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# GROUND MAGNETIC SURVEY

over

the

## ALUM PROSPECT

ESMERALDA COUNTY, NV

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for

## SIERRA GEOTHERMAL POWER CORP.

## SEPTEMBER 2009

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**SUBMITTED BY**

**Magee Geophysical Services LLC**

465 Leventina Canyon Rd  
Reno, Nevada 89523 USA

TEL 775-742-8037  
FAX 775-345-1715

Email: [chris\\_magee@gravityandmag.co](mailto:chris_magee@gravityandmag.co)  
Website: [www.gravityandmag.com](http://www.gravityandmag.com)



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## INTRODUCTION

A ground magnetic survey was conducted over the Alum Prospect in Esmeralda County, Nevada for Sierra Geothermal Power Corp. during the period of September 18 to September 23, 2009. A total of 325 line kilometers of magnetic data were acquired using Geometrics Model G-858 magnetometers. Real-time differentially-corrected GPS was used for positioning.

Measurements of the total magnetic intensity were taken in the continuous mode at two-second intervals along east-west lines spaced 400 meters apart with 200 meter infill lines through the middle of the survey area. A base magnetometer was operated during all periods of data acquisition and recorded readings every two seconds. The field operations were based out of Tonopah, Nevada.

All raw and processed data are included on a CD that will be delivered separately.

## DATA ACQUISITION

### Survey Personnel

Brian Page, Chris Michalowski, and Sean Watters acquired the ground magnetic data and operated the GPS for navigation and positioning. Christopher Magee supervised survey operations, performed quality-control analysis and processed all of the magnetic data.

### Roving Magnetometer

Geometrics G-858 Cesium Vapor magnetometers were used on this project. The magnetometer sensors were mounted on aluminum poles attached to backpacks with a sensor height of about 2.9 meters above ground level. The relatively high sensor height was necessary to maximize the distance between the sensor and the GPS antenna and minimize the heading errors caused by the presence of the GPS antenna. The heading error with this system is on the order of one nT. The magnetometer was set up to record the total intensity of the magnetic field every two seconds resulting in an average sample spacing of two to three meters or less.

### Base Magnetometer

A Geometrics Model G-858 magnetometer was also used as a base magnetometer to record diurnal changes in the Earth's magnetic field. The base magnetometer was set up in an area where the gradient of the magnetic field is low as determined by a quick site survey that was performed. The base magnetometer sensor was secured to a 6-foot staff and the unit was set up to automatically record a total field measurement every 2 seconds.

The NAD27 UTM Zone 11 North coordinates (in meters) of the base magnetometer location are 436731.60m E and 4194275.94m N with a NAVD88 elevation of 1523.74m. An International Geomagnetic Reference Field (IGRF) 2005 value of 50230 nT was assigned to the base magnetometer location by occupying the Alum base location with a roving magnetometer while continuing to operating the base at Silver Peak, thus establishing a relative value for the Alum base. The base magnetometer was operated at all times that magnetic data were being acquired with the roving magnetometer.

