Relationship of faults in basin sediments to the gravity and magnetic expression of their underlying fault systems

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Open-File Report 01-502

2001

U. S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

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ACKNOWLEDGEMENTS

I would like to thank several people who have helped me in the past three years financially, intellectually and spiritually. My family and friends, thank you for getting me to this point, I could not have done it without you. Mary Poulton and Karl Glass, who served on my thesis committee, thank you for the challenges that come with higher education, your knowledge and support has motivated and elevated me to goals I thought once impossible. Thank you to the USGS and WAIME for funding me through my period here at the University. Special thanks goes to my mentor and thesis advisor, Mark Gettings, your endless patience, kindness and knowledge will remain with me forever. Thank you.

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ABSTRACT

Gravity and magnetic surveys were performed along the western flanks of the Santa Rita Mountain range located in southeastern Arizona to develop an understanding of the relationship between surface fault scarps within the basin fill sediments and their geophysical response of the faults at depth within the bedrock. Data were acquired for three profiles, one of them along the northern terrace of Montosa Canyon, and the other two along the northern and southern terraces of Cottonwood Canyon. A total of 122 gravity stations were established as well as numerous magnetic data collected by a truck-mounted cesium-vapor magnetometer. In addition, aeromagnetic data previously acquired were interpreted to obtain a geologically sound model, which produced a good fit to the data.

Gravity anomalies associated with faults exhibiting surface rupture were more pronounced than the respective magnetic anomalies. More credence was given to the gravity data when determining fault structures and it was found in all three profiles that faults at depth projected through alluvium at a steeper dip than the bedrock fault indicating brittle behavior within the overlying sediments. The gravity data also detected a significant horst and graben structure within Cottonwood Canyon. The aeromagnetic data did not provide any insight into the response of the minor faults but rather served to verify the regional response of the whole profile.

INTRODUCTION

The objective of this project was to gain a better understanding of the relationship between the gravitational and magnetic expressions of faults at depth in bedrock and the geometry and character of their fault scarps through methods of forward geophysical modeling. Existing aeromagnetic data were also modeled to help understand the subsurface geology. Previous gravity work done by U.S. Geological Survey (M.E. Gettings, unpublished), Mary Hegmann (1998) and Khalid Tanbal (1987) combined with the data acquired for this project were used to create gravity contour maps of the areas of study. Tanbal (1987) conducted gravity surveys to identify the position and displacement of Quaternary faults located north of the present study area.

The survey was conducted in Santa Cruz County, Arizona, along the west flank of the Santa Rita Mountains near Elephant Head. The Santa Rita Mountains are located about 55 km south of Tucson and trend NW - SE. They begin near Pantano Wash and extend southward to Sonoita Creek, which is 19 km north of the Mexico border. Fig. 1 shows the location of the field area. Figs. 2 and 3 are aerial photographs of the Rex Ranch and Cottonwood Canyon areas showing the surface fault scarps and profile lines.

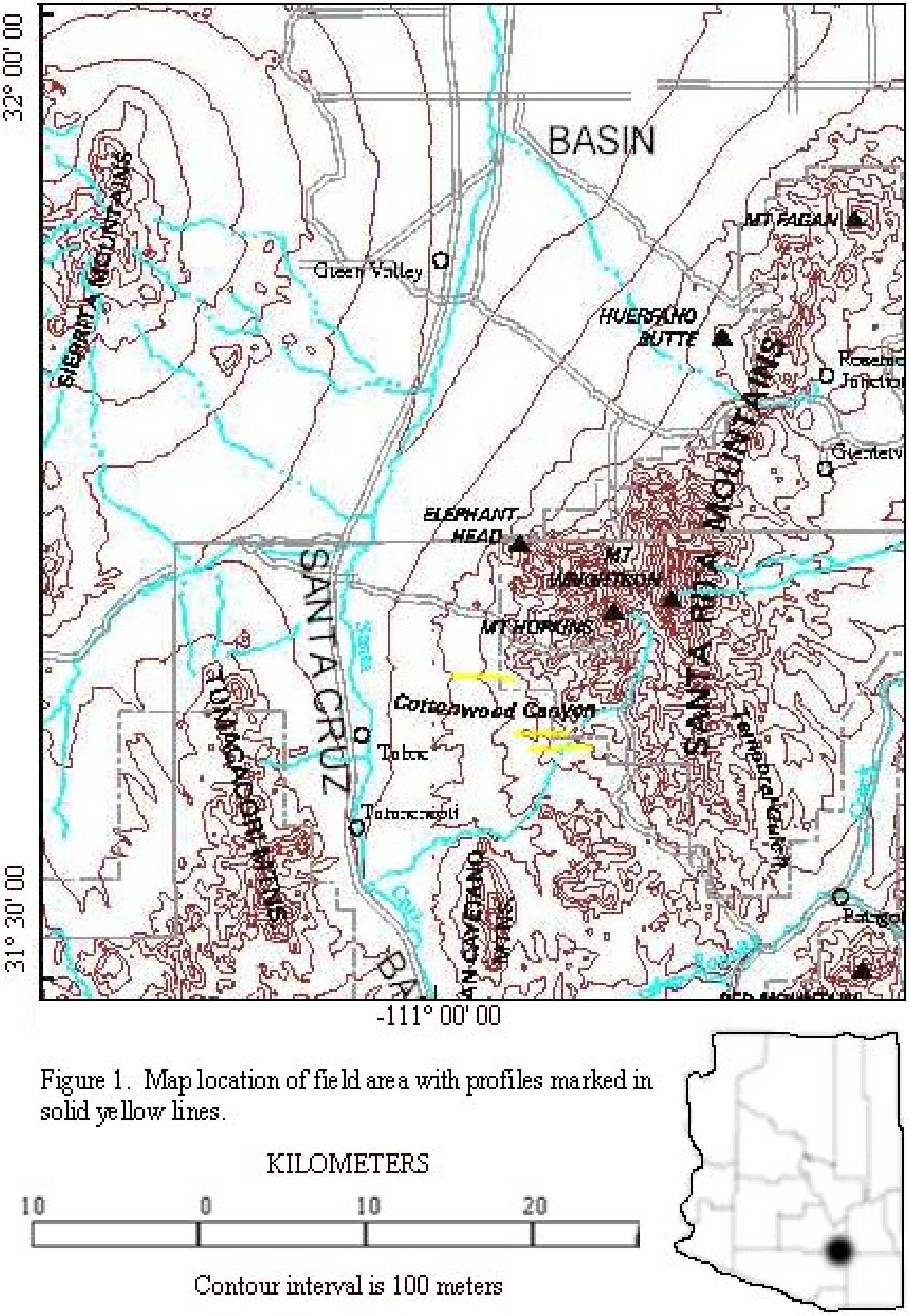


Figure 1. Map location of field area with profiles marked in solid yellow lines.

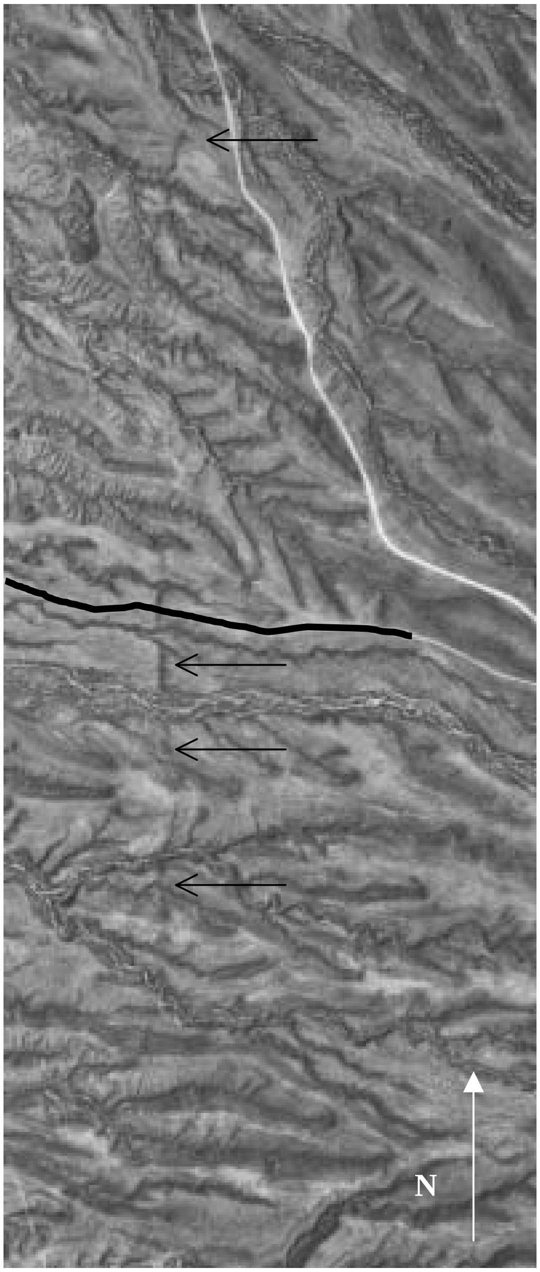


Figure 2. Aerial photograph of Rex Ranch fault as indicated by arrows. Solid lines indicate the gravity and magnetic profiles.

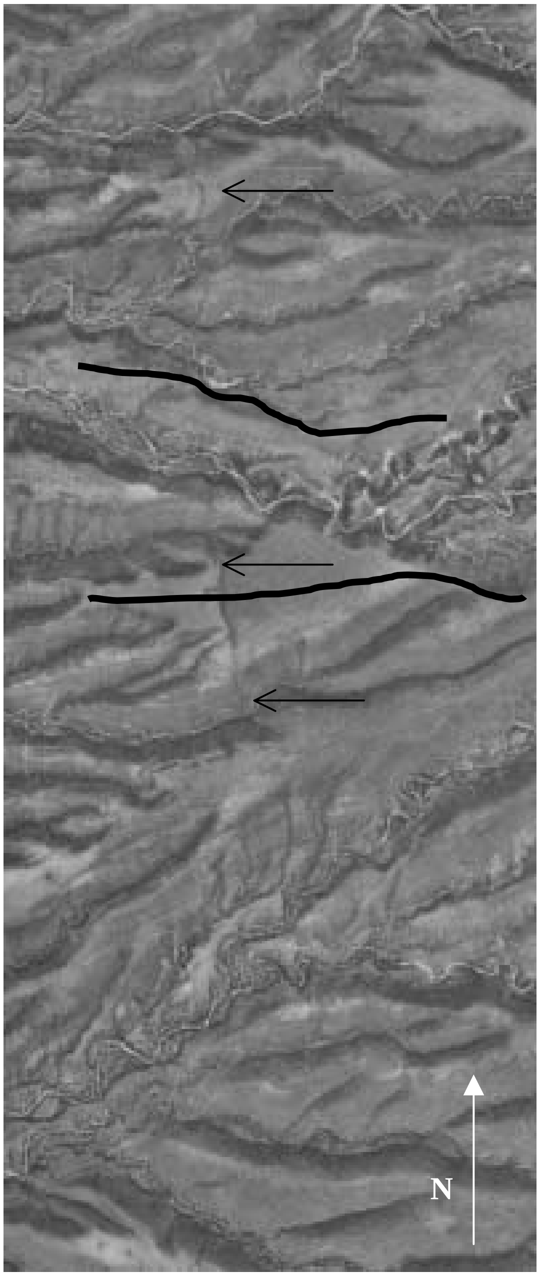
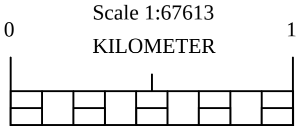


Figure 3. Aerial photograph of Cottonwood Canyon as indicated by arrows. Solid lines indicate the gravity and magnetic profiles.



GEOLOGICAL SETTING

The project area lies in the Southern Basin and Range Province on the western flank of the Santa Rita Mountains (see Fig. 1). The Santa Ritas have been extensively studied because of their unusually complete stratigraphic and structural record. An extensive sequence of sedimentary, intrusive, extrusive and metamorphic rocks ranging from Precambrian to Holocene in age compose the Santa Rita Mountain Range. The majority of basement rock, known as the Continental Granodiorite is a coarse-grained porphyritic granodiorite and quartz monzonite (Drewes, 1976). It has been radiometrically dated to be at least 1.45 b.y. old. The Continental Granodiorite of the Santa Rita Mountain range has been intruded by stocks of Triassic monzonites, Jurassic granitic stocks, and a host of Tertiary Volcanics (Drewes, 1976).

The Precambrian rocks are overlain by a section of shallow marine rocks deposited during the Paleozoic. This section is dominated by limestone and dolomite with clastic rocks present at the top and bottom of the section representing a history of marine transgressions and regressions, until the Middle of the Permian Period when the area was uplifted and exposed to continental conditions (Drewes, 1976).

Throughout the Mesozoic Era southeastern Arizona was part of a continental margin volcanic arc along the North American Cordillera from Mexico to Alaska (Coney, 1987). Three major sequences of volcanic rocks were deposited over Precambrian and Paleozoic rocks. During the Triassic, rhyodacite and andesite as well as some eolian sandstone and conglomerates were deposited as two different formations, the Mt. Wrightson Formation overlain by the Gardner Canyon Formation. Between mid-

Permian and mid-Triassic significant uplift associated with the Sonoran Orogeny occurred in the present area of the Santa Rita Mountain Range. Subsequent erosion stripped away nearly 1.5 km of Paleozoic rocks and exposed the Precambrian rocks to further erosion and deposition as detritus into the Mt. Wrightson Formation. Evidence for block faulting is coupled with the fact that the linear distribution of Triassic volcanics was the result of deposition in the block-faulted troughs (Drewes, 1971). Near the end of the Triassic Period the Piper Gulch Monzonite intruded through the Santa Rita fault scar. Of significant importance is the Squaw Gulch Granite that intruded through Precambrian, Paleozoic and Triassic rocks sometime during the Jurassic Period. The volcanic rocks intruded by this granitic batholith are contact metamorphosed. Near to the project area, the Squaw Gulch granite intruded and actually recrystallized the Continental Granodiorite. The contact between the two formations is concealed and postulated to be sharp and irregular. In exposures closer to Cottonwood Canyon, the contact of the Squaw granite with Paleozoic rocks is sharp and dips irregularly. The host rock forms either xenoliths or roof pendants within the batholith, rather than acting as wallrock to the batholith. Faulting and subsequent erosion occurred after the emplacement of the granite batholith. During Early Cretaceous time the Temporal Formation, Bathtub Formation and Bisbee Group consisting of rhyolitic and andesitic volcanic material, as well as arkosic rocks and conglomerates were deposited. In the latest of the three volcanic sequences are of Late Cretaceous age and consist of arkose and conglomerate overlain by dacitic and rhyodacitic volcanic rocks. The volcanic rocks deposited during the

Mesozoic have been well preserved and only slightly metamorphosed, however, due to repeated deformation they have been fragmented through faulting.

The rocks that compose the present day Santa Rita Mountains have a long history of deformation. During the Precambrian and Paleozoic Eras there was mostly epierogenic activity with little orogenic activity. During the Mesozoic and Cenozoic Eras, however, tectonism increased in both strength and frequency. The Laramide Orogeny, left a pronounced effect lasting from the Late Cretaceous through the Early Tertiary, 90 to 52 mya.

There were two phases of deformation during the Laramide Orogeny separated by a period of tectonic quiescence. The first phase, called the Piman Phase, lasted from 90 to 63 mya, and the second phase, known as the Helvetian Phase, lasted from 57 to 52 mya. The Piman Phase was defined by basement-cored block uplift (Drewes, 1972). The direction of compression was along an axis oriented northeast - southwest. Northeasterly thrust faulting and associated tear faulting was also prevalent during this phase. A transition from volcanism to plutonic emplacement marked the end of the Piman Phase.

A period of quiescence during the Middle of the Laramide lasted from 63 to 57 mya (Drewes, 1972). The direction of compression slowly changed and probably created a tensional environment. The existence of intrusive rocks such as the Cottonwood Dike Swarm provides evidence for the existence of extensional conditions. Also, nearby volcanism deposited the Gringo Gulch and Red Mountain volcanics.

The Helvetian Phase of the Laramide Orogeny began in the Late Paleocene and is associated with less severe tectonics relative to the earlier phase. Compressional forces re-oriented about 90 degrees from the Piman Phase. Minor northwest thrust faulting was activated as well as reactivation of earlier faults systems, however, in a fashion much different from the original. Stocks appropriately named the Helvetian Stocks were emplaced. Intrusion of quartz latite porphyries marked the close of the Helvetian Phase of the Laramide Orogeny.

Post-Laramide deformation is characterized by normal faulting and drag folding resulting from tensional stresses or possibly the relaxation of compressional forces (Drewes, 1972). Faulting was relatively shallow, although some older faults were reactivated. The primary orientation of faults was northeast to east. From the Paleocene to Oligocene, quartz veins were emplaced to the south and rhyolitic and andesitic volcanics were deposited to the north. Magmatic activity began again in the Late Oligocene with the deposition of the Grosvenor Hill volcanics, primarily rhyolitic in composition, and extruded as flows and tuffs. Feeder dikes and laccoliths commonly intruded the Grosvenor volcanics (Drewes, 1971b).

During the Miocene, about 17 mya, extensional forces dominated when the spreading ridge of the Pacific plate was subducted under the North American plate causing the movement of the two plates to become strike-slip as opposed to subduction (Coney, 1987). Block faulting began to reform the present day Santa Rita Mountains. Extension was directed along an east-northeast/west-southwest axis. Reactivation of older Mesozoic faults occurred but due to the different direction of compression a zigzag pattern of basin and ranges subsequently formed. Extensive deposits of gravel, sand and conglomerates called the Nogales Formation, filled the basins adjacent to the uplifted

Santa Ritas (Drewes, 1972). The Nogales comprised of volcanic detritus was indurated and then deformed by normal faulting, resulting in blocks dipping 10 – 25 degrees towards the mountains. From the Pliocene until present day several formations, separated by unconformities, have been deposited. The sediments are mainly derived from formations above in the Santa Rita Mountains.

Figure 4 shows the geology around the Cottonwood Canyon area, the Rex Ranch profile is to the northwest of the Cottonwood Canyon area, however, it is not shown in this figure. There are no bedrock exposures near the Rex Ranch profile and it is completely covered by Holocene gravel. Table 1 describes some of the exposed rocks especially those used in the modeling.

