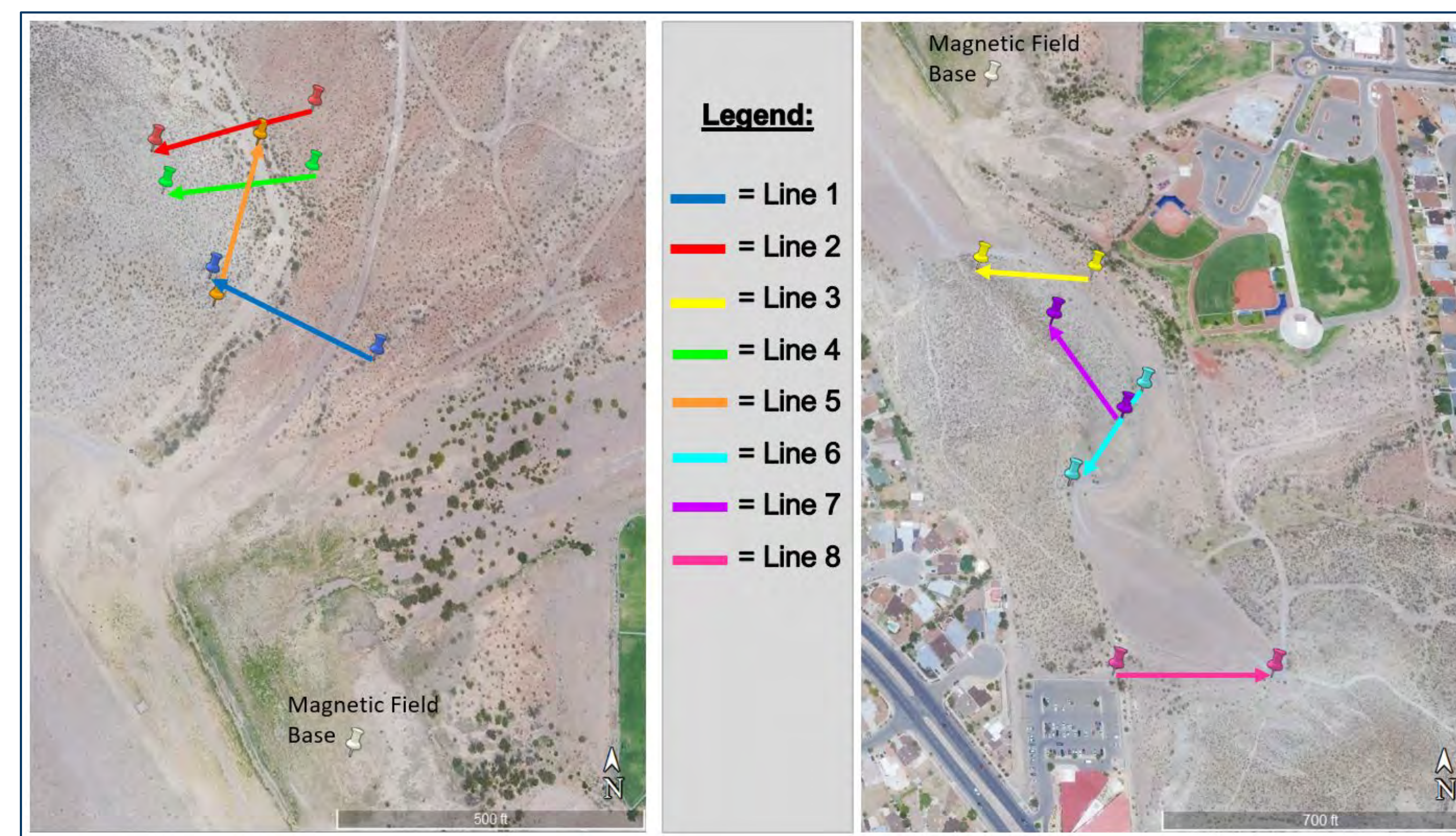
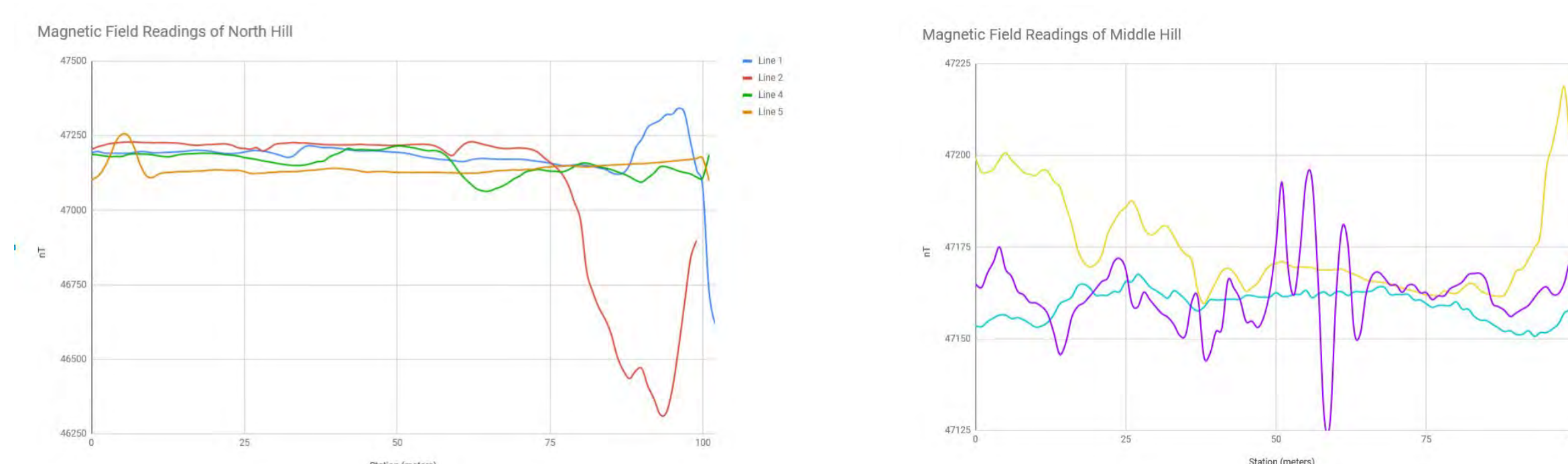


Figure 4.1. Map of lines conducted on the North Hill

Figure 4.2. Map of the lines conducted on the Middle and South Hill

Results



Results

Sample 1	Sample 2	Sample 3	Sample 4
2.67% magnetite	2.33% magnetite	1.17% magnetite	3.17% magnetite
North Hill Susceptibility: 91 CGS units	North Hill Susceptibility: 91 CGS units	South Hill Susceptibility: 27 CGS units	Middle Hill Susceptibility: 17 CGS units

Images captured at 4x power in plain polarized light, and are 3mm across.

Discussion

- The maximums of lines 1 and 5 are of the same andesite drift that was visible on the surface and previously referred to as an outcrop
- The minimum of line 2 is a very thick shale bed (interbedded with limestone) with no indication of andesite underneath
- The increasing magnetic field strength up the North Hill was a pattern also observed in a study conducted in 1970

Conclusions

- The North Hill intrusion is smaller than previously mapped
- The magnetic highs indicating andesite were influenced by large pieces of drift: no andesite outcrops were detected

Future Work

To better refine these conclusions, more lines, and longer lines, could be tested with the Proton Precession Magnetometer, particularly farther up towards the tops of the hills where andesite is more likely to be detected so that the actual size of the intrusion can be determined. In addition, more extensive mineralogic analyses could be explored.

Works Cited

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- West Texas Regional Overview

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