## GPS Positioning

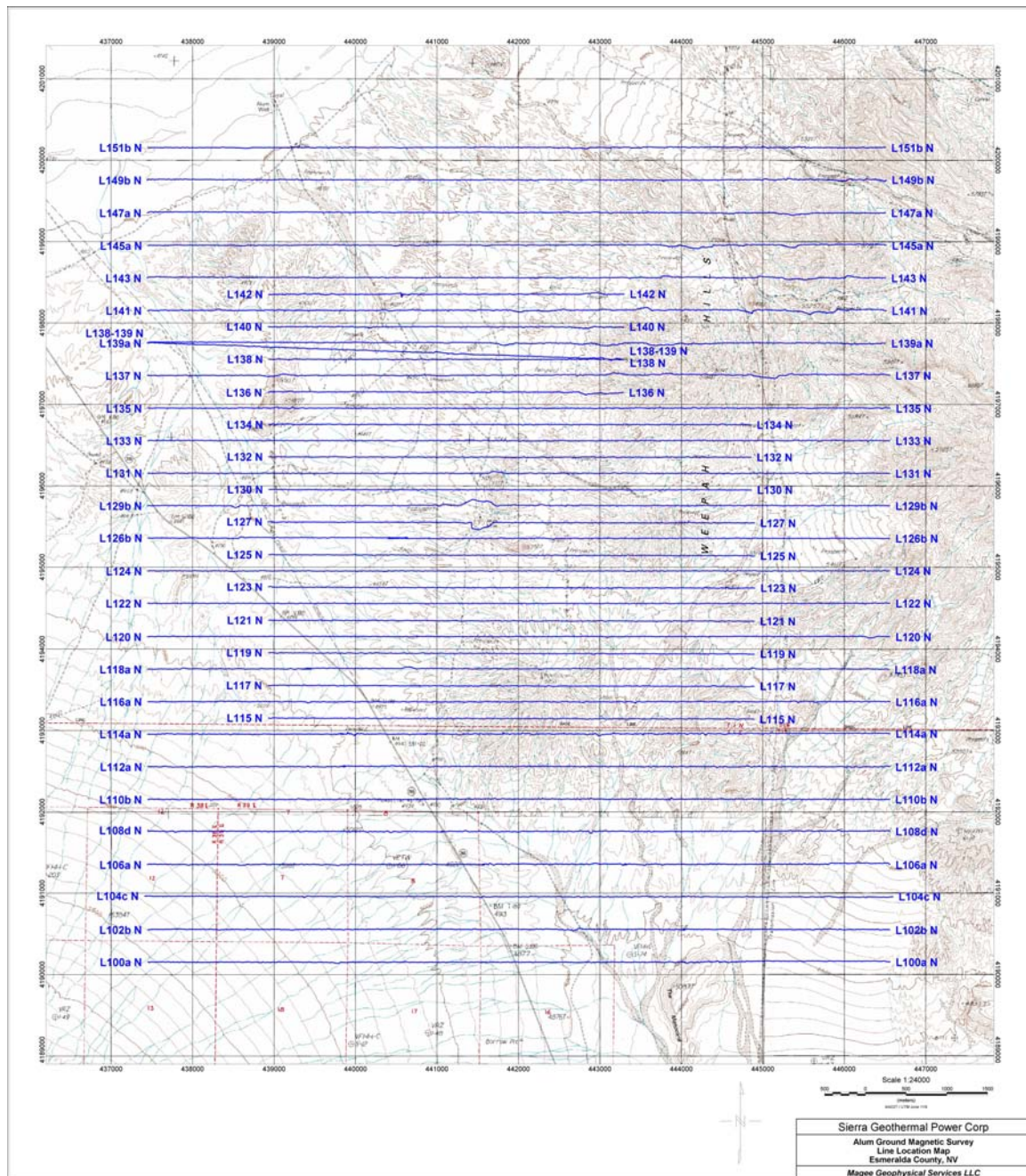
Trimble Model GeoExplorer XT GPS receivers were used to provide navigation and positioning. The receivers were configured to receive differential corrections in real-time from WAAS (Wide Area Augmentation System) geo-stationary satellites. This system is operated by the United States Government Federal Aviation Administration. The resulting positions usually have an accuracy of about two meters. The GPS receiver was set up to output a NMEA string of positional data to be recorded on the magnetometer along with the magnetic readings. The NMEA string format that was used is the GGA format described below:

<u>Field</u>	<u>Meaning</u>
1	UTC of position fix
2	Latitude
3	Direction of Latitude (N or S)
4	Longitude
5	Direction of Longitude (E or W)
6	GPS Quality Indicator: 0: Fix not available or invalid 1: GPS fix 2: Differential GPS fix 4: RTK (fixed) 5: RTK (float)
7	Number of Satellites in fix
8	HDOP
9	Orthometric Height
10	Units of orthometric height
11	Geoid Separation
12	Units of geoid separation
13	Age of differential correction
14	Reference Station ID

The positions of the magnetic readings were recorded on the G-858 magnetometer in WGS-84 latitude and longitude.