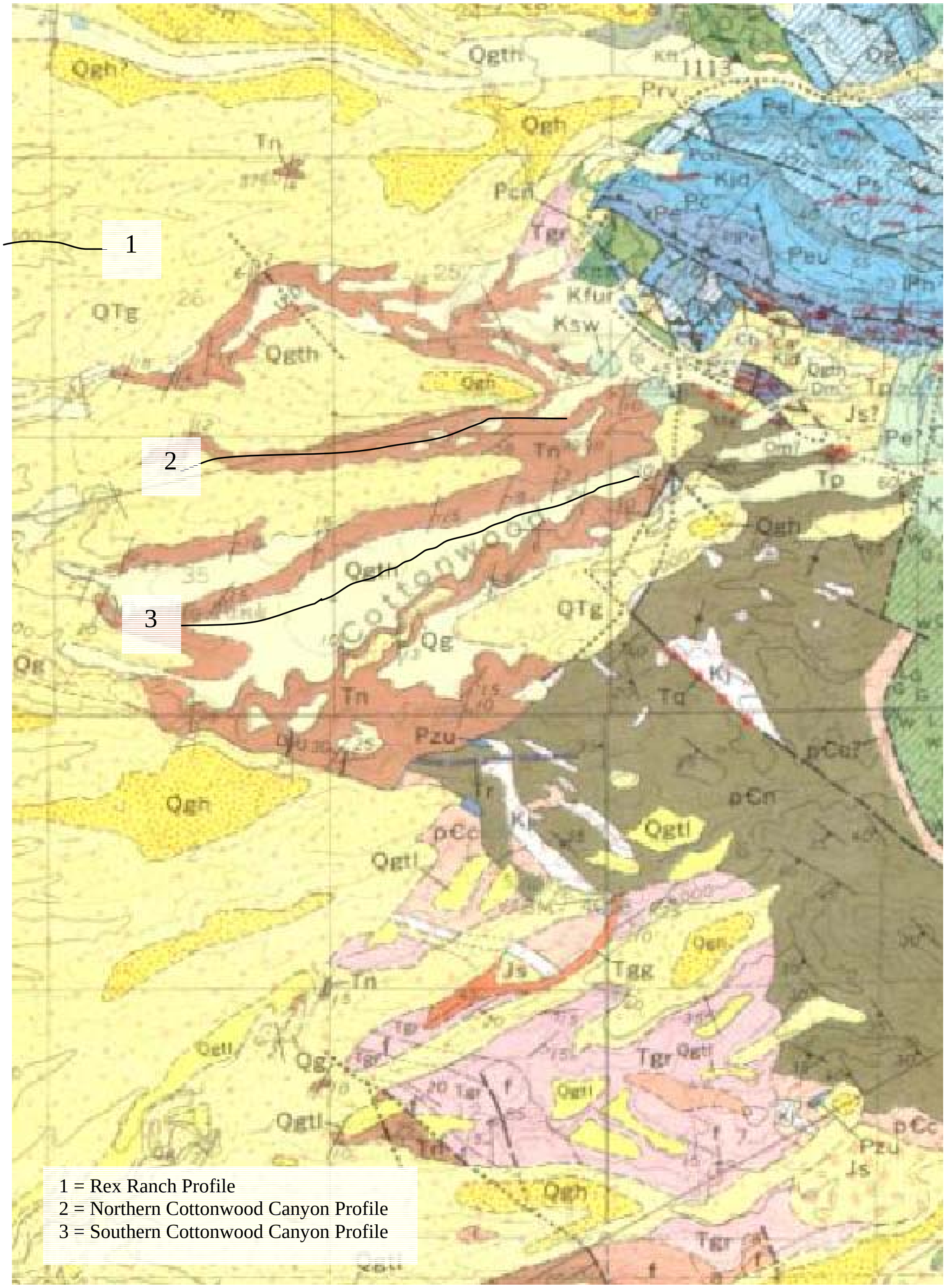


Figure 4. Geologic map of field area (Drewes, 1971a) with location of profiles.

Table 1: Description of modeled rock units (Drewes, 1971a)

Symbol	Unit Name	Geologic Age	Unit Description
Qg	Gravel	Holocene	Alluvium of streams draining the Santa Rita Mountains
Qgth	Terrace Gravel	Late Pleistocene	Alluvium capping higher terraces, carrying a well-developed soil
Qgh	Gravel	Early Pleistocene	Alluvium caps high surfaces
Tn	Gravel at Nogales	Miocene	Gravel, conglomerate, and sand comprised of abundant volcanic detritus
Tgr	Rhyolite Member	Oligocene	Largely undifferentiated tuff breccia (Grosvenor Hills Volcanics)
Kj	Josephine Canyon Diorite	Late Cretaceous	Moderately coarse-grained quartz diorite phase
Kse	Exotic Block Member	Late Cretaceous	Undifferentiated tuffaceous sandstone, conglomerate and tuff breccia
Js	Squaw Gulch Granite	Jurassic	Pink coarse grained granite and quartz monzonite, includes some lamprophyre dikes.
Ps	Scherre Formation	Permian	Fine-grained quartzitic sandstone and a medial dolomite unit
pCn	Gneiss	Precambrian	Hornblende gneiss and granite gneiss, possibly part of Pinal Schist

GRAVITY SURVEY

Theory of Gravity Method

In 1687, Isaac Newton came forth with the Universal Law of Gravitation. Newton's law is a mathematical description of one of the most fundamental phenomena of nature. This law states that each particle of matter in the universe attracts all others with a force directly proportional to its mass and inversely proportional to the square of its distance of separation (Telford, Geldhart, Sheriff and Keys, 1976).

In cartesian coordinates, the mutual force between a particle of mass *m* centered at point Q = (x', y, z') and a particle mass of m_o at *P* = (x, y, z) is given by:

$$F := \gamma \cdot \frac{m \cdot m_0}{r^2} \qquad 1$$

where

$$r = [(x-x')^2 + (y-y')^2 + (z-z')^2]^{1/2}, \qquad 2$$

and where γ is Newton's gravitational constant. Allowing the mass m_o to be a test particle with unit magnitude, then dividing the force of gravity by m_o results in the gravitational attraction produced by mass *m* at the location of the test particle:

$$g(P) := -\gamma \cdot \frac{m}{r^2} \cdot r \qquad 3$$

where r is a unit vector directed from the mass *m* to the observation point *P*. This value is negative because **r** is directed from the source to the observation point, opposite in sense to the gravitational attraction.

So, the gravitational acceleration **g** can be described as the gradient of the scalar potential

$$\mathbf{g}(P) = \nabla U(P) \qquad 4$$

where

$$U(P) := \gamma \cdot \frac{m}{r} \qquad 5$$

The convention used here defines the gravitational potential as the work done on a test particle and is the negative of the particle's potential energy, hence U(P) is positive. Acceleration is seen to be a function only of the mass of the Earth and the distance from the center of it to the gravity station. The unit of gravitational acceleration is called the Gal and is equivalent to 1 cm/sec^2 (Telford et al, 1976)

Gravitational potential obeys the principle of superposition and so the net force on a test particle is the vector sum of the forces due to all of the masses in space. This principle can be applied to the gravitational attraction in the limit of a continuous distribution of matter whose mass can be thought of as an infinite number of very small masses $dm = \rho(x, y, z)dv$, where $\rho(x, y, z)$ is the density distribution. Applying the principle of superposition yields

$$U(P) = \int \gamma \cdot \frac{\rho(Q)}{r} dv \qquad 6$$

where integration is over V, the volume occupied by the mass. *P* is still the point of observation, Q is the point of integration, and r is distance separating *P* and Q. However, only the vertical component of the gravity is measured by the gravimeter in the

DATA REDUCTION

It is necessary to correct for all of the factors that are not due to the density contrasts in the subsurface, such that the:

Gravity Anomaly = Observed Gravity – Earth Model Gravity

The Earth model is a function of several effects such as the latitude correction, the free air correction and finally the Bouger correction. And the observed gravity is a function of the conversion factor for that specific meter, drift correction and tidal correction.

Drift Correction

A phenomenon known as drift occurs in every gravimeter. Drift is defined as the change in the elasticity of the springs over time and is different for every gravimeter. Correction to the observed gravity readings for instrument drift requires one to occupy a base station several times during the day of the survey. It is important to take readings

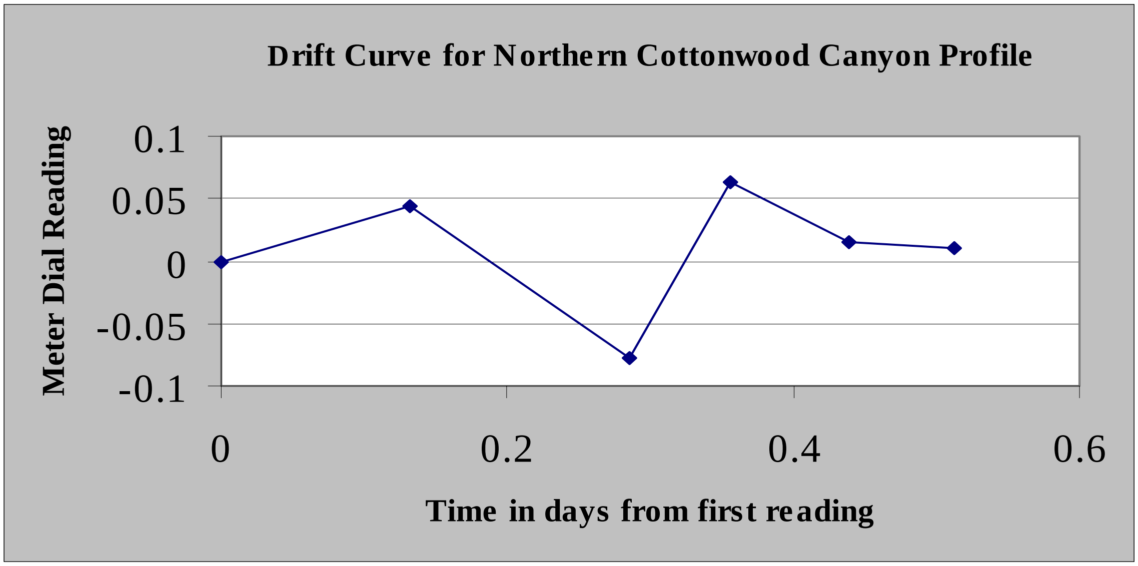


Figure 5. Showing a drift curve for the Northern Cottonwood Canyon profile

periodically because of the erratic nature of drift. The meter reading is plotted against time and it is assumed that drift is linear between re-occupations. The drift correction is then subtracted for each station. Fig. 5 shows an example of a drift curve used for the Northern Cottonwood Canyon profile.

Observed gravity readings at a fixed location will change with time due to the periodic motion of the sun and the moon. The moon, despite its smaller mass than the sun, has a larger gravitational attraction because of its proximity to earth. The same gravitational attraction which causes tidal effects at sea also cause the solid earth to react in the same way. These solid Earth tides can cause the gravity station to vary in elevation by a few centimeters, thus increasing the distance to the center of the Earth causing a maximum change of 0.3 mGals in a minimum period of 12 hours. In a high precision survey, these tidal variations must be corrected for by reoccupying the base station at an interval less than the period of Earth tides. The tidal effect is then removed during the drift correction, which was discussed earlier.

Latitude Correction

There are two factors that contribute to the latitude correction (1) spinning of the Earth and (2) its slight equatorial bulge. The centripetal acceleration of the Earth’s rotation varies with latitude such that it is at a minimum near the poles and a maximum at the equator. Consequently, the negative radial component generated by this rotation decreases the gravity from the poles to the equator. The radius of the Earth measured through the equator is approximately 21 km larger the radius of the Earth measured through the poles. So, gravity decreases from the poles to the equator because of the increase in the distance to the center of the Earth. The international formula for the latitude effect is:

$$\mathbf{g = 978\,031.846(1 + 0.005278895 \sin^2 \phi + 0.000023462 \sin^4 \phi) \quad mGals}$$

where ϕ is the angle of latitude.

Free Air Effect

The second correction to the Earth model is known as the free air effect, which accounts for the difference in elevation between the gravity station and the surface of the geoid. The free air correction is added to the observed gravity because the observed gravity would be lower at an elevation higher than the geoid surface. There is an approximate change of –0.094 mGal/ft due to elevation differences. The formula for the free air correction is (Telford et al, 1976):

$$\mathbf{FAC = \frac{(0.09411549 - 0.137789 \sin^2\phi)h}{0.3048} - \frac{0.67\mathrm{x}10^{-8}h^2}{(0.3048)^2} \quad mGals}$$

where h is the elevation of the gravity station.

Bouger Correction

The third correction for gravity to the Earth model, known as the Bouger correction, takes into account the material between the gravity station and the geoid surface. There are three parts to this correction. The first part assumes an infinite horizontal slab of rock of uniform density whose thickness is the elevation difference between the gravity station and the geoid surface. The density is equivalent to the mean density of bedrock found in the region. Generally, for the purpose of comparison to other surveys this density is 2.67 gm/cm^3. Observed gravity readings are increased by the rock mass between the station and the datum, therefore, the Bouger correction is subtracted when the station is above the geoid surface. The Bouger correction is:

$$\mathbf{BC = 0.012774\,\rho\,h \qquad mGal}$$

Where ρ is the density of the slab and h is the thickness of the slab.

The second part of the Bouger correction adjusts the slab to account for the curvature of the Earth's surface. This modification changes the horizontal slab to a slab with a spherical cap with a radius of 167 km. The formula for this correction is:

$$\mathbf{CC = \frac{4.462x10^{-4}h}{0.3048} - \frac{3.282x10^{-8}h^2}{(0.3048)^2} + \frac{1.27x10^{-15}h^3}{(0.3048)^3} \qquad mGal}$$

The concept of a horizontal infinite slab existing between the station and the datum is not really valid due to local variations around the station in topography. Regions that exist above the Bouger slab and therefore not accounted for in the Bouger correction, exert an upward pull at the station thus decreasing the observed gravity reading. It is necessary to add a positive terrain correction to compensate for this upward attraction. Depressional features are accounted for in the Bouger slab, however, they do not contain mass. The Bouger correction therefore overcompensates for these regions and so a positive terrain correction is needed to restore the slab to a flat area. Therefore, for both hills and valleys the terrain correction is added back to the gravity readings.

Once corrections have been made to the observed gravity values, the result would reflect the variations of geology within the Earth model. This is called the Complete Bouger Gravity Anomaly (CBGA) and is represented below:

$$\mathbf{CBGA = g_{observed} - g_{latitude} + FAC - BC + TC - CC}$$

CBGA values are the standard for Earth gravity models and are used for modeling all of the profiles in this survey (Keary et al, 1991).

GRAVITY DATA ACQUISITION AND PROCESSING

Gravity Meter and Base Station

During this gravity survey, measurements were made in the field using a LaCoste and Romberg Model G Land Gravity Meter (Serial No. G-551). The gravity response of this instrument is based on the use of a zero-length spring. This meter measures the vertical change of gravitational force acting up a fixed mass in such a manner that the actual length of the zero-length spring is proportional to the tension acting on it. The LaCoste and Romberg G-meter is designed to measure the changes in the Earth's gravitational field from station to station. This method of relative measurement requires the survey to open and close with a gravity reading at a primary base station where an absolute value has already been established. Later on, the absolute readings for the field stations can be calculated. For this survey, the primary base station is located in the basement of the USGS Southwest Field Office at the University of Arizona and is tied to International Gravity Standardization Network 1971 (IGSN 71). The absolute value has been determined to be 979 240.507 milligals (Don Pool, pers. comms., 2000).

Field Procedure

There are several steps during the gravity surveys to ensure repeatable and consistent readings. The gravimeter is transported from station to station and set upon a base plate where it is then leveled. The clamp, which holds the zero-length spring down during transportation, is then released. The observed gravity values were displayed on a counter wheel with hundredths of units shown and thousandths of units estimated. For consistent readings, the meter dial is rotated so the needle always approaches the null reading from the right. If the dial is overturned and the needle passes by the null reading then the process is repeated. Once the needle has settled on the null reading, the meter reading is then recorded in the field book. The G-551 meter's sensitivity is 0.005 scale divisions, which corresponds roughly to 0.005 mGals. The operating temperature of the instrument is 53.0°C and is powered by a portable battery. The instrument is sensitive to expansion and contraction from exposure to direct sunlight, therefore the time and meter readings are then double-checked before the spring is clamped down. After the survey, the meter dial readings are converted to milligals by a conversion factor specific to the G-551 meter.

Station Elevation and Location Control

The horizontal and vertical coordinates for all of the gravity stations were obtained by using a Trimble differential Global Positioning System (GPS) unit. A benchmark described by the United States Coast and Geodetic Survey in 1953 was used as the primary base station to set up secondary base stations in the Rex Ranch, and the Cottonwood Canyon profiles. The benchmark was located in the town of Amado, AZ, along the Southern Pacific Company Railroad, at the water tank, in the top of the concrete foundations east of the track about 2 ft higher than the track. The Permanent Identifier for this station is CG0375. The National Geodetic Survey provided the horizontal coordinates in the North America Datum 1983 (NAD 83), and the vertical coordinates in the North American Vertical Datum 1988 (NAVD 88). The horizontal coordinates were scaled from a topographic map and have an estimated accuracy of +/- 6 seconds. The NAVD 88 height was computed by applying the VERTCON shift value to the NGVD 29 height value taken in 1953. Software from Trimble, GPSurvey Version 2.30a, was used to perform coordinate transformations from NAD 83 to NAD 27, as well as from WGS 84 to NAD 27. All gravity stations were transformed to NAD 27 geographical coordinates, or to NAD 27 UTM (Zone 12 North) coordinates, for reduction, plotting, modeling, and contouring purposes. Information for this benchmark was obtained from the following website:

http://www.ospl.state.nc.us/geodetic/ngsdb.html

Survey Layout

There were three gravity profiles collected for this survey. The profiles are referred to as the Rex Ranch, Northern Cottonwood Canyon, and Southern Cottonwood Canyon profiles. The northern and southern profiles were collected along the terraces above the canyon floor. Whenever possible, stations were positioned along the available roads except in cases where it was necessary to keep on a straight line. All of the profiles are perpendicular to the strike of the surface fault scarp of interest in this project. The fault scarps for each of the Cottonwood Canyon profiles were not easily distinguishable due to erosion and weathering. Aerial photographs provided by Brenda Houser (Figs. 2 and 3) aided in locating the fault trace. A handheld Magellan 2000 XL GPS unit was employed to help measure the spacing between stations. Generally, there was about 100 m between stations near the ends of the profiles, then 50 m spacing for intermediate areas and then 20 – 25 m over the fault scarps.

Fig. 6 shows the plan view of the three gravity profiles. The Rex Ranch profile consisted of 40 gravity stations along an east-west line that extends for nearly 2 km. Most of the stations were collected just north or south of the access roads in the field area. The spacing of the stations ranged from 100 m near the ends of the profile to 5 m near the fault scarp. The fault scarp was clearly evident on the surface. The naming convention for this profile was rr-01 through rr-40. This profile was collected over a period of several days.

The Northern Cottonwood Canyon profile consisted of 33 gravity stations primarily along an east-west line that extended for nearly 2.3 km. A dirt road was present for half of the profile, however, only 5 stations were directly on the road. The spacing of stations ranged from 130 m near the ends of the profile to 20 m near the fault scarp. The naming convention for this profile was cw-01 at the east end through cw-33 at the west end.