## Magnetic Profile Lines

A total of 325 line kilometers were surveyed along 40 east-west profiles. Lines varied in length from 4.3 km to 9.1 km. A line location map is shown on the following page. The survey required 18 man-days to setup and complete with three operators surveying at a time.



**Alum Ground Magnetic Survey  
Line Location Map**

## DATA PROCESSING

### Overview

After downloading the magnetic data from the magnetometers onto a notebook PC, diurnal corrections were applied (by assigning the appropriate value (in nT) to the base magnetometer location) using the Geometrics software package, *MagMap2000*. Geosoft compatible XYZ files were then generated with WGS-84 geographic coordinates for each magnetic measurement. After importing the XYZ files into a Geosoft Oasis

montaj database, NAD27 UTM coordinates were generated, profiles were prepared, and additional editing was performed as necessary. The editing mostly consists of deleting readings affected by cultural noise and deleting dropouts which are large-amplitude negative spikes that occur when the magnetometer sensor is tilted too far from a vertical orientation.

## Mapping and Gridding

The Alum Total Magnetic Field data were gridded, mapped, and contoured to insure high quality data were collected. Contoured color images of the diurnally-corrected Total Magnetic Intensity (TMI) are shown in Appendix A. Other images include TMI with IGRF removed, TMI Reduced to Pole (RTP), and the First Vertical Derivative of TMI-RTP.

## DATA FILES

### Raw Data Files

All of the raw data files for the project are included with the delivered data. Field and base magnetometer files are in binary format with the filename extension *.bin*. The *.bin* files are unedited. XYZ files are output from MAGMAP 2000 and contain the raw measurements, diurnal corrections, and WGS-84 latitude and longitude. Files are named with the date and operator.

### Geosoft Database File and Final XYZ File

The Geosoft database file with the all of the processed and edited ground magnetic data included on the CD is named [Alum\\_Mag2.gdb](#). The Geosoft database file was exported as an XYZ file and is named [\\_Alum\\_Ground\\_Magnetic\\_Data\\_Nov\\_23\\_2009.XYZ](#).

### Map and Grid Files

The file names for the Geosoft grid files used to create the maps in this report are as follows and are included with the delivered data. Each map has been exported as a registered Geotiff and has been converted to a PDF. Each grid file has been saved as a Geosoft database and exported as an XYZ file.

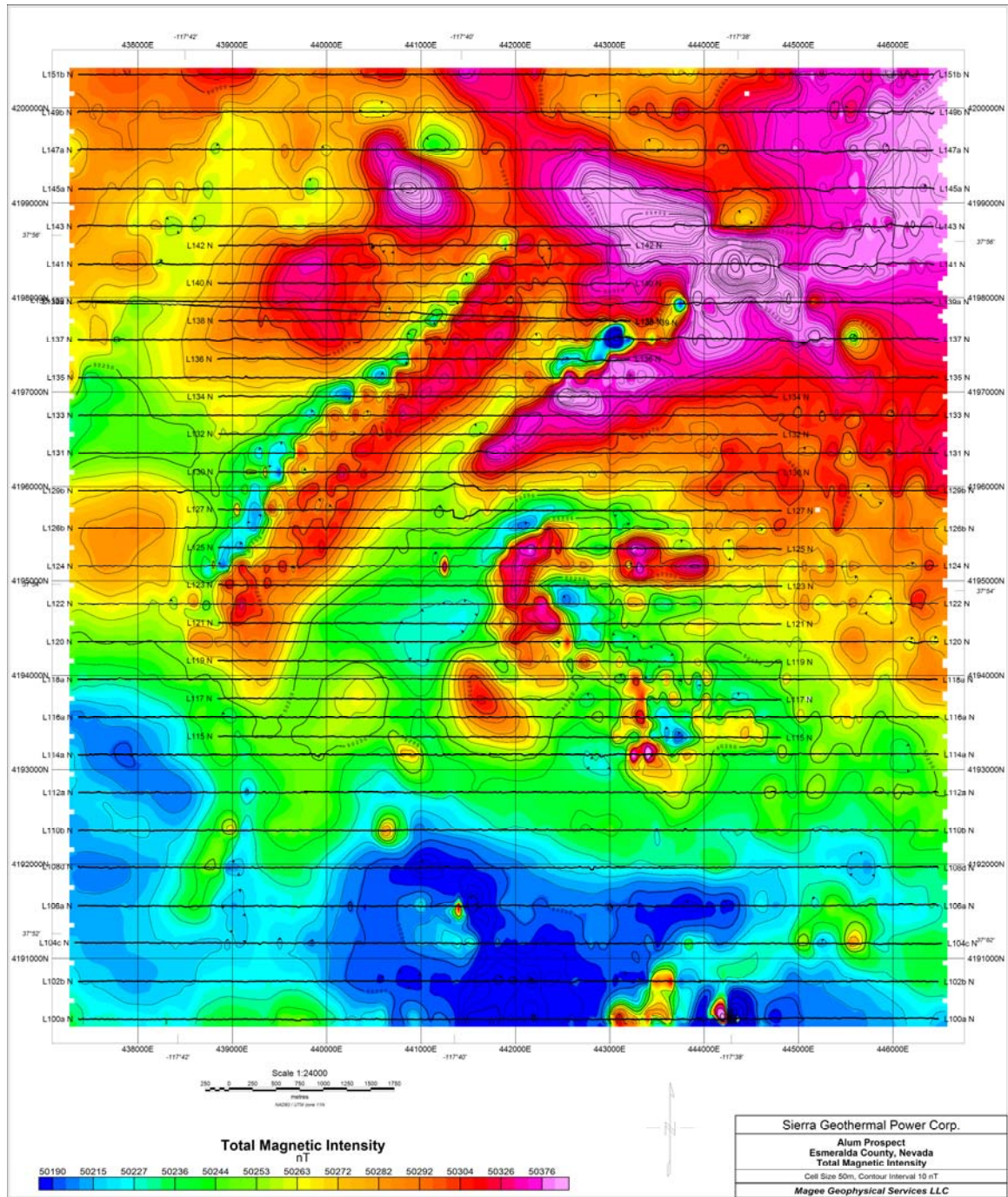
Total Magnetic Intensity (TMI)	<a href="#">tmi_alum.grd</a>
Calculated IGRF Values	<a href="#">igrf_alum.grd</a>
TMI with IGRF Removed	<a href="#">igrf_removed_alum.grd</a>
TMI with IGRF Removed Reduced to Pole (RTP)	<a href="#">igrf_removed_alum_rtp.grd</a>
First Vertical Derivative of TMI-RTP	<a href="#">igrf_removed_alum_rtp_VD_SM.grd</a>

Submitted by:

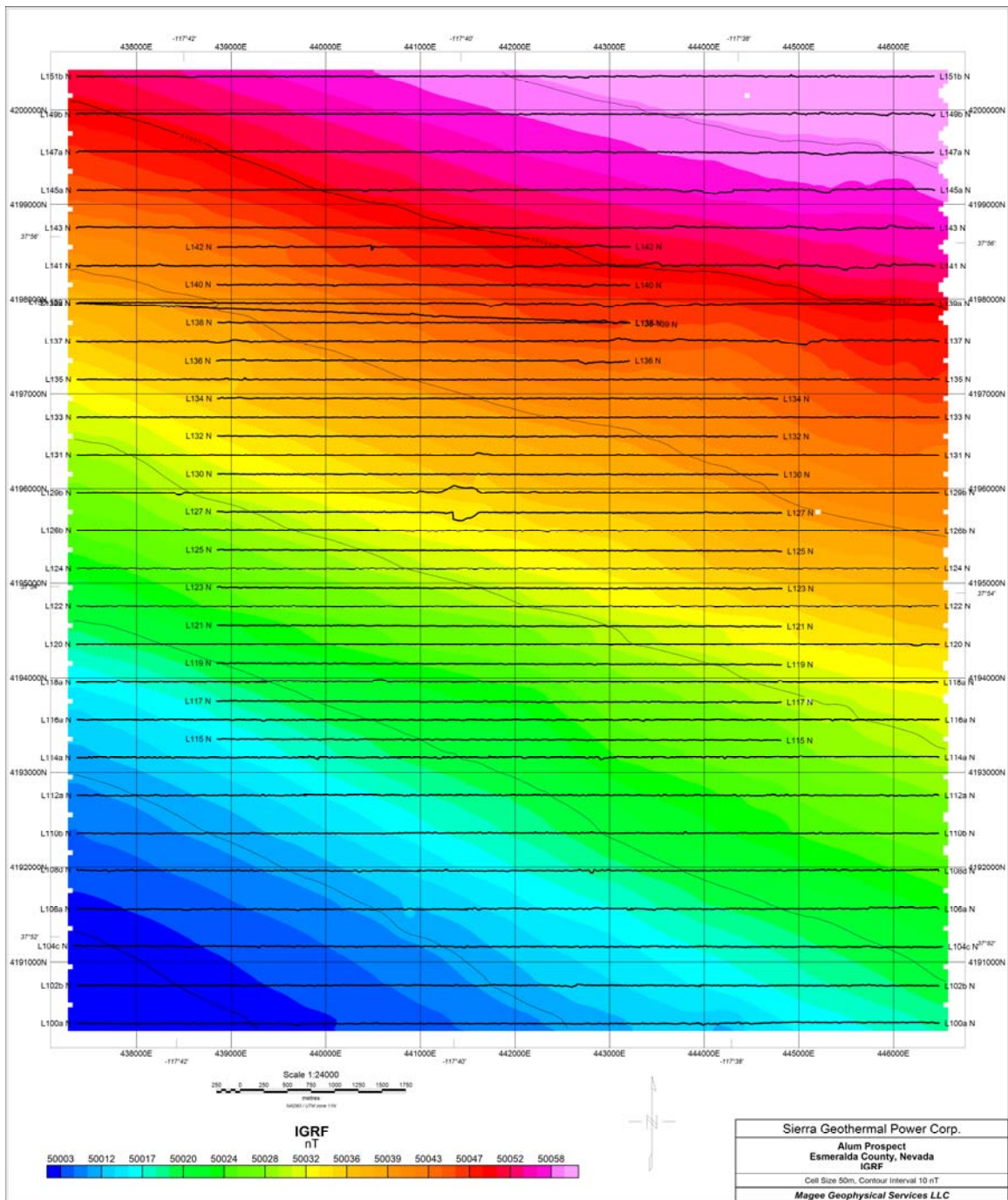
Christopher Magee  
Consulting Geophysicist