The Southern Cottonwood Canyon profile consisted of 43 gravity stations over 2.7 km. The spacing ranged from 170 m to 20 m depending on the proximity to the fault scarp. All of the stations were collected along the road, primarily because of the steep terrain on either side of the access road. The stations were cc-01 through cc-43. For the Southern and Northern Cottonwood Canyon profiles, new gravity stations were added to either extend the profile or to obtain higher detailed gravity information around the fault location. Information about all of the gravity stations is provided in the appendices.

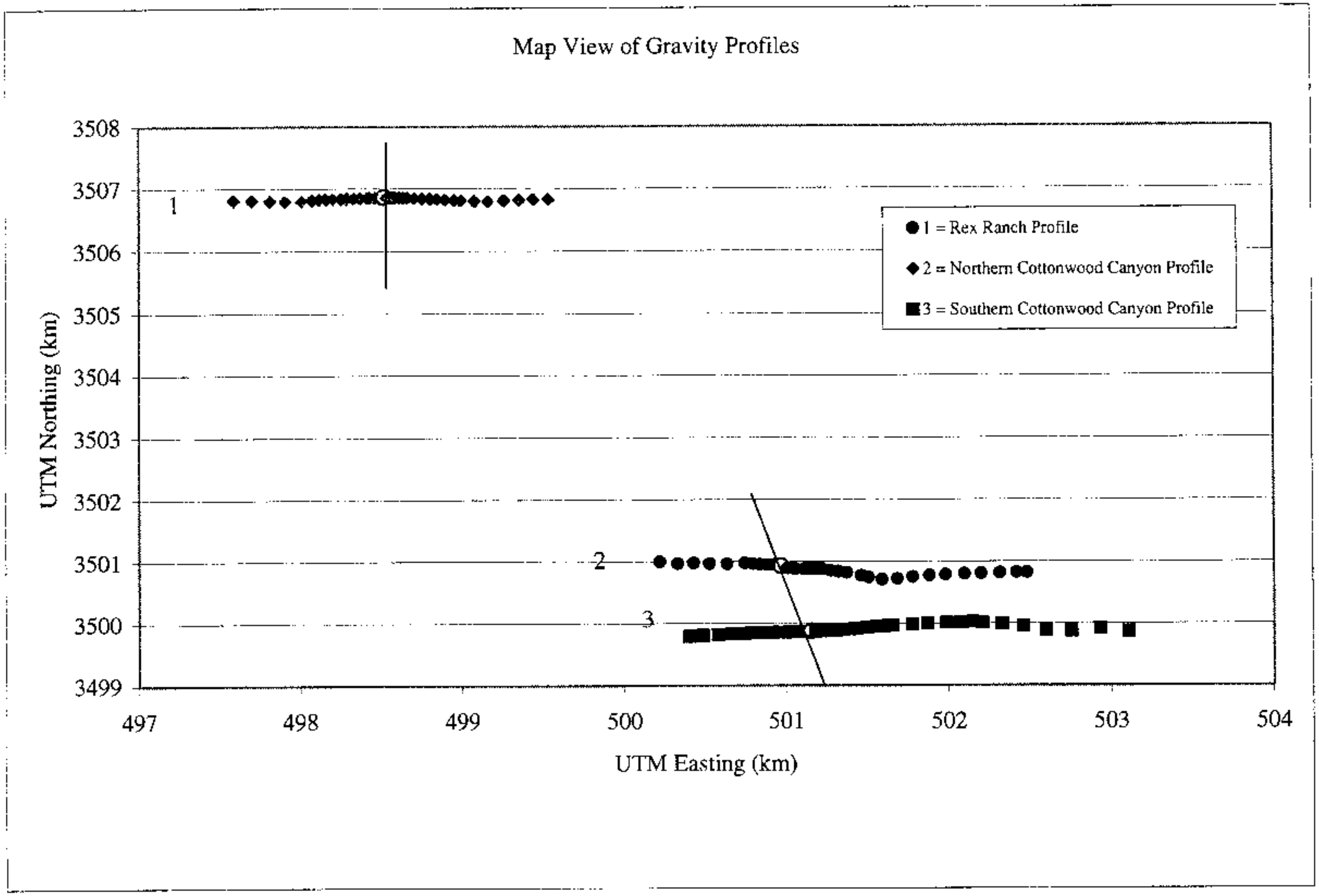


Figure 6. Location of gravity survey lines with fault traces.

Reduction Programs

Once the field data were collected they were entered into several gravity reduction programs provided by the USGS. The first program, **grvrdn**, was written by M. E. Gettings. The input to this program consists of the station id, the latitude and longitude, the elevation, the time and date, the designation of the station being a base station or just a gravity station, and the meter reading. The program converts the meter reading into observed gravity by taking into account the drift correction, the Earth tide correction, and the specific calibration factor for the G-551 meter. The first run of this program establishes the absolute value of gravity for the stations, if the station was used as a re-occupation then the all of the absolute values are averaged for that station. That average value is entered into a file where base station information is stored and referred to by **grvrdn**. The designation of that secondary base station is changed in the input file to denote that it is now a base station. The program is re-run and the drift correction was then applied. During this survey, the NGS established the absolute value for the primary base station located in the basement of the USGS Southwest Field Office building to be 979 240.507 mGals. Because of timing issues, however, the absolute value for the base station located in the basement of the Gould-Simpson Building at the University of Arizona was used for reduction purposes. Upon access of the absolute value for the true base station the gravity data were adjusted by the appropriate factor. This pseudo-base station, called tucgs87, had an absolute value of 979 241.136 mGals.

During the survey, at each station, the local variations in topography where noted and sketched in the field book. Slope angles were measured with an Abney level, elevation of hills and valleys were estimated, or in some cases measured. Anything of significant mass excess or deficiency within 68 m of the station was noted. This information was used in programs such as **hhslope**, **bhslope** and **sect** written by P.E. Gettings, to calculate the inner zone terrain correction which corresponds to the Hayford-Bowie AB correction (Robbins and Oliver, 1970). These corrections were entered into the observed gravity file and then it was run through **terrain_correct** to compute the total terrain correction to a radius of 167 km from the gravity station. This program references a digitized elevation database to compute the terrain correction to 167 km and then adds the innerzone correction. The output of **terrain_correct** is used in the program called **pfact**, which computes the free-air anomaly, the simple and complete Bouger anomalies using the reduction density of 2.67 gm/cm^3 and other densities. The following graphs show the CBGA values plotted against the projected downline distances. The fault scarp location is also plotted on each profile.

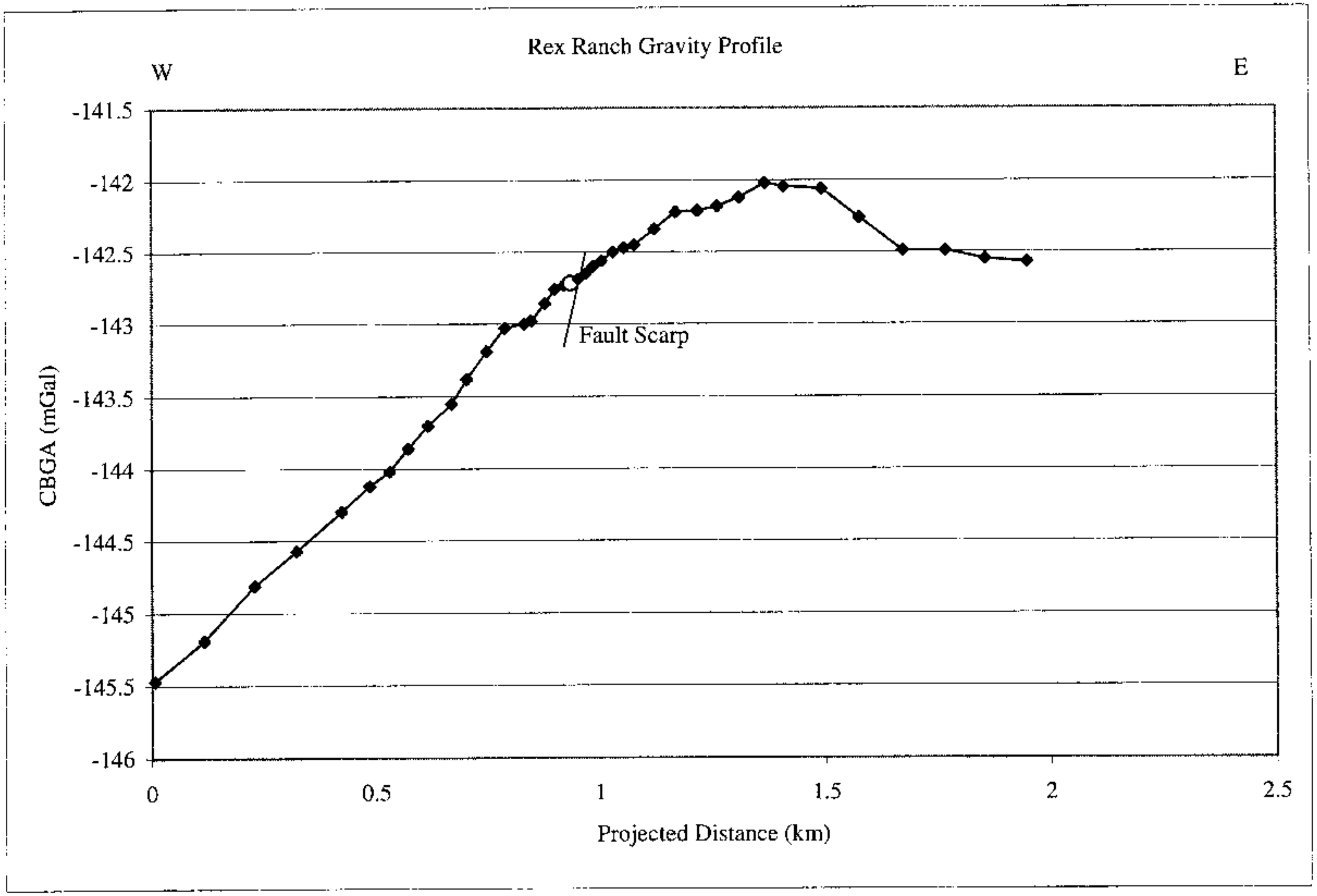


Figure 7. Complete Bouguer gravity anomaly data for Rex Ranch profile.

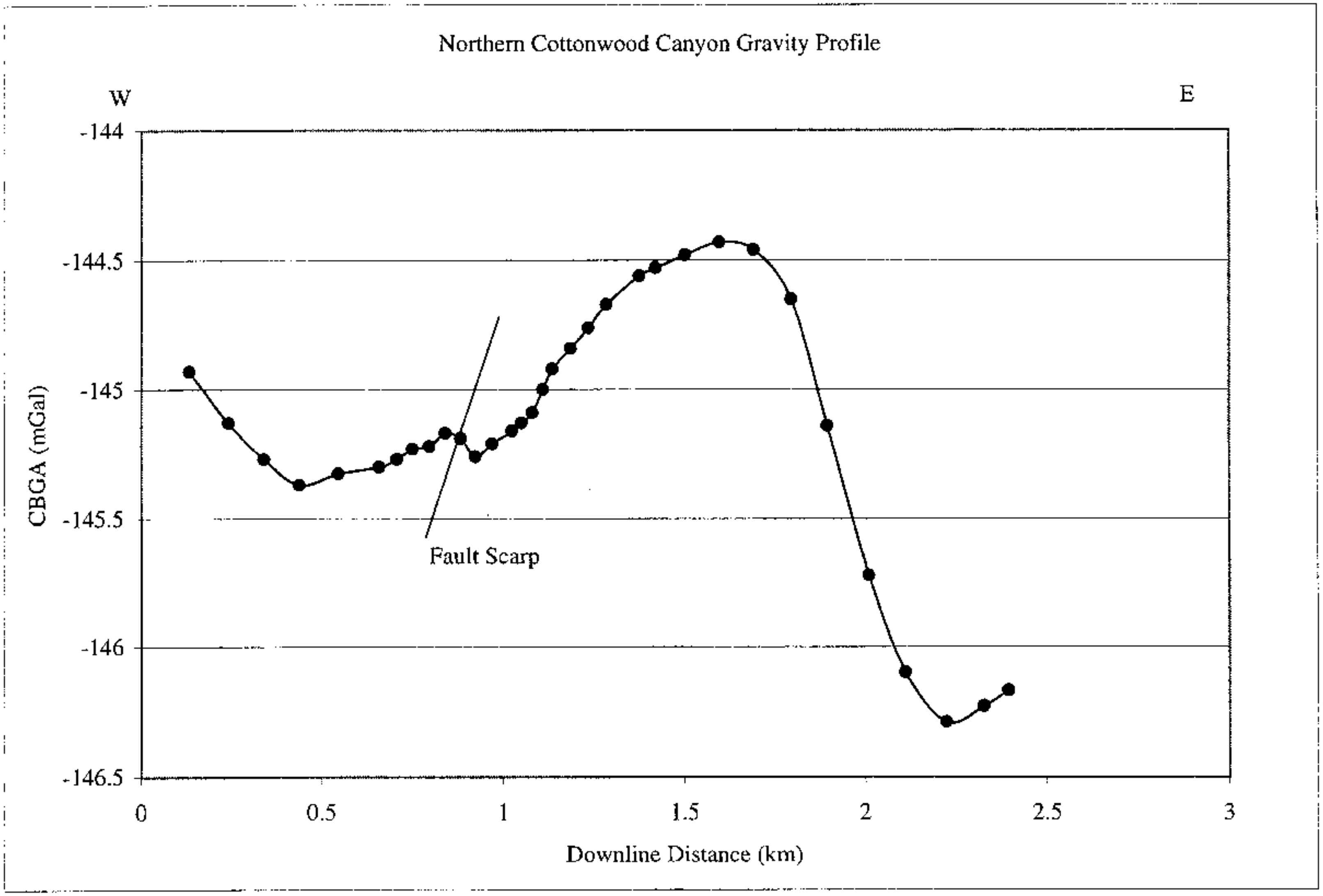


Figure 8. Complete Bouguer Gravity anomaly data for Northern Cottonwod Canyon profile.

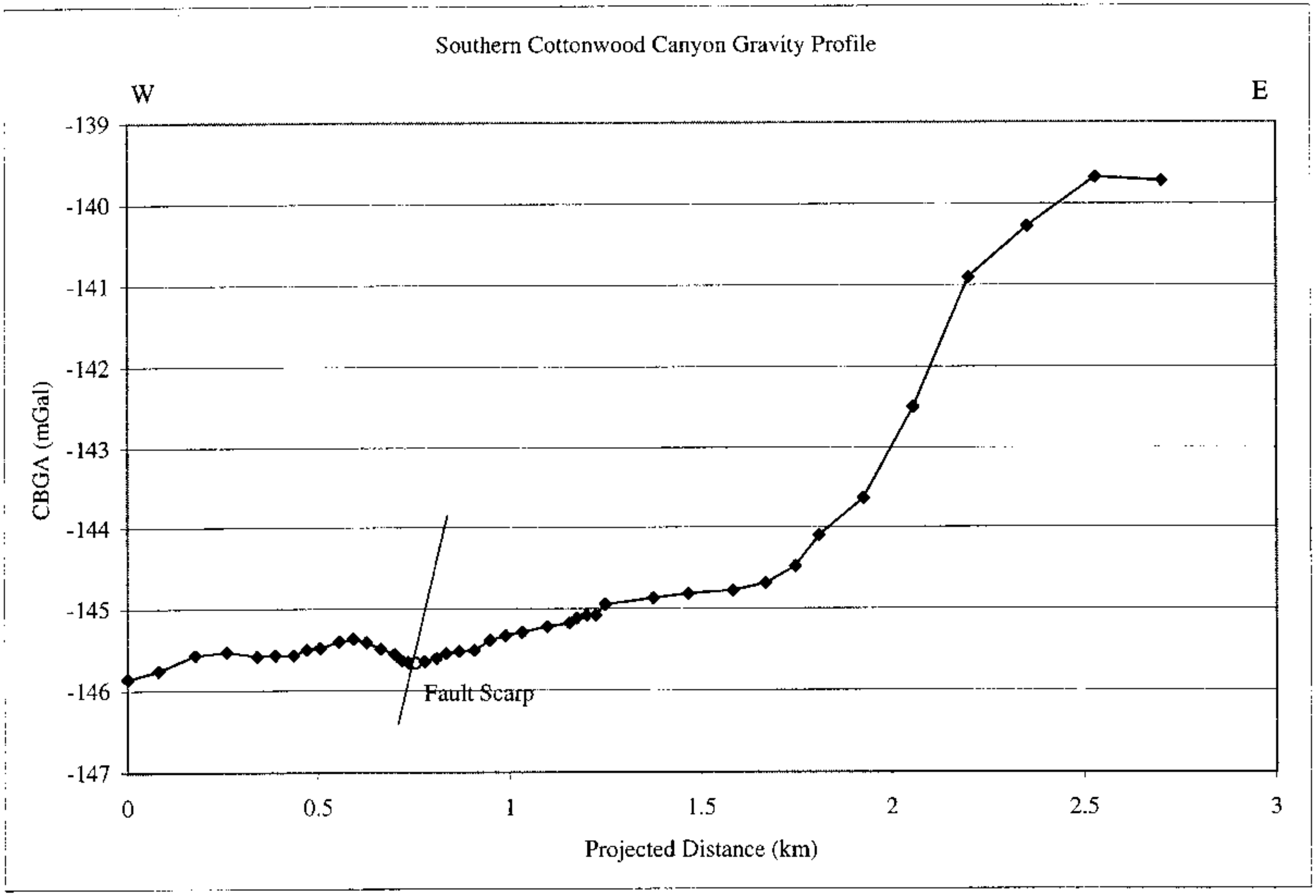


Figure 9. Complete Bouguer gravity anomaly data for Southern Cottonwood Canyon profile.

MAGNETIC SURVEYS

THEORY OF MAGNETIC METHOD

The discussion of gravitational potential began by examining the mutual attraction between two point masses. The case for magnetism is similar in that we now consider the mutual attraction of two small loops of electric currents instead of two point masses. Magnetic dipoles can also interact with one another at distance, by means of their magnetic fields. The force between two magnetic poles of strength m_1 and m_2 separated by a distance r is given by

$$F = \frac{\mu_0 m_1 m_2}{4\pi\mu_R r^2}$$

where μ_o and μ_R are constants corresponding to the magnetic permeability of vacuum and the magnetic permeability of the medium separating the poles, respectively. The force is attractive if the poles are of opposite sign and repulsive if they are of like sign. The magnetic field strength, *H*, is a more practical form of *F*, is defined as the magnetic force on a unit pole.

$$H = \frac{F}{m'}$$

where m' is essentially the instrument used in measurement (Telford et al, 1976).