# APPENDIX A      MAPS

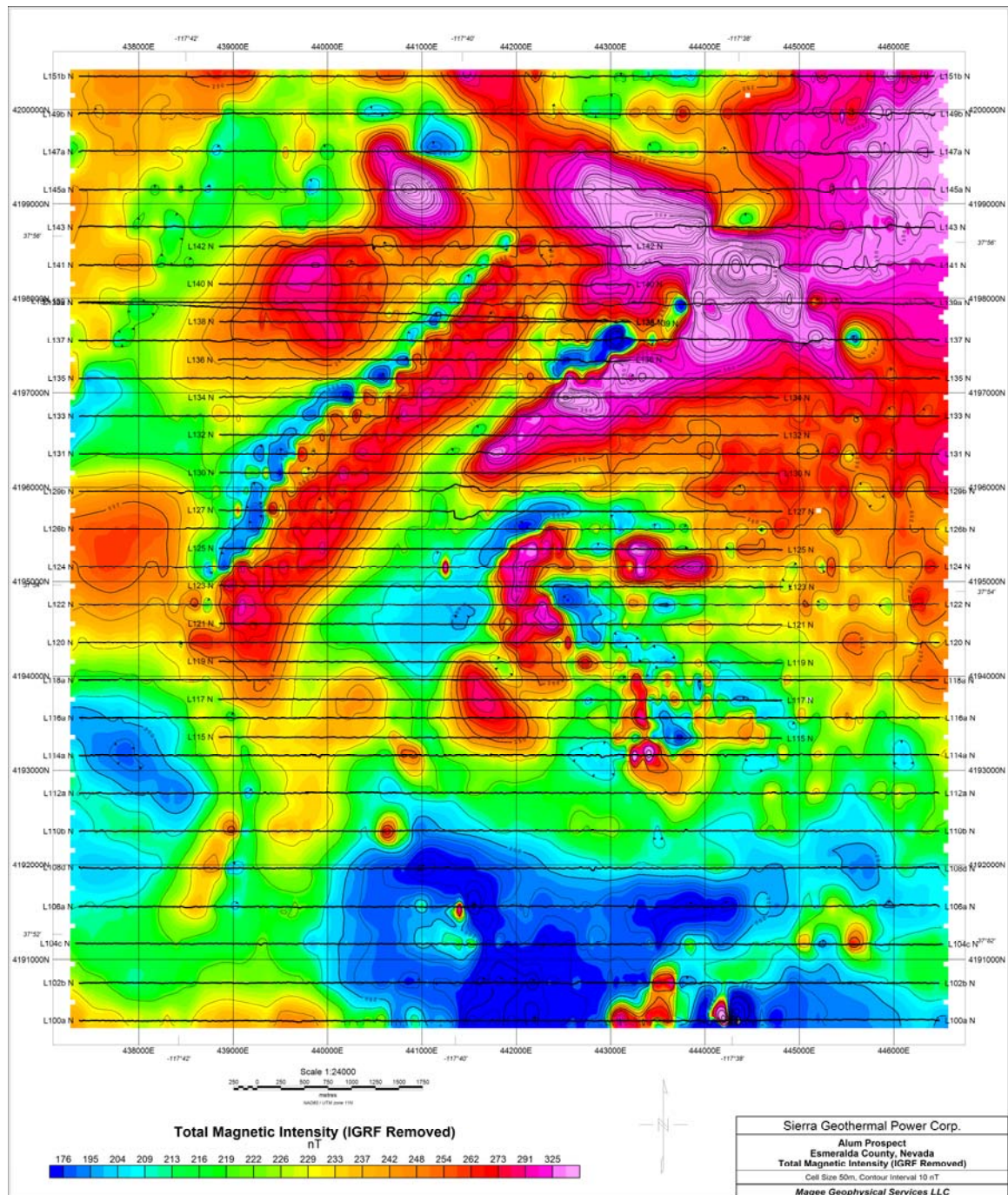


**Alum Ground Magnetic Survey  
Total Magnetic Intensity**



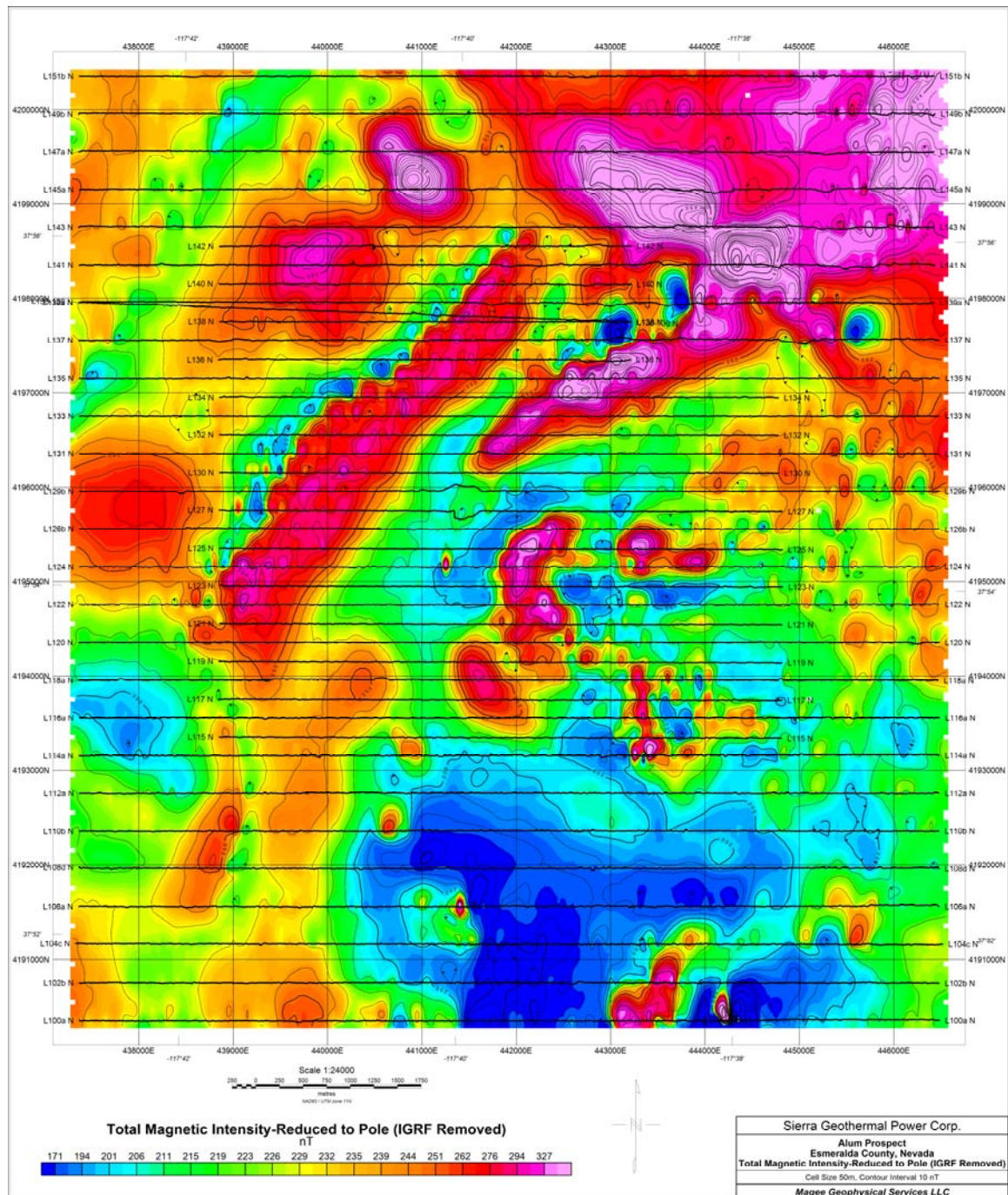
**Alum Ground Magnetic Survey**  
**IGRF**