The magnetic field *B* due to a pole of strength *m* at a distance *r* from the pole is defined as the force exerted on a unit positive pole at that point

$$B = \frac{\mu_o m}{4\pi\mu_R r^2}$$

However, magnetic poles always exist as pairs in nature and are called dipoles. The magnetic moment is defined as M:

$$M = ml$$

with m being the strength of the poles and l the distance separating them. As opposed to the gravitational field, the magnetic field varies both in magnitude and direction. Also, the magnetic field has a large alternating component that depends on time, whereas, the gravitational field predictably varies with time. The Earth acts like a great spherical magnet, in that it is surrounded by a magnetic field. The Earth's magnetic field resembles, in general, the field generated by a dipole magnet (i.e., a straight magnet with a north and south pole) located at the center of the Earth. The axis of the dipole is offset from the axis of the Earth's rotation by approximately 11.5 degrees. This means that the north and south geographic poles and the north and south magnetic poles are not located in the same place. At any point, the Earth's magnetic field is characterized by a direction and intensity, which can be measured. Often the parameters measured are the magnetic declination, D, the horizontal intensity, H, and the vertical intensity, Z. From these elements, all other parameters of the magnetic field can be calculated. These components may be measured in units of Oersted (1 oersted=1gauss) but are generally reported in nanoTesla (1nT * 100,000 = 1 0ersted). The Earth's magnetic field intensity is roughly between 25,000 - 65,000 nT (.25 - .65 oersted) (Kearey and Brooks, 1991). All magnetic anomalies are superimposed on the Earth’s magnetic field. This is similar to gravity anomalies, however, the magnetic field changes with both the magnitude and direction. Unlike the Earth’s gravitational field, the Earth's magnetic field is constantly changing and is impossible to accurately predict what the field will be at any point in the very distant future (Kearey et al, 1991).

When a material is set in an external magnetic field it can acquire a magnetization in the direction of the field and is lost when the substance is removed from the field. This is referred to as induced magnetization and is caused by the alignment of dipoles within the material in the direction of the field. The intensity of induced magnetization, J_i, is defined as

$$J_i = \frac{M}{LA}$$

where M is the magnetic moment, L is the length of the sample and A is the cross-sectional area.

The degree to which a material is magnetized is determined by its magnetic susceptibility. The susceptibility, k, of a substance is defined as the ratio of intensity of magnetization to the magnetizing field and is with respect to unit volume:

$$k = \frac{J_i}{H}$$

Magnetic susceptibility is the most important variable measured in magnetics, and serves the same purposes as density in gravity interpretation. Susceptibility is dimensionless, however in the SI system it is greater by a factor of 4π than the c.g.s system. Anomalies in the presence of the Earth’s field are entirely caused by the presence of magnetic minerals in the underlying rocks. The magnetic susceptibility of most rocks is proportional primarily to the magnetite content, and to a lesser degree minerals such as ilmenite or pyrrhotite. Magnetite is generally an accessory mineral and can comprise up to 10% of the rock therefore, because of this variability in magnetite content a direct correlation between lithology and susceptibility is difficult. However, it has been shown that sedimentary rocks have the lowest average susceptibility and basic igneous rocks having the highest average (Telford, et al 1976).

The magnetic field *B*, is generated by two different sources. Conduction currents deep from within the Earth's core form the primary source, and the presence of ferromagnetic materials in basement rocks, intrusive rocks, or magnetic ore bodies form the secondary source. Methods based on measuring the secondary source help to understand subsurface geology in this project. The total magnetization of rocks is the vector sum of two fields:

$$J = J_i + J_r$$

where J_i, the induced magnetization is dependent on an external field, and, J_r, remanent magnetization, which is present even in the absence of an external field. On an atomic level all substances are magnetic (Heiland, 1968). Each atom acts as a dipole and for different substances the arrangement of these dipoles defines its magnetic behavior. All materials can be classified in one of three groups based on their magnetic properties: diamagnetic, paramagnetic, and ferromagnetic. The ferromagnetic group is subdivided into two divisions: ferrimagnetic and antiferrimagnetic. The coupling of dipoles within ferrimagnetic substances such as magnetite are aligned antiparallel to each other, however, the number of dipoles in each direction is different. As a result, these materials produce a very strong magnetization and a high susceptibility. The strength of magnetization decreases with temperature until the Curie temperature at which point the magnetization disappears. Minerals such as magnetite, titanomagnetite, ilmenite, iron, and oxides of iron, titanium, and pyrrhotite are examples of ferromagnetic minerals (Telford, 1976).

Remanent magnetization is a permanent magnetization that was acquired when the rock formed. For the case of igneous rocks, some of the dipoles within the magnetic minerals aligned with the existent Earth's magnetic field when solidified through the Curie temperature. If the field is strong enough then the dipoles would permanently orient themselves across imperfections within the grains of the mineral setting up a permanent magnetization that exists separately from an external field. Any rock containing magnetic minerals may have both remanent and induced magnetizations. The amplitude of magnetic anomalies is based on the magnitude of the J and the shape of the anomaly is affected by the direction of the J vector (Telford et al, 1976).

MAGNETIC DATA ACQUISITION AND PROCESSING

Instrument and Procedure

All magnetic data were collected with a truck-mounted magnetometer with the assistance of Mark Bultman of the USGS. Total intensity Earth's magnetic field data was acquired by a Geometrics G-823A cesium-vapor magnetometer. The instrument sample rate is 10 readings per second. The unit operates over a magnetic field range of 20,000 to 90,000 nT. The sensor is compensated to provide a flat response over the center most angular orientation of less than 0.5 nT. The magnetometer is mounted on a fiberglass boom suspended 3.1 meters behind the rear bumper of a 4 wheel drive utility vehicle and 3.6 meters above the ground (when the vehicle is level). The utility vehicle contains a computer to record the output from the frequency counter and to simultaneously record Y-code GPS data. The latitude, longitude, and elevations were collected in the truck during the survey. Heading correction is done in the data reduction software.

Survey Layout

Truck-mounted magnetic data were collected along the same roads used for gravity acquisition. The Rex Ranch and Northern Cottonwood Canyon profiles are identical to their corresponding gravity profiles. However, because the road ended the Southern Cottonwood Canyon magnetic profile is approximately half the length of its corresponding gravity profile. See Fig. 10 for the survey layout. Aeromagnetic data were also used to supplement this project and the map view of the profiles is shown in Fig. 11.

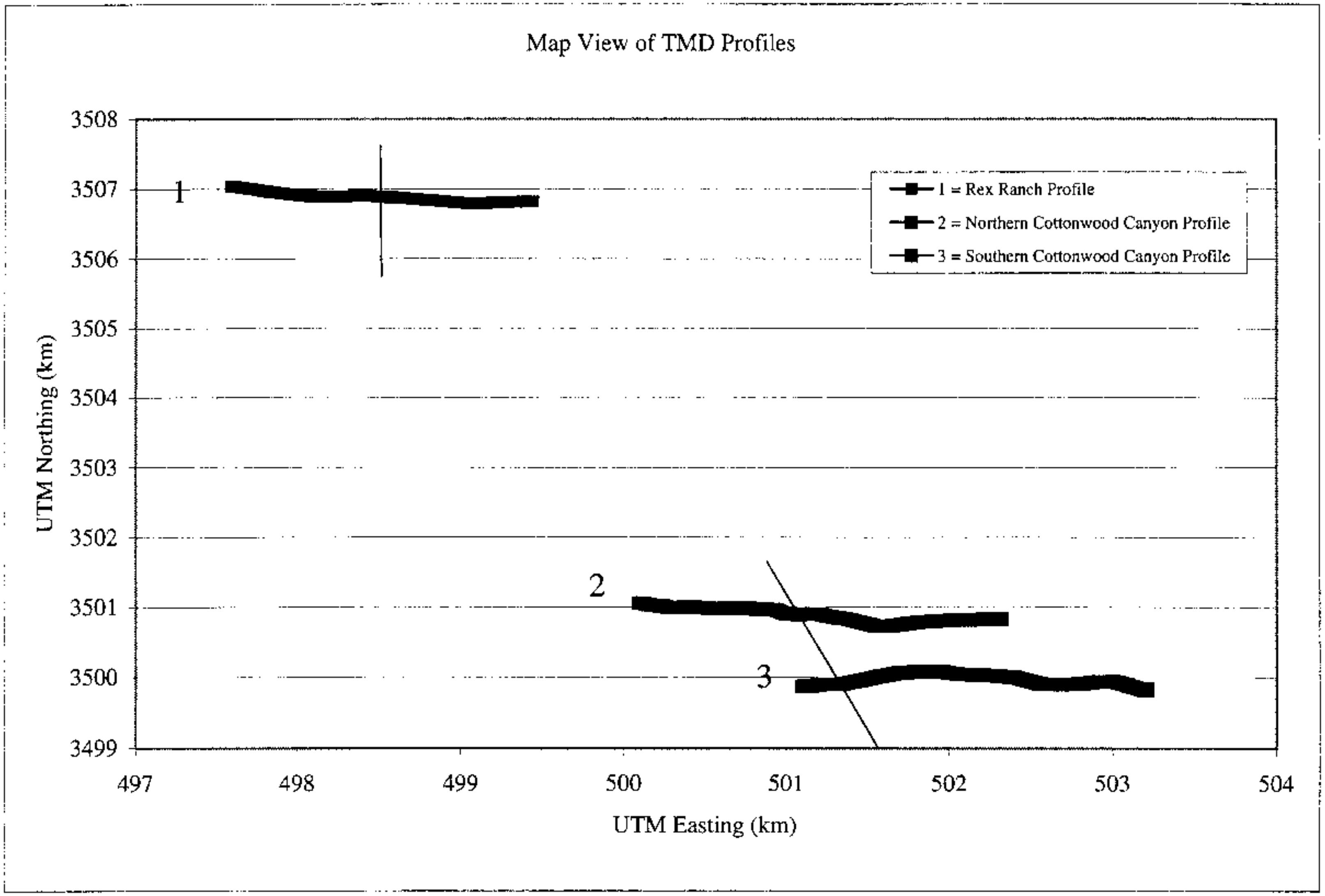


Figure 10. Location of magnetic survey lines.

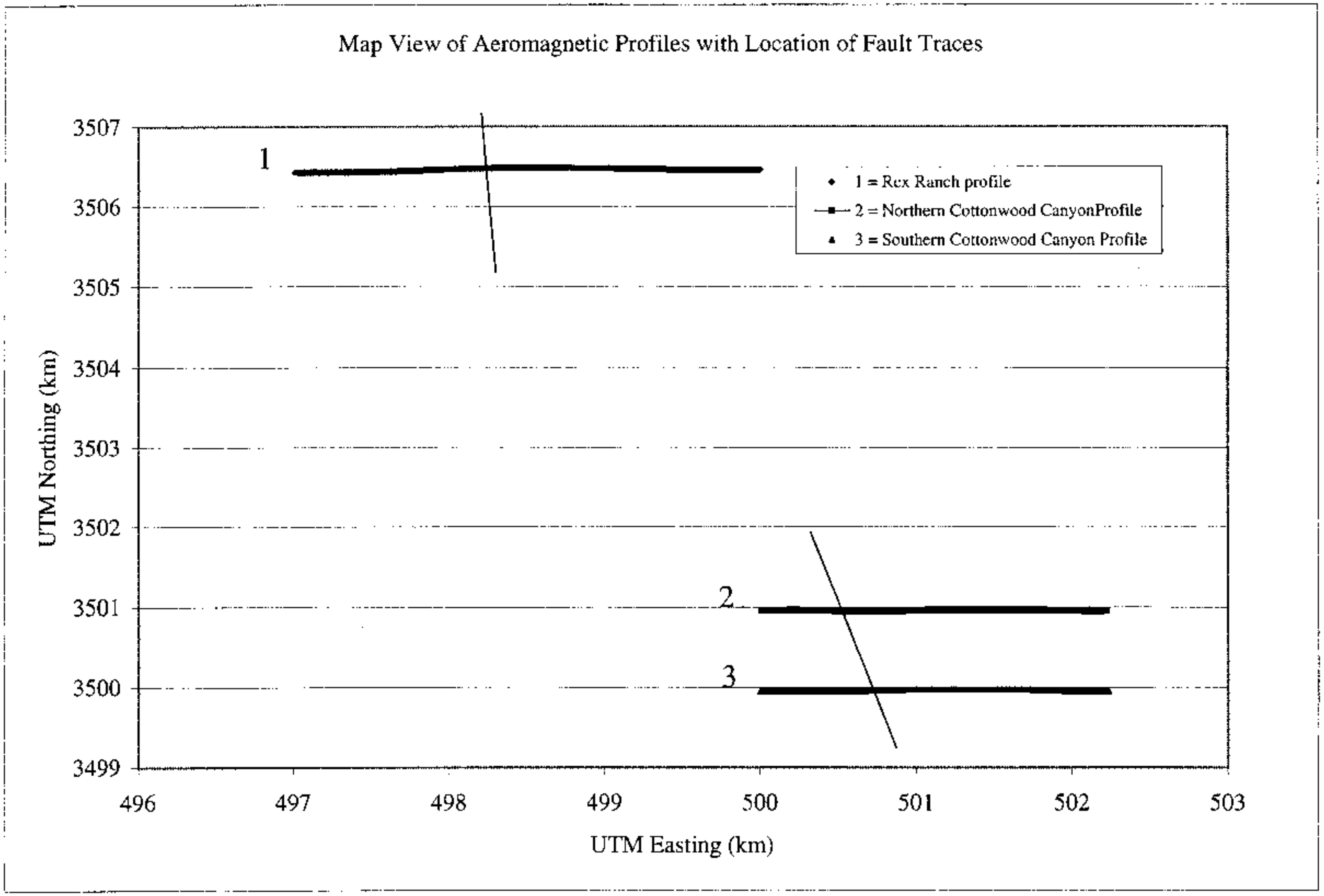


Figure 11. Location of aeromagnetic survey lines.

DATA REDUCTION

The magnetic data were reduced using programs provided by the USGS. The reduction process is much more simple than reduction of gravity data. Generally, a diurnal variation correction is applied to the data. However, it was deemed unnecessary to correct for the diurnal variation because of the short duration of time it took for data acquisition. The average time for the truck to acquire data for the three profiles was less than 10 minutes. Therefore, this eliminated the need for a base station. Later, the one-minute archives were checked from the National Geophysical Data Center to verify that no magnetic storms were present during the survey.

The International Geomagnetic Reference Field, IGRF, defines the theoretical undisturbed magnetic field at any point along the Earth’s surface. The IGRF was removed from the magnetic data so that variations from this theoretical field were eliminated. Finally, a heading correction was applied to the data because of the strong magnetic effect of the truck. The corrected and reduced magnetic profiles are shown in Figs. 12, 13, and 14. Also, previously acquired aeromagnetic data are shown in Figs. 15, 16 and 17. A moving average of the data was added to the profiles to smooth out the highly fluctuating nature of the magnetic survey. The surface fault scarps were also noted in the plots, as well as any cultural artifacts such as cattleguards or gates.

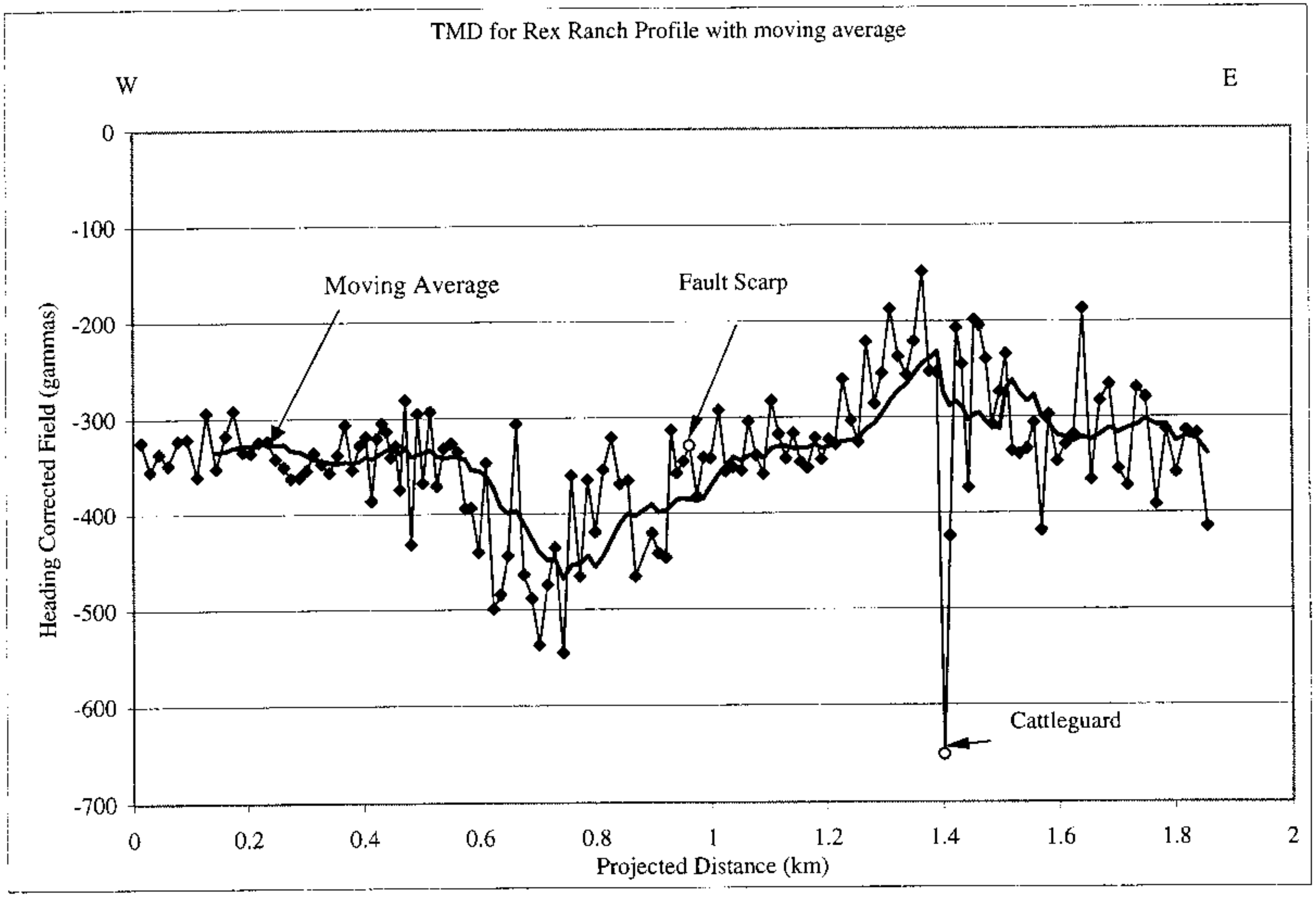


Figure 12. Rex Ranch magnetic anomaly profile.

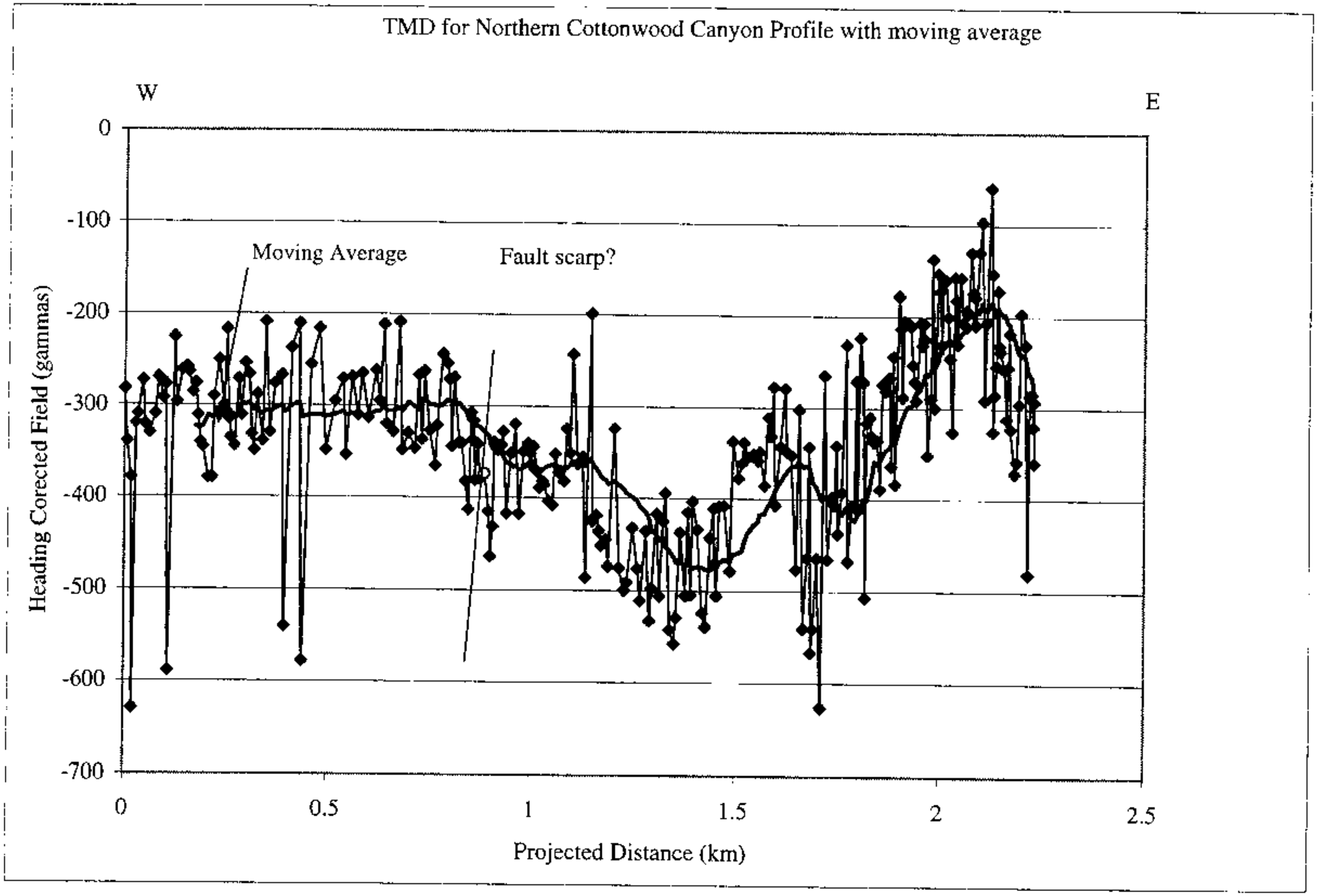


Figure 13. Northern Cottonwood Canyon magnetic anomaly profile.

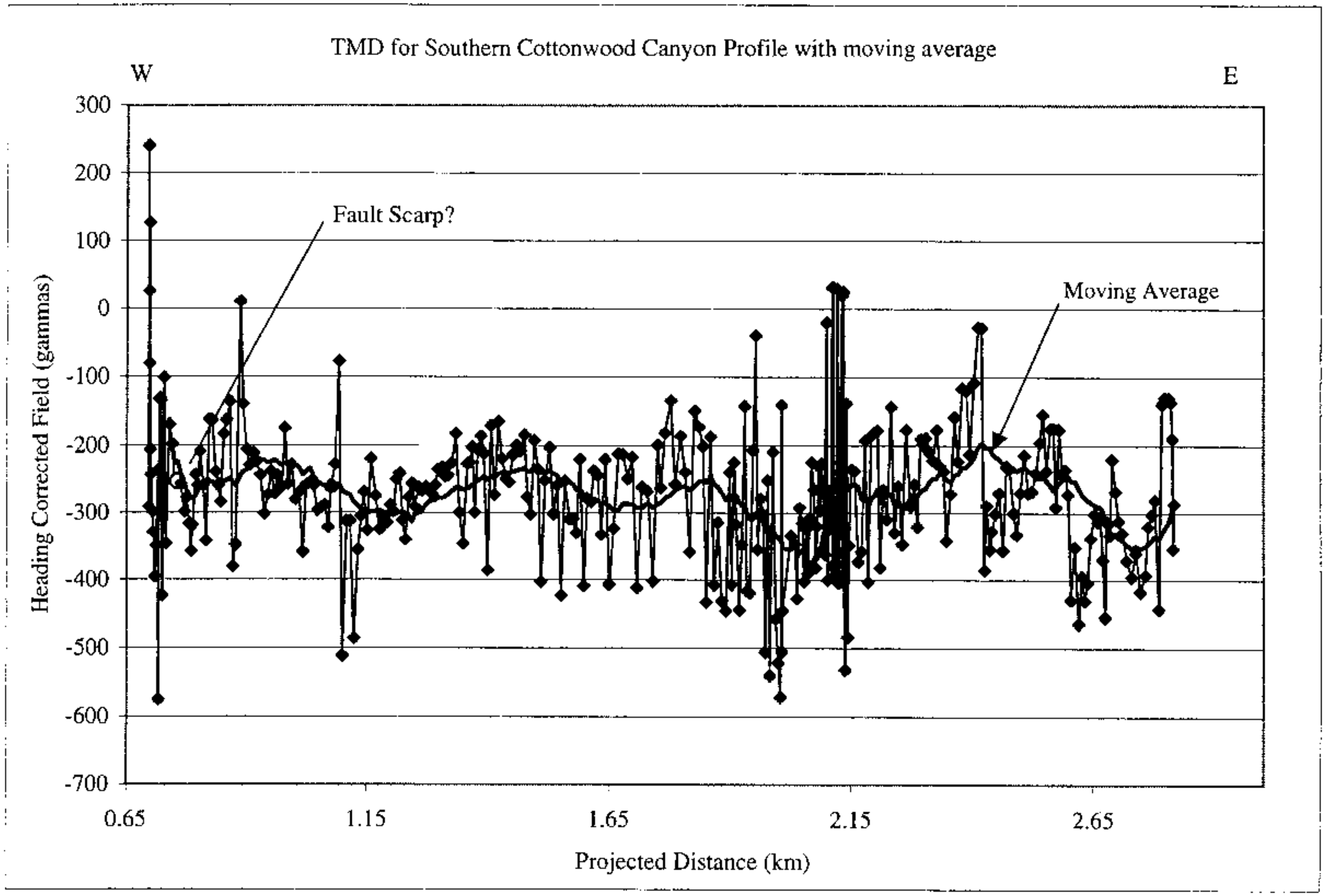


Figure 14. Southern Cottonwood Canyon magnetic anomaly profile.

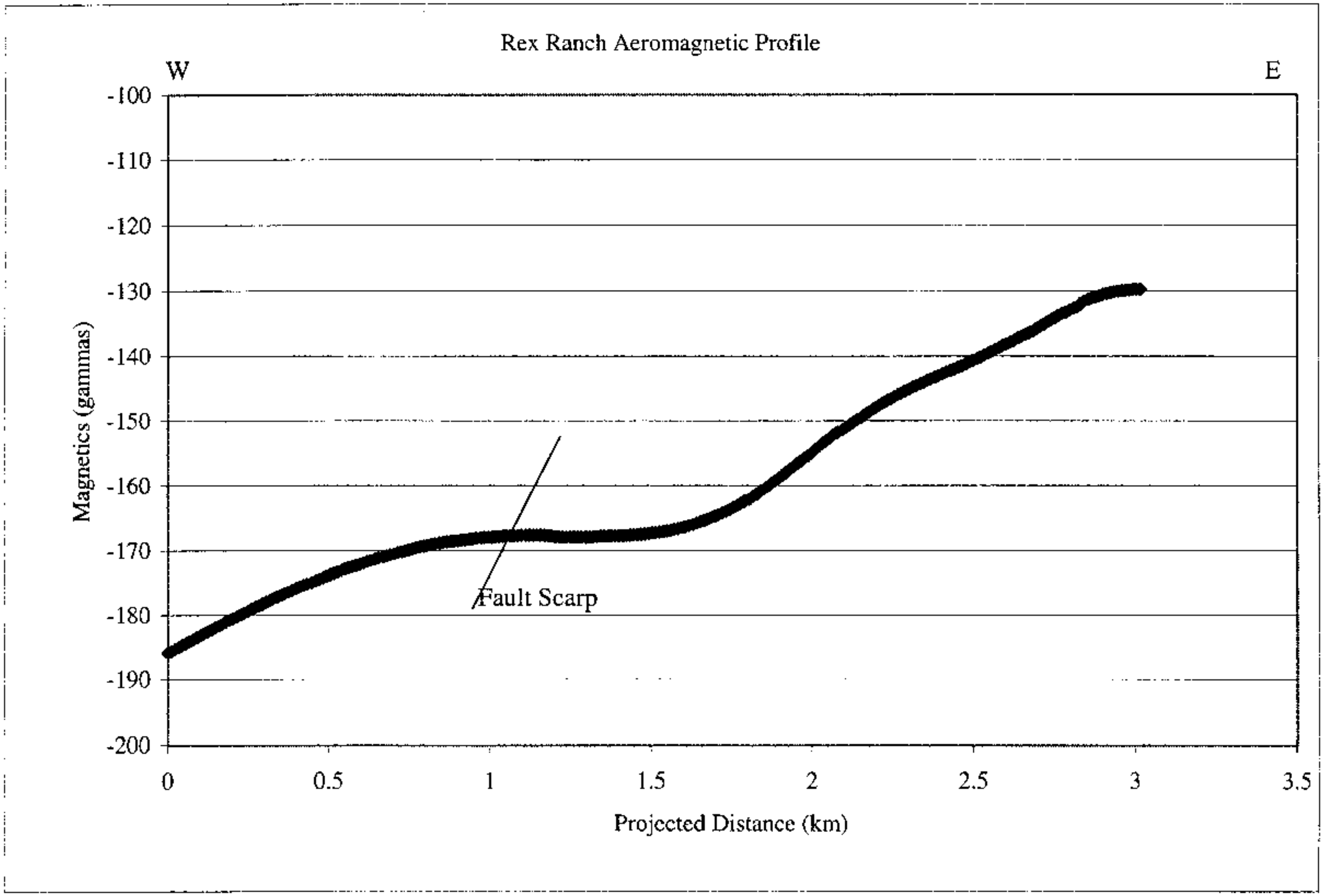


Figure 15. Rex Ranch aeromagnetic anomaly profile.

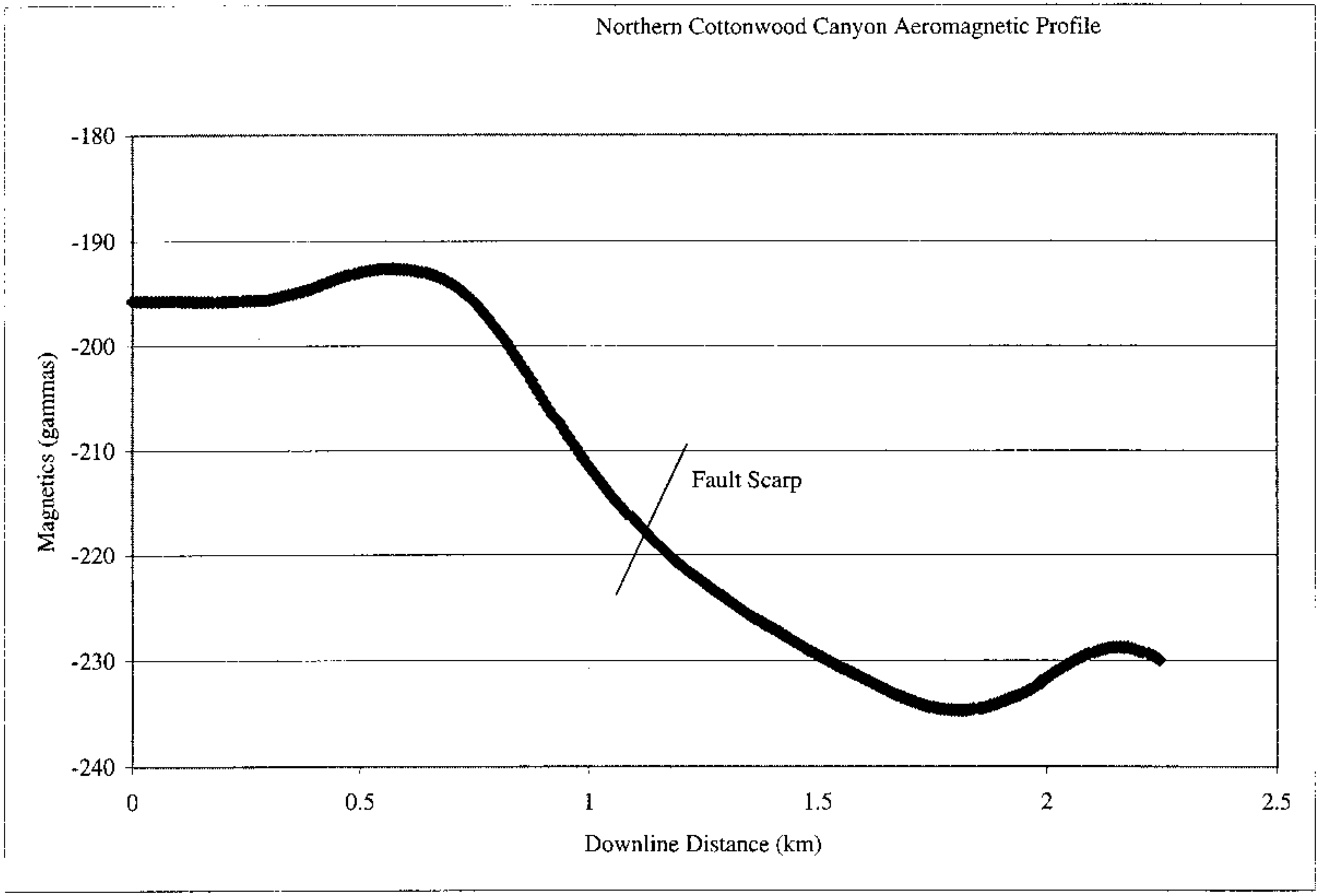


Figure 16. Northern Cottonwood Canyon aeromagnetic profile.

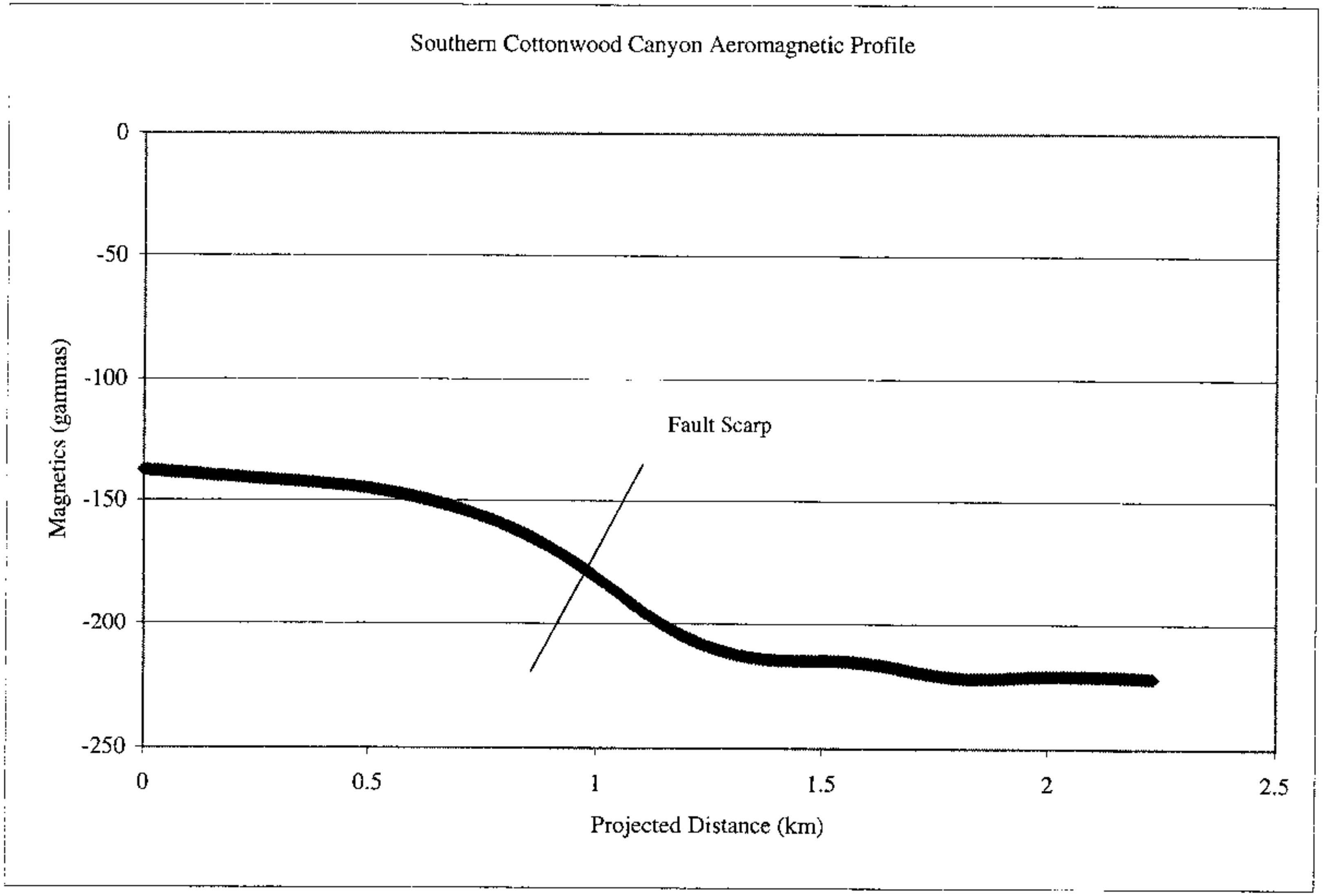


Figure 17. Southern Cottonwood Canyon aeromagnetic anomaly profile.

MODELING AND INTERPRETATION

Software

A software program called **GM-SYS** was used for the majority of the modeling in this project. **GM-SYS** uses a Marqardt inversion algorithm (Marquardt, 1963) to linearize and invert the calculations. This program executes this algorithm for gravity and magnetics developed by the USGS and is used in their modeling program, SAKI (Webring, 1985). **GM-SYS** implements a two-dimensional, flat-earth model for the calculations. This means each structural unit extends infinitely in a direction perpendicular to the profile. The model also extends to 30,000 km along the x-x axis, so as to avoid edge effects. Forward modeling is the creation of a geologic model and the subsequent calculation of the magnetic and gravity response to that earth model. The difference between the observed data and the calculated data is minimized by reshaping the model, or by altering the physical properties of the structural units contained within, i.e. density and susceptibility. Inversion algorithms within GM-SYS compute an earth model based on the observed field data and a user-specified starting model. The inversion is used to optimize the earth model, therefore, a poorly-formed starting model will result in unreasonable results. Gravity and magnetic models are inherently nonunique, so several models may fit the data equally well. Measured physical properties such as rock density and rock susceptibility can constrain the models to geologically reasonable ones. The most geologically reasonable model that fit the data was chosen. Initial estimates for rock properties were obtained from textbooks (Carmichael, 1982 and

Clark, 1966), from physical measurement of rock properties (Gettings and Houser, 1997). Rock lithologies were based on geologic mapping by Drewes (1971a).

Projection to a straight line

GM-SYS requires the data to be in a straight-line profile. However, due to the nature of fieldwork the data is not often collected in a perfectly straight line, therefore it must be projected onto one. A program provided by M.E. Gettings (pers. comm., 2000) projects the coordinates of the station onto a line that is perpendicular to the azimuth of the fault scarp. The azimuth of the fault scarp was measured as positive degrees clockwise off true north from field maps. The Rex Ranch fault strikes zero degrees, the Northern Cottonwood Canyon fault strikes 355 degrees, and the Southern Cottonwood Canyon fault strikes 347 degrees. The projected distances in all figures and models were measured eastward from the farthest westward station. In all of the profiles the view is north and the cross-section is west to east. The same origin was used for the ground magnetic, aeromagnetic and gravity data in each profile so that simultaneous modeling could be performed. The visual representation of the truck-mounted magnetic data within the software was improved by replacing them with a moving average of the data Figs. (12-14). The convention for the CBGA values used in modeling is oriented so that the positive axis represents and higher density values. For each theoretical model the gravity response, magnetic response, and the aeromagnetic response were interpreted to test the validity of the earth model. Figs. 18 and 19 represent the plan view of the profiles in their original locations, and then their projected locations. The fault traces are shown perpendicular to the projected profiles.

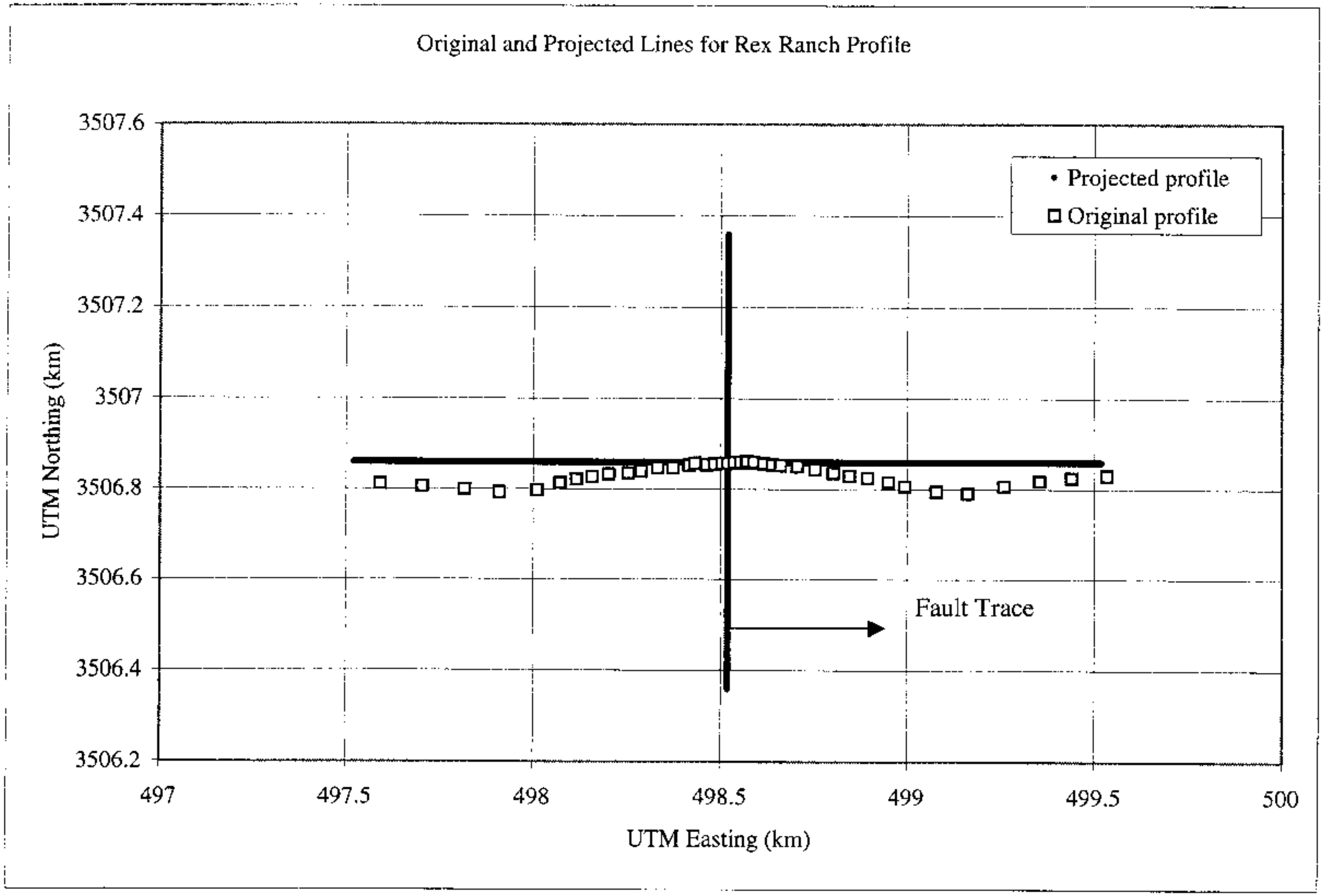


Figure 18. Location of original lines and projected lines for Rex Ranch profile.

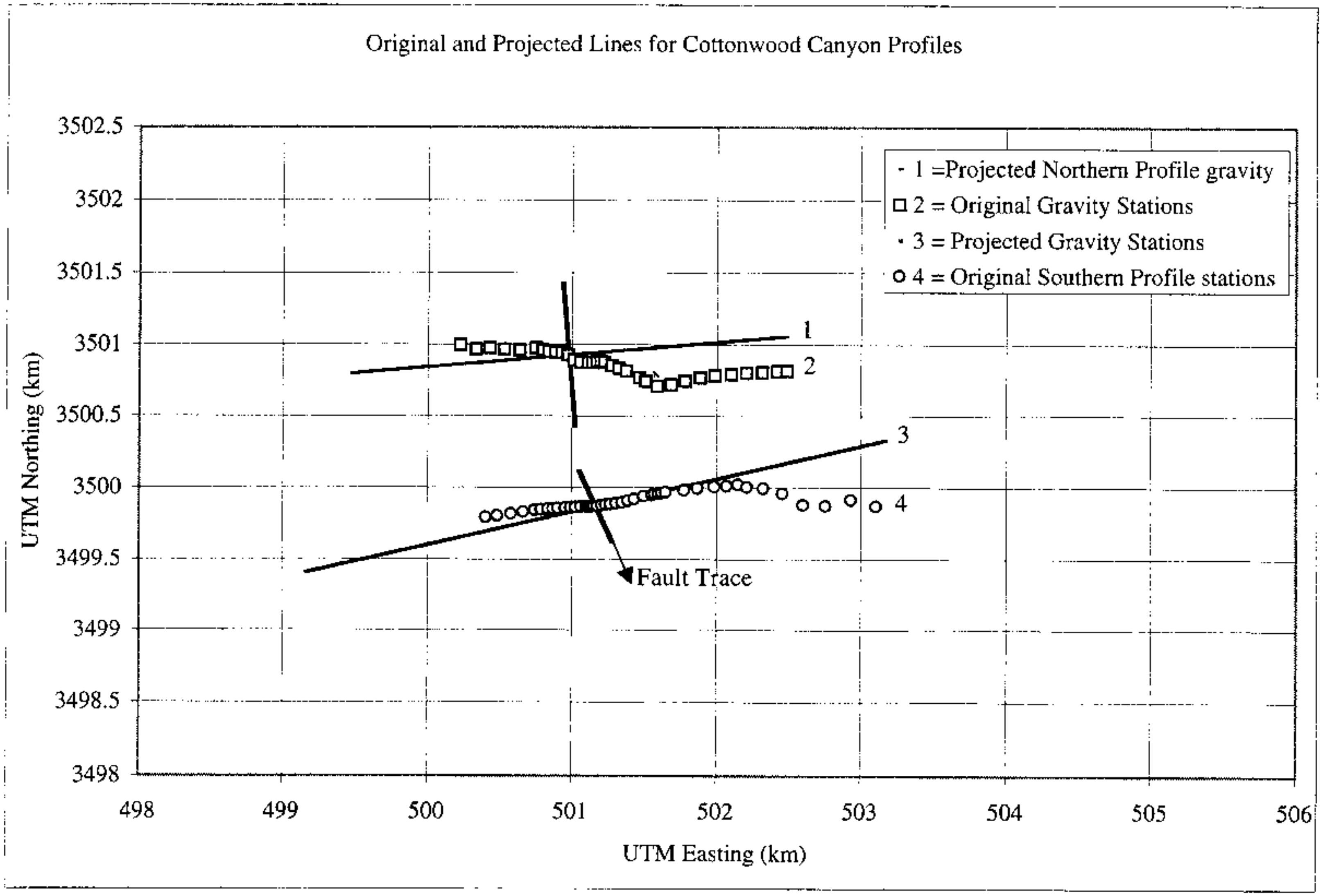


Figure 19. Location of original and projected lines for Cottonwood Canyon profiles.

REX RANCH PROFILE

The Rex Ranch fault scarp is observed (see Fig. 2) in aerial photographs to extend for over 3 km along the western flank of the Santa Rita Mountains. It shows up on the northern side of Montosa Canyon and continues down to the southern side of Sheehy Canyon. The fault scarp has been eroded away down in the canyons, but, it is still well exposed in the higher terraces. The fault scarp cuts Holocene gravel deposits mapped by Drewes (1971a), which consist mainly of alluvium carried by streams from the neighboring mountains to the west, as well as some colluvium and talus. Unlike the other profiles, the fault scarp is still preserved where the profile crosses over it. It dips 6 degrees to the west with nearly 3 m of relief between the upthrown and downthrown side of the fault. There is no well log information available in this area to help constrain lithology and their respective geophysical properties. Bulk density measurements were made for a locality near the profile in upper basin fill, and the observed value was 1.87 g/cc (Gettings and Houser, 1997). The upper basin fill unit is thought to be Miocene to lower Pleistocene in age and is unconsolidated to poorly consolidated (Gettings and Houser, 1997).

The modeled profiles of Rex Ranch are presented in Fig. 22, 23, and 24. The rock descriptions for all units are presented in Table 2. The gravity data were modeled first because of the available measured constraints on the density of the upper basin fill. The Continental Granodiorite was used as the basement rock with a density of 2.67 g/cc. Although this unit was used as the primary source of basement rock it is very likely that other stocks have intruded the granodiorite throughout time. These intrusions were assumed to have the same density (ρ =2.67 g/cc), as the Continental Granodiorite, therefore, subsequent magnetic modeling will require the addition of intrusive bodies with different susceptibilities to the earth model.

The gravity anomaly gradient steepens to the west towards the center of the Santa Cruz Basin (Fig. 23). Initial gravity modeling of depth to bedrock show a basinward thickening of sediments. Although, the gravity anomaly gradient does not flatten out in this profile there is at least 3.5 mGal of relief in the gravity anomaly profile. An infinite horizontal slab model shows that a body with a density of 2.67 g/cc and a thickness of 30 m would have a gravity effect of 3.5 mGal. The thickness of this theoretical infinite horizontal slab model approximates the offset in bedrock at depth. The earth model used has 100 m of relief in the bedrock so this value is acceptable because the infinite horizontal slab model represents the minimum thickness required to produce the same gravity effect.

There are several other minor gradients in the gravity data, which may correspond to smaller faults within the bedrock. Some of these faults have propagated to the surface, while others have not, resulting in only the folding of sedimentary layer above the faults. In the case where faults have propagated to the surface they have become exposed to erosion and may have disappeared. The prominent fault trace that is present today most likely represents a younger fault with enough movement at depth to have caused surface rupture. The fault trace is located 0.93 km along the x-axis on Fig. 23 and 24 . The top of the headwall of the fault at depth believed to be causing the surface fault scarp is at 0.84 km along the x-axis and dips about 40 degrees to the west with about 30 m of relief

(Figs. 22 and 23). The relationship between the fault at the surface with the fault at depth is bounded by two limiting cases, which depend on the brittle/ductile nature of basin-fill sediments. Figure 20 illustrates the two cases. The movement along the bedrock fault could propagate in such a manner as to cause the surface fault scarps to be directly above the top of the footwall. This case would most likely occur in unconsolidated, hence, ductile sediments. The other limiting case is that the movement of the bedrock fault through the sediments would project along the up-dip angle through to the surface. This case would represent movement through brittle sediments. The most likely scenario would be for the surface fault scarp to be within this range and depends on factors such as the amount of cementation of sediments, the amount of compaction and the presence of a heat source possibly from an intrusion. For the Rex Ranch profile, the up-dip projection is located at 0.95 km and the top of the footwall is located at 0.84 km (Figs. 22 and 23). The fault scarp being at 0.93 km lies closer to the case of up-dip movement. In Fig. 21, the location of the surface rupture is indicated by the bold arrow and the up-dip projection of the fault at depth is represented by the dotted line.

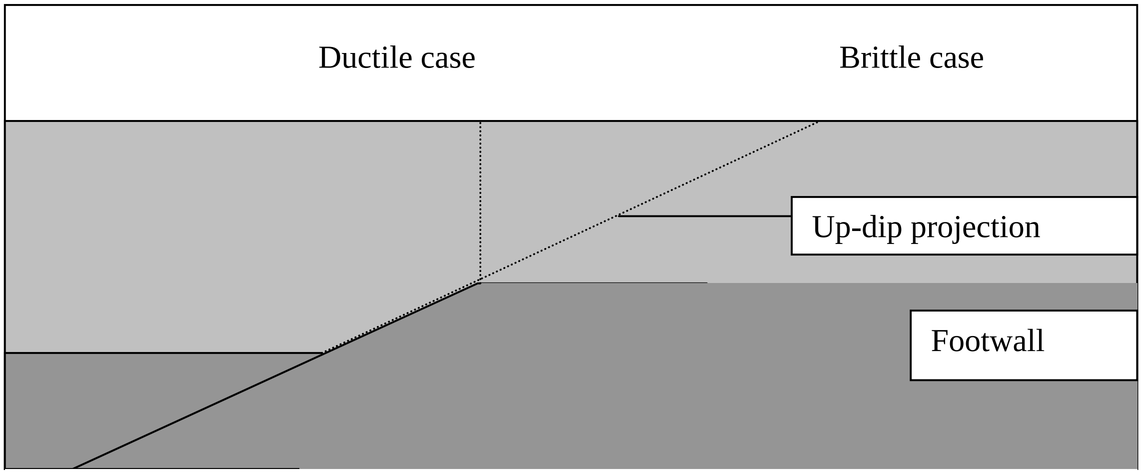


Figure 20. Model of fault propagation through ductile and sediments.

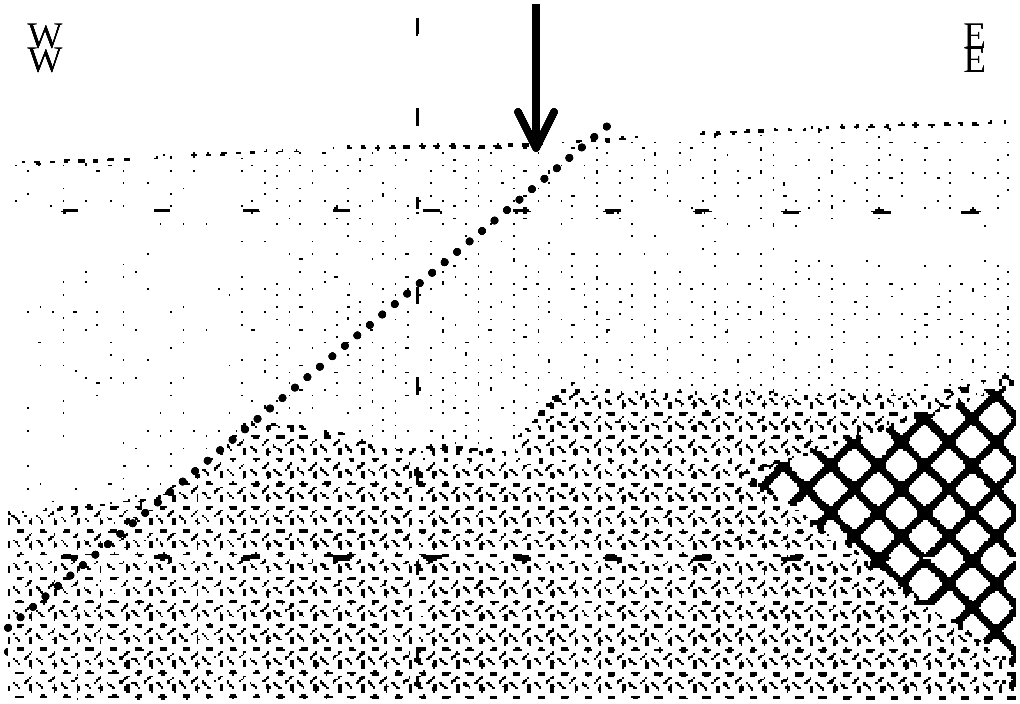


Figure 21. Magnification of Rex Ranch model.

As seen in the model for the Rex Ranch profile (Figs. 21, 22 and 23) there are several step faults within the vicinity of the fault chosen to cause the surface fault scarp. It is possible that one of these faults is responsible for movement on the surface. Since the existence of only one prominent fault on the surface is present however, it is probably caused by the most recent fault. Older faults at the surface may have existed at some point but have since had their escarpments eroded away. If the sequence of faulting between the range of 0.7 km and 1.4 km on the x-axis in figs. 22 and 23 were assumed to be from the same extensional period of time then the progression of faulting would advance towards the basin so that the youngest fault would be closest to the center of the basin. The possibility exists that a combination of faults have caused the surface fault scarp, however, this could only be supported if the overlying sediments have changed in terms of their brittle-ductile characteristics. Possibly the sediments have been re-cemented and re-hardened through time to fulfill the criteria for this multi-fault theory. This multi-fault system might also be explained by having slightly different angles of dip for the several faults such that they superimposed each other at the present day surface fault scarp.

The magnetic data were modeled by starting with the previously discussed gravity model and then were refined by using the aeromagnetic data. There is a large 100 gamma anomaly centered at 1.2 km along the x-axis (Figs. 22 and 23). This significant magnetically low anomaly does not correspond to a large anomaly in the gravity data and so it was modeled as an intrusive body with the same density as the surrounding bedrock. The long wavelength of the anomaly indicates that a deeper cause within the bedrock is the source. The intrusive body known as the Squaw Gulch Granite is exposed extensively to the southeast closer to the Santa Rita Mountains (Fig. 4) and is described by Drewes (1971a) as a pink coarse-grained granite and quartz monzonite. This Squaw Gulch Granite is nearly batholitic in size and was emplaced during the Jurassic coinciding with a period of a magnetic field reversal (Gettings, pers. comms., 1999). The intensity of remanent magnetization of this body used to fit the magnetic data was $9x10^{-4}$ emu/cc. This value is probably too high for the granitic phase of the Squaw Gulch Granite so the quartz monzonite phase is more likely the cause of the magnetic response.

Farther to the east a magnetic high in the data is located at 1.85 km (Fig. 22 and 23) coupled with a gravity gradient that dips towards the mountains. An intrusive igneous body slightly dipping to the east was inserted into the model with a higher magnetic susceptibility ($6.5\text{x}10^{-4}$ cgs) than the surrounding bedrock material ($2.0\text{x}10^{-4}$ cgs). The contact between the intrusive body and the host rock is nearly vertical. The only intrusive body nearby with a higher percentage of magnetite by volume than the host rock is the Josephine Canyon Diorite, which is exposed 5 km to the east in Montosa Canyon. Assuming the bedrock is the Continental Granodiorite, Mooney and Bleifuss (1953), showed that the magnetite content by volume ranged from 0.4 % to 3.9% with a mean value of 2.0%. The Josephine Canyon Diorite which was emplaced during the Late Cretaceous has a mean value of 3.0%, ranging from 0.9% to 5.3%. The higher magnetite content and near proximity to the field area makes it a reasonable candidate to explain the magnetic anomaly.

The model used to fit the gravity data and the truck-mounted data (TMD) did not originally fit the aeromagnetic data. The magnetic highs in the TMD did not coincide with magnetic highs in the aeromagnetic set and were consistently shifted by approximately 0.5 km as illustrated in Figure 21. The flight line of the aeromagnetic data was north of the TMD profile. So, the apparent shift between the two sets of data was concluded to be a result of a geologic body striking to the northwest and that any offset is due to where the profile crosses that anomaly. The TMD were shifted by 0.5 km and the peaks and troughs were then aligned with one another.

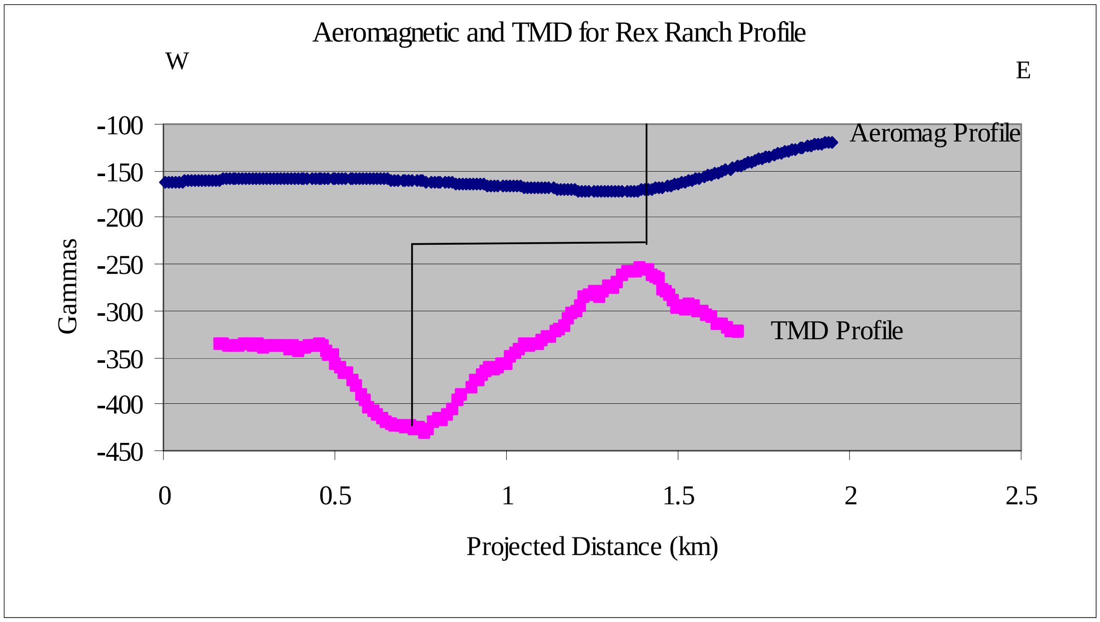


Figure 22. Offset in peaks due to the profiles crossing the trace of the fault at different locations.

The western half of the model up until 1.65 km (Fig. 23 and 24) shows a very reasonable fit to the three observed data sets and their respective models. Beyond 1.65 km the two magnetic sets deviate from the observed values. The aeromagnetic data suggest that either the intrusive body is too deep or the susceptibility is too low. The gravity model constrains the depth to bedrock at this point so moving this body up or down would then cause a major misfit to the gravity data. The susceptibility of the intrusive body was increased to gain a better fit to the aeromagnetic data however, this caused the fit of the TMD to become worse.   This area is difficult to model because the positive gradient in the aeromagnetic data coincides with a negative gradient in the TMD. This discordance between data sets may due to: (1) GM-SYS requires that the polygons in the earth model be perpendicular to the cross section and extend to infinity without change in shape, or change in physical properties, this is rarely achieved in reality; (2) the flight line and TMD lines are along different azimuths to the strike of the causing body; or (3) the absence of data farther to the east means that the model is unconstrained and therefore impossible to model. The redeeming quality of this section in the model is that the same inflection point is present in both sets of the magnetic data and that both data sets have a gradient dipping to the east.

Table 2. Description of modeled rock units. Modeled units are seen in Figs. 22-27.

Unit Name	Density (g/cc)	Magnetic Susceptibility (cgs)	Remanent Magnetization Intensity (cgs units)	Remanent Magnetization Inclination (degrees)	Remanent Magnetization Declination (degrees)	
Upper Basin Fill	1.87	0.00002				Density given by (Gettings, 1997)
Nogales Formation	2.38	0.00002				Density given by (Gettings, 1997)
High-density sediments	2.64	0.0002				Density given by (Gettings, 1997)
Continental Granodiorite	2.67	0.0003				Drewes (1976) based on 2% magnetite by vol.
Squaw Gulch Granite	2.67	0.0002	0.0009	-60	-170	Drewes (1976) based on 1.4% magentite by vol. Inc. and Dec. from Gettings and Gettings (1996)
Josephine Canyon Diorite	2.67	0.00065				Drewes (1976) based on 3% magnetite by vol.

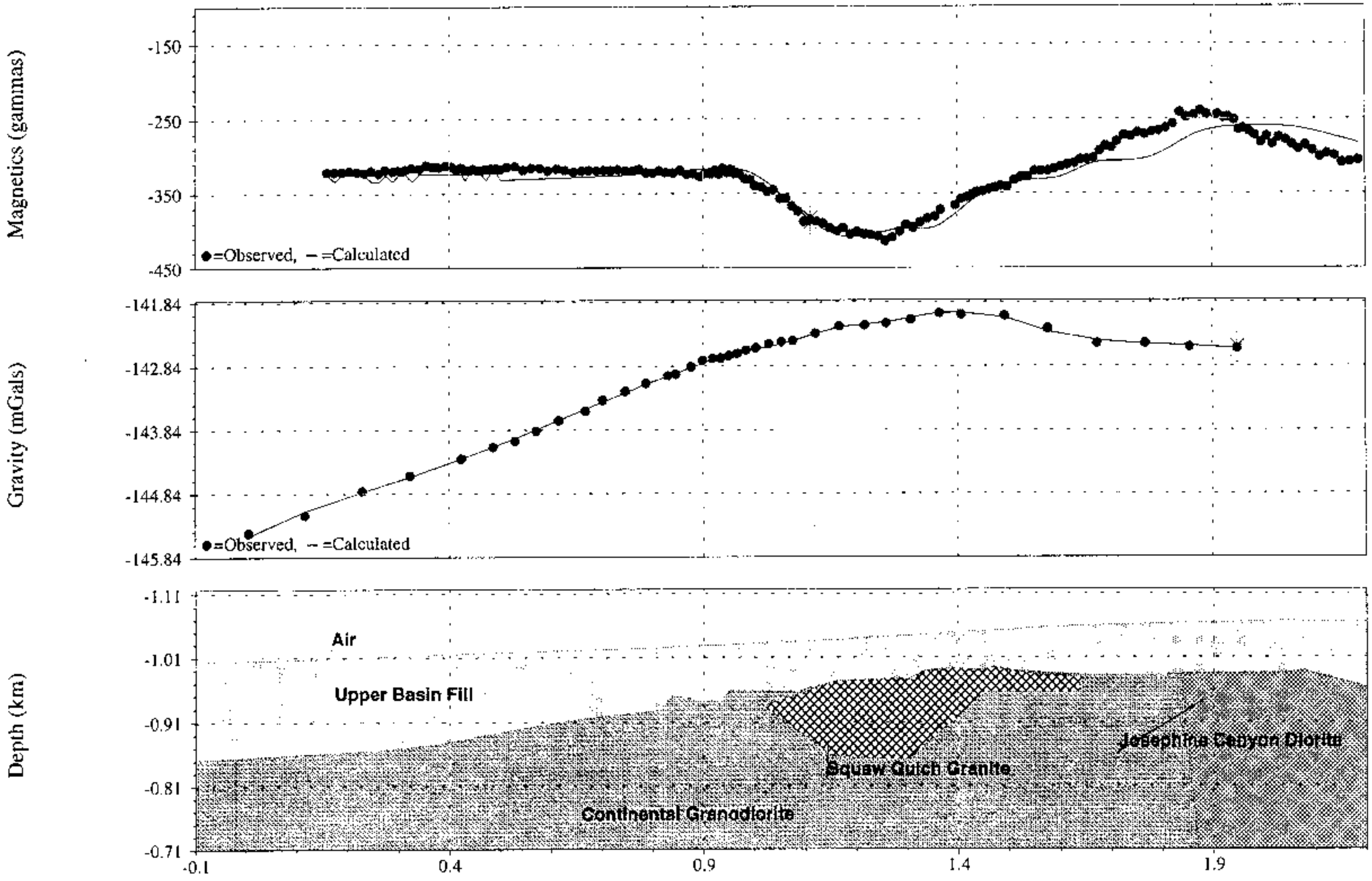


Figure 23. Rex Ranch Profile using truck-mounted magnetic data

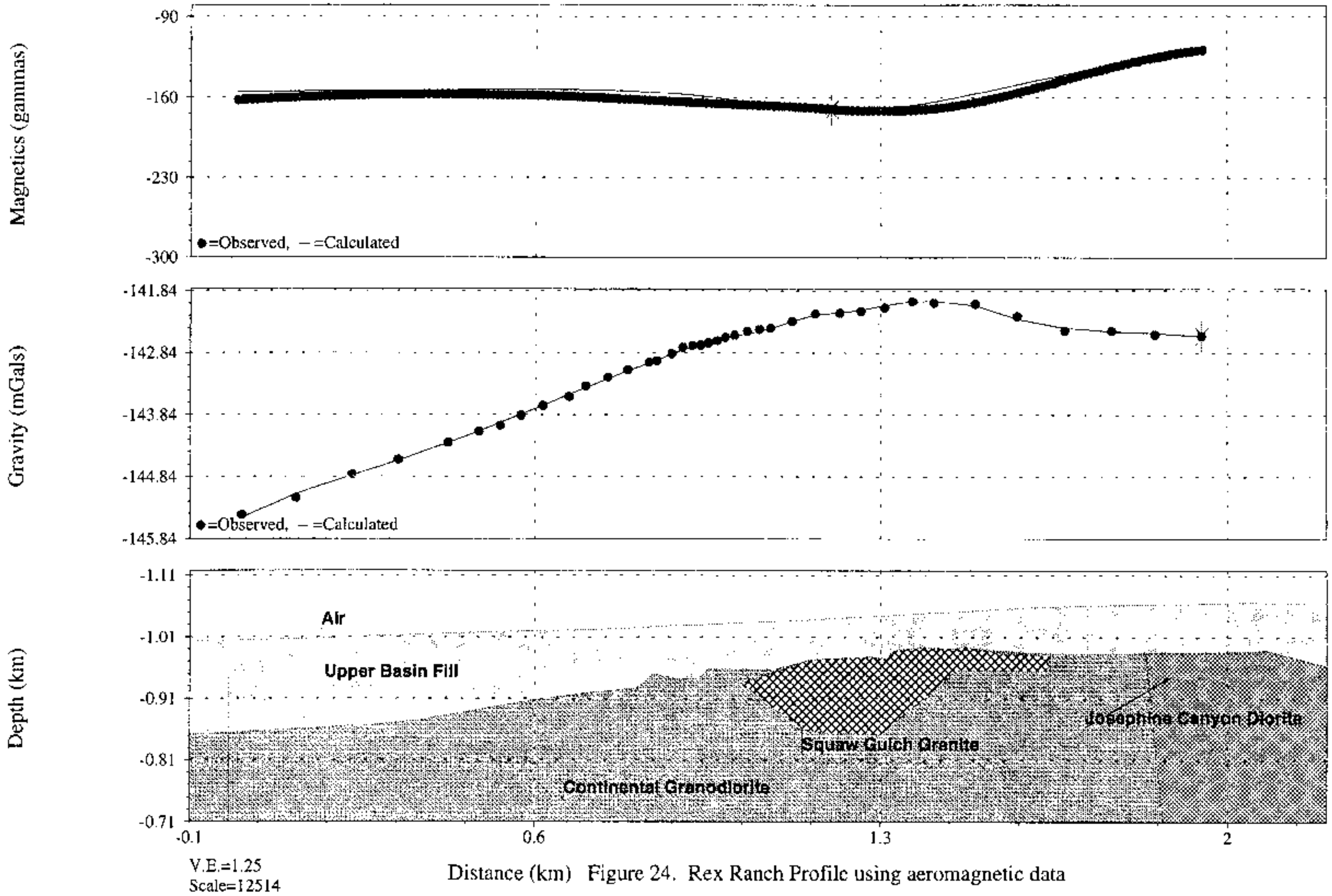


Figure 24. Rex Ranch Profile using aeromagnetic data

NORTHERN COTTONWOOD CANYON PROFILE

The modeled lines for this profile are presented in Figs. 25, 26 and 27. The surficial escarpment that extends across Cottonwood Canyon is eroded away where the northern profile crosses it. The fault trace is evident in the aerial photographs (see Fig. 3) and the location is interpolated from field maps (Houser, pers. comms., 2000). The fault is located at 0.88 km along the x-axis on Figs. 24 and 25. The dip and relief of this fault is similar to the fault to the northwest that crosses the Rex Ranch profile.

Unlike the Rex Ranch area, the basement rocks are exposed very close to the Cottonwood Canyon area and help to constrain the earth model for the Cottonwood Canyon profiles. Drewes (1971a) mapped the geology and location of faults near this area. The reversely polarized Squaw Gulch Granite discussed earlier is exposed at the surface, as well as the strongly magnetic Josephine Canyon Diorite, which outcrops closer to the field area. The Nogales Formation, a thick, dense sedimentary sequence containing mostly volcanic material composes the entire terrace where this profile was collected.

The model for this profile was constrained by using the available structural controls mapped by Drewes (1971a) and the bulk density measurements of the Nogales Formation (Gettings and Houser, 1997). Due to the close proximity of the southern profile to the northern profile a model that was geologically reasonable had to be made that simultaneously took into the account the geophysical data collected for both the northern and southern profiles.

The gravity data were modeled first using the simplest model of the Nogales Formation, where the bulk density, ρ = 2.38 g/cc (Gettings and Houser, 1997), overlying the basement rock ρ = 2.67 g/cc. The inclusion of intrusive bodies into the model was reserved for the magnetic modeling. On the eastern half of the profile there is a 2 mGal anomaly that peaks at 1.7 km (Fig. 26) and then steepens to the east before reaching the trough at 2.0 km, at this point the gradient changes inflection and increases before the profile ends. This was first modeled with a large fault dipping to the east, however, this did not fit the data at the east end of the profile (Fig. 26). So, a horst and graben structure was adopted to provide the mass excess needed to fit the positive gradient at the end of the gravity profile. The depth to the down dropped graben is approximately 0.19 km with the eastern wall dipping 55 degrees and the western wall dipping 30 degrees, however, there was variability with these angles. If these angles were steepened then the other half of the profile became misfit to the data and depth to bedrock on that half had to be increased to compensate for the excess mass of the bedrock. Drewes (1971a) mapped other faults that run into Cottonwood Canyon as well as some fault splays off of the major fault. Brenda Houser (pers. comms., 1999) located a fault higher up in the canyon that strikes NE and SW, dips 60 degrees to the NW with Tertiary volcanics and Precambrian igneous and metamorphics on the southeast side and the Nogales formation on the northwest side. The geologic evidence of northwest-southeast faulting supports the possibility of a horst and graben feature.

On the western half of the profile the data were fit very well. The anomaly at 0.78 km (Fig. 26) associated with the surface fault scarp was modeled as a fault along the Squaw Gulch Granite, which was added to model the magnetic data. The contact between the intrusive body and the bedrock fits a fault model. The faults at depth, which cause displacement at the surface, have occurred in the last few thousand years and this sill of Squaw Gulch Granite was emplaced during the Jurassic. The fault may be older than a few thousand years and may have been reactivated during different periods of tectonic activity. The fault continues to have normal movement today. The fault plane dips about 58 degrees down to the west with 0.05 km of relief (Fig. 25). In Fig. 25, the bold arrow indicates the location of the surface rupture and the up-dip projection of the fault at depth is represented by the dotted line. The surface fault scarp exists just to the west of the up-dip plane suggesting a brittle deformation within the overlying Nogales

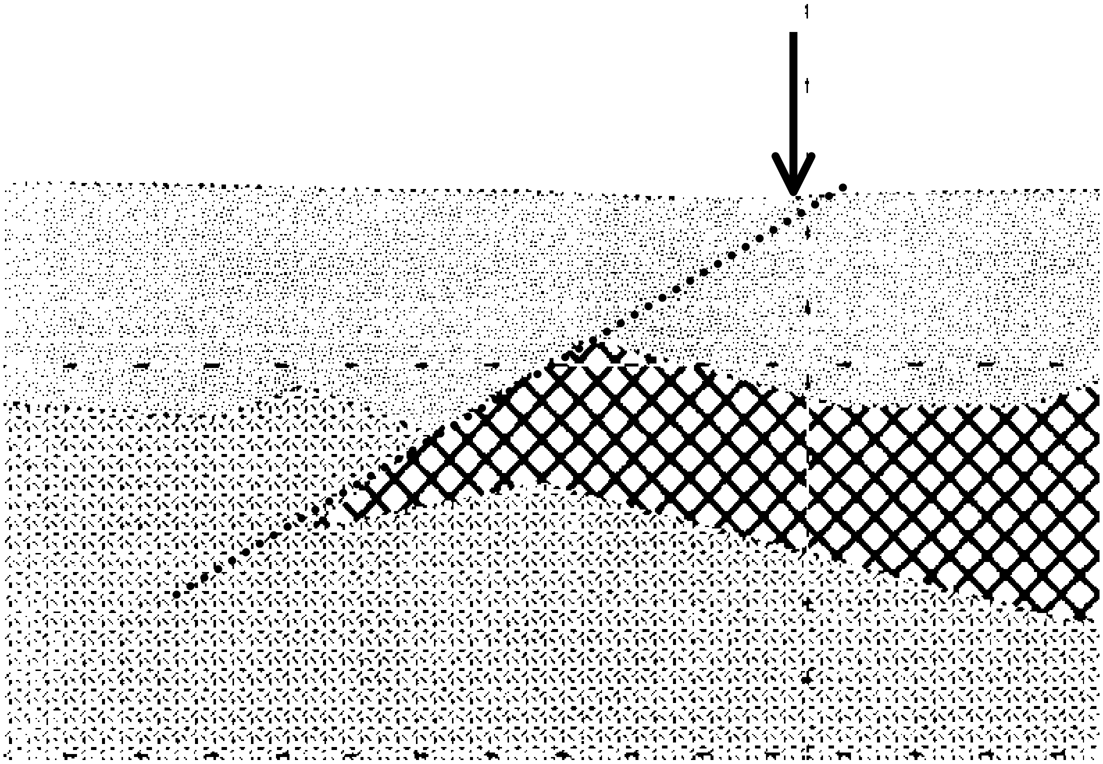


Figure 25. Magnification of Northern Cottonwood Canyon Fault.

sediments. This is sensible given that the Nogales is a high-density unit that has been described as well indurated (Drewes, 1971b).

The magnetic model is composed of three different bodies excluding the Nogales Formation. The exposure of the Squaw Gulch Granite very close to the profile justified its insertion into the model. However, it was quickly determined that this body alone could not fit the magnetic data. Since the gravity model was very sensitive to change near the horst and graben area, it was a primary constraint on the magnetic model. The western half of the profile was stable and relatively level at 300 nT until 0.8 km (Fig. 26) where it begins to dip towards the east and decrease until 1.2 km where it reached a low of 500 nT. This was modeled by inserting a sill of the Squaw Gulch Granite, which extended laterally for 1.3 km. The gravity model defined the top of this body, and the bottom of the body was adjusted to obtain a good fit to the magnetic data without affecting the fit to the gravity data. The magnetic high towards the eastern end at 1.9 km (Fig. 26) of the profile could not be modeled with reversely polarized Squaw Gulch Granite. Therefore a normally polarized intrusive body with a higher susceptibility than the host rock was inserted into the model. The susceptibility of this body needed to fit the magnetic high was $6.5X10^{-4}$ cgs, which corresponds to 2% magnetite by volume (Mooney and Bleifuss, 1953). The magnetite content of the Josephine Canyon Diorite ranges from 0.9% to 5.3% by volume (Drewes, 1976) and is exposed nearby so it is very likely to be the cause of the magnetic high. Since there is no geologic control on the subsurface shape and extent of this body its shape and size could be freely adjusted to fit the data. At 1.0 km (Fig. 26) there is a slight anomaly superimposed on the regional gradient, which coincides with the surface fault scarp. The fit to this section is not perfect however, the inflection point in the calculated data mimics the inflection point in the TMD. Efforts to better fit this section resulted in a misfit to the gravity data. Taking into account that data set is a moving average of the TMD and that the gravity values have not been modified, the model, which fit the gravity data very well, was chosen.

The earth model created for the gravity and magnetic data was then applied to aeromagnetic data. Except for the extreme ends of the profile fit the aeromagnetic data (Fig. 27) very well. However, the deviation from the observed data was very small at about 10 gammas on both ends and was deemed to be a reasonable fit.

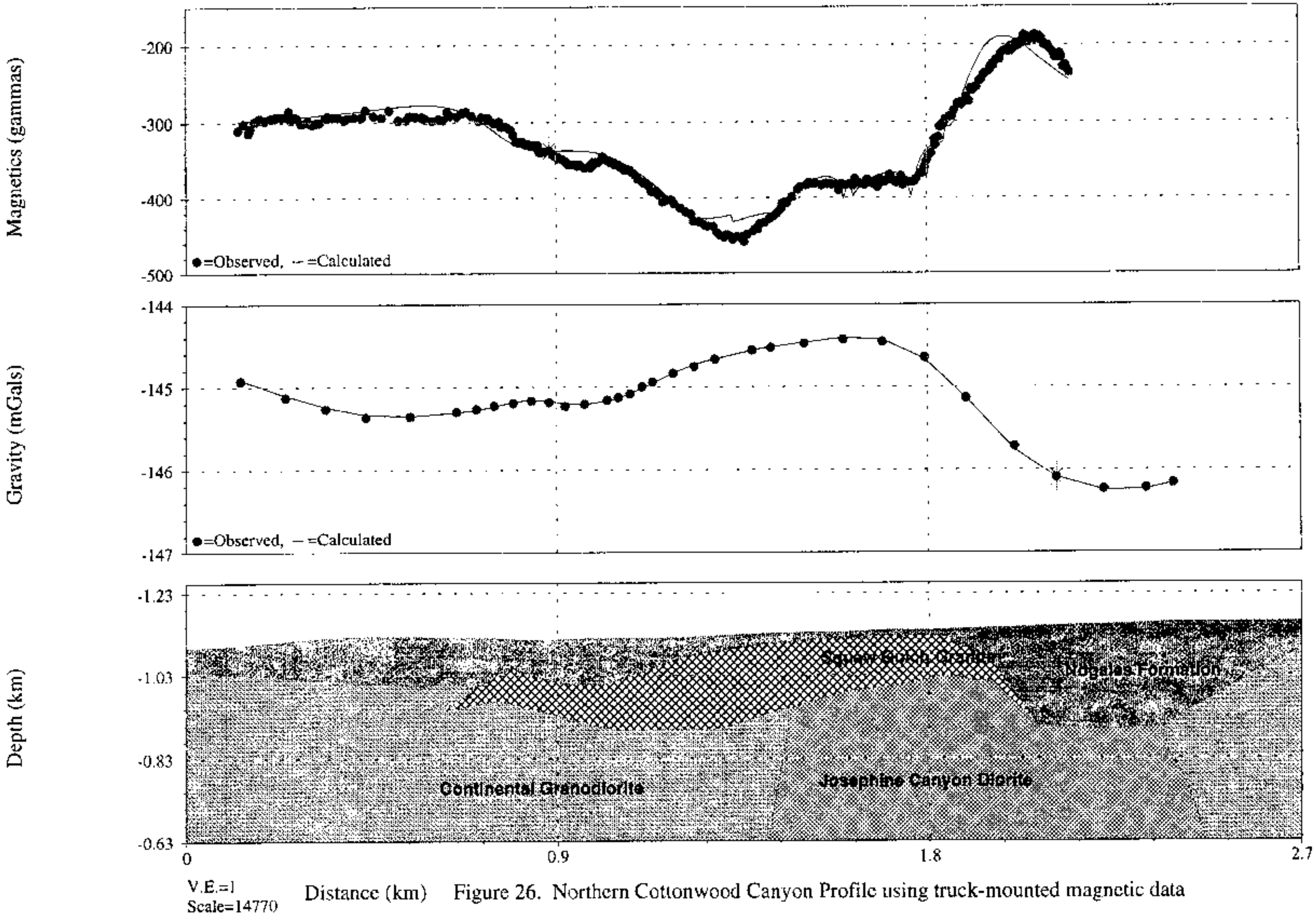


Figure 26. Northern Cottonwood Canyon Profile using truck-mounted magnetic data

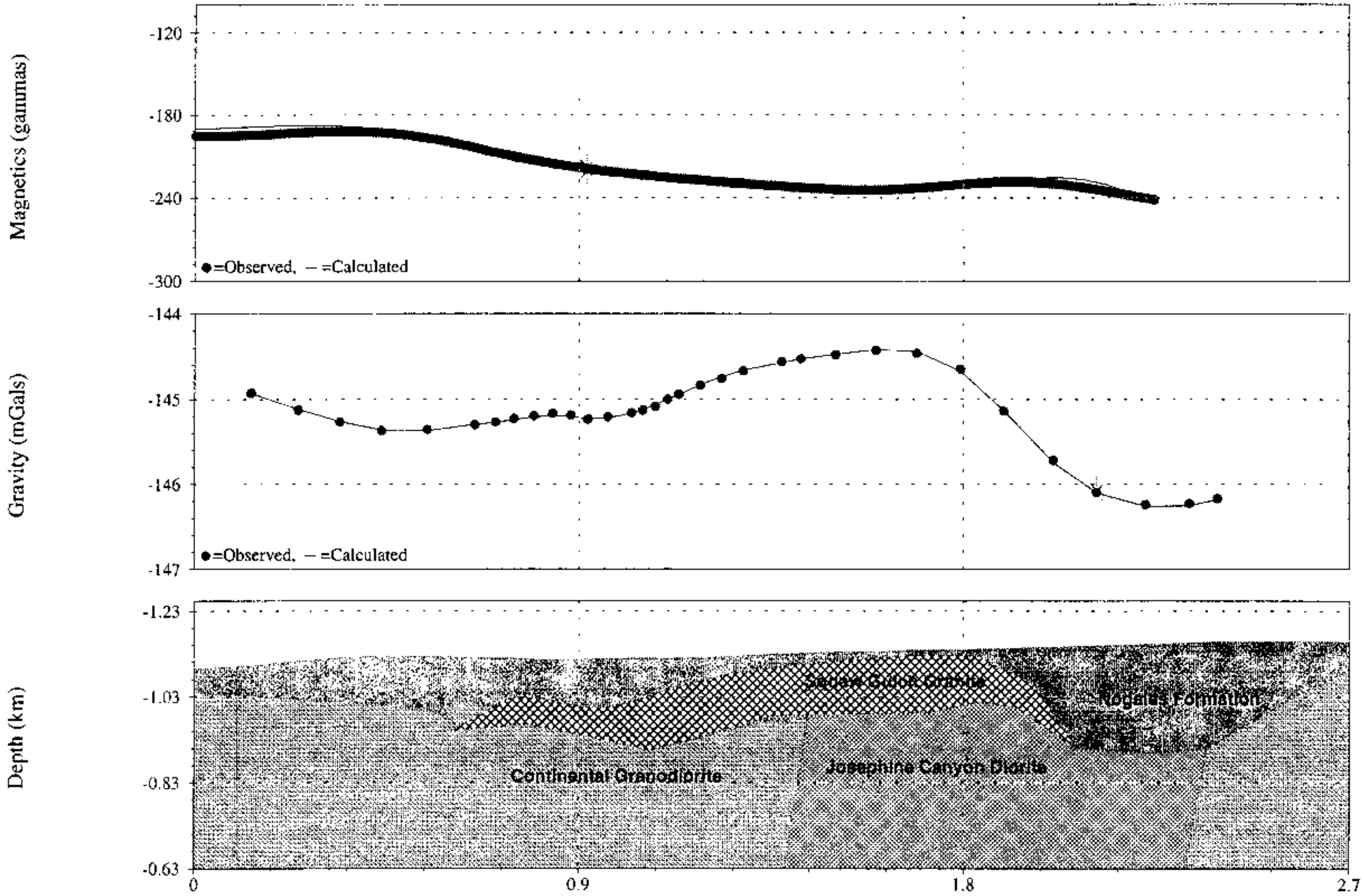


Figure 27. Northern Cottonwood Canyon Profile using aeromagnetic data

SOUTHERN COTTONWOOD CANYON PROFILE

The profile along the southern terrace of Cottonwood Canyon was located about 1.2 km to the south of the northern profile. The fault scarp was visible where the profile crossed it and dips towards the west with 2 meters of relief. The fault is located at 0.75 km on the model shown in Figs. 28, 29 and 30.

The gravity anomaly for the southern profile was again modeled first using the available geological and geophysical constraints. The bedrock units used in modeling the northern profile were used in the southern profile. Unlike the northern profile, the upper basin fill, ρ = 1.87 g/cc, is present and overlies the Nogales formation (Drewes, 1972). Also, there is a high-density caliche layer, ρ = 2.64 g/cc within the upper basin fill that has a variable thickness (Gettings and Houser, 1997). The large range of CBGA values is about 6 mGals within the southern profile. The trace of the fault mapped by Houser farther up Cottonwood Canyon was projected to intersect the profile at 2.1 km which coincides with the inflection point of the large 5 mGal anomaly as seen in the eastern portion of the profile (Fig. 29). Therefore, a fault dipping to the west with relief approximately 0.3 km was used to model the data. It appears that the profile begins in the graben and crosses the rising southern flank of the horst feature (Fig. 29). The gravity model indicates the presence of several other smaller faults located within the Squaw Gulch Granite, however, as they are modeled they do not offset the Nogales above. This suggests that faults are not present but rather are variations in the paleotopography of the top of the Squaw Gulch body. The surface fault scarp has an anomaly similar to the one

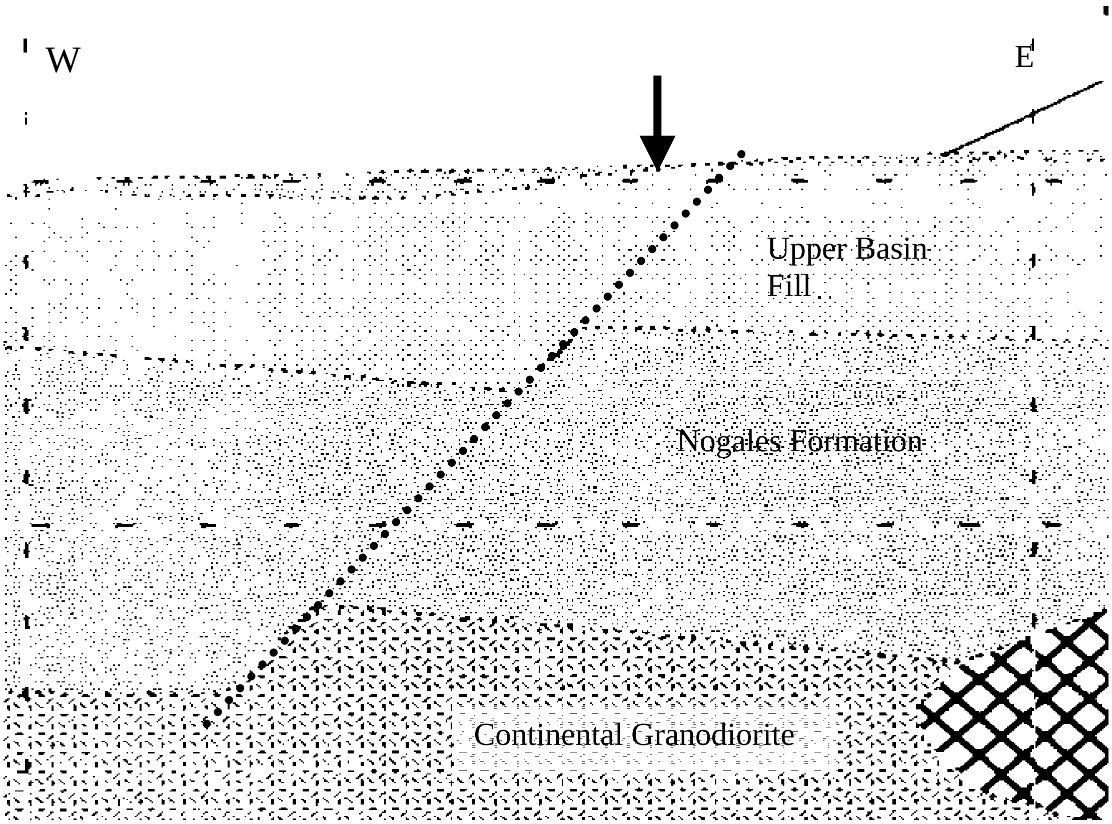


Figure 28. Magnification of Southern Cottonwood Canyon model.

in the northern profile. However, the fault at depth does not coincide with the contact of the Squaw Gulch granite, but exists solely in the bedrock material. The fault within the bedrock dips about 50 degrees to the west with 0.06 km of relief. The Nogales sediments above are faulted as a result, and Fig. (28) shows that the fault plane is exactly up-dip from the fault within the bedrock. The fault propagated through the upper basin fill unit to the surface in a few meters west of the up-dip projection of the bedrock fault. This would suggest that upper basin fill unit is also a well-indurated layer. The presence of the high-density layer near the surface somewhat masked the subsurface geology. A model was created without the caliche layer and the results were very poor. The fault that modeled the anomaly was an unrealistic feature resembling a spike of significant relief. Although the high-density layer was required to help fit the gravity data, its thickness was constrained to less than 10 meters so that it would not dominate the model.

Lack of roads prevented the acquisition of magnetic data west of the fault scarp so only half of the profile could be modeled. The magnetic data were modeled using a combination of the reversely polarized Squaw Gulch Granite and highly magnetized Josephine Canyon Profile. There is a magnetic low located at 1.9 km, which coincides with the large fault modeled in the gravity. The sharp anomaly could not be modeled by varying the susceptibility of the Continental granodiorite alone, so, the reversely polarized, Squaw Gulch Granite (k = $1.0x10^{-4}$ cgs) was added as intrusive sill into the bedrock and the anomaly around 1.9 km was well fit. To the east however, the magnetic response of the Squaw Gulch was systematically lower than observed data. Increasing the thickness of the body made the fit worse. The Josephine Canyon