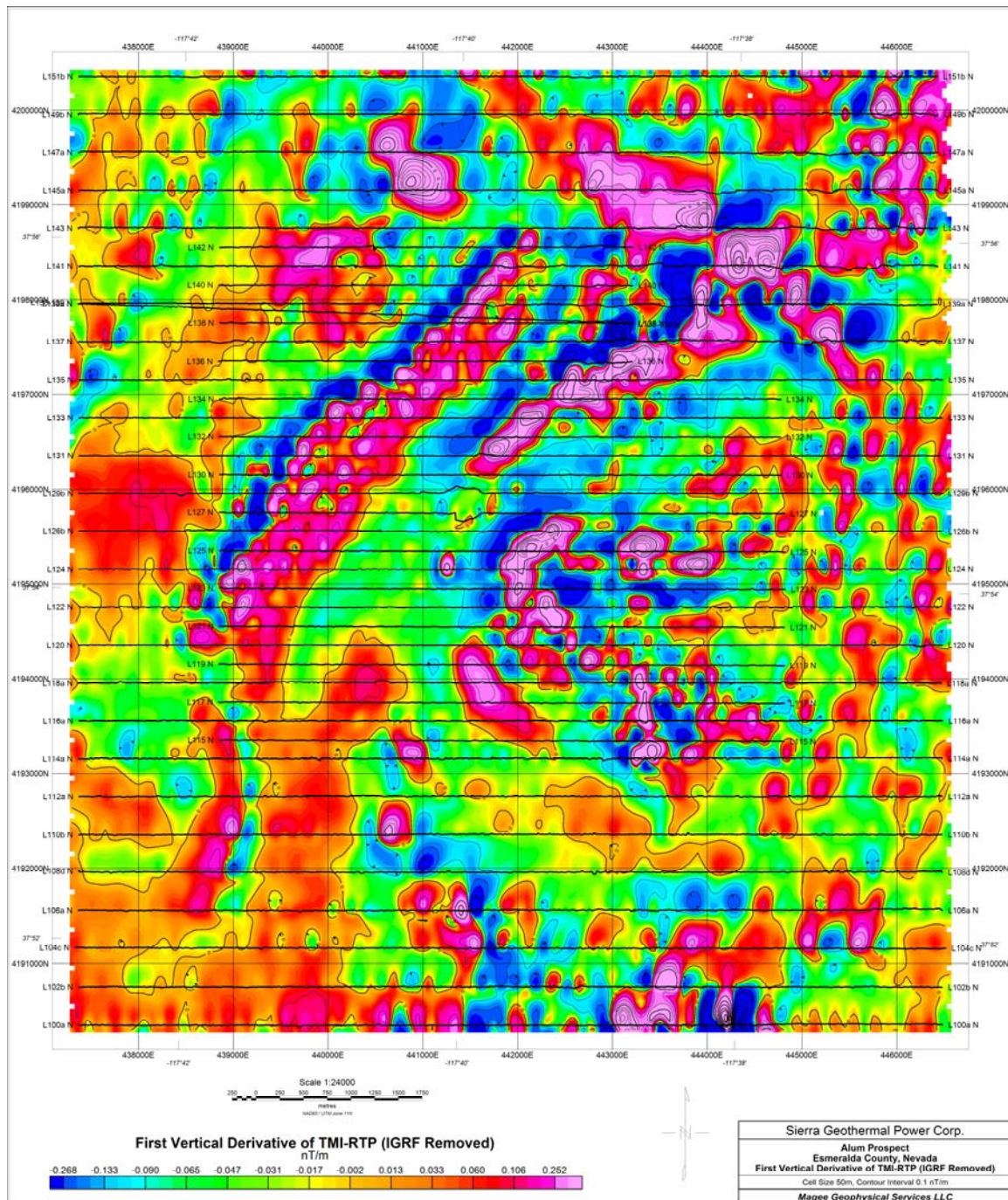
**Alum Ground Magnetic Survey**  
**Total Magnetic Intensity (IGRF Removed)**





**Alum Ground Magnetic Survey**  
**Total Magnetic Intensity – Reduced to Pole (IGRF Removed)**





**Alum Ground Magnetic Survey**  
**First Vertical Derivative of Total Magnetic Intensity – Reduced to Pole (IGRF Removed)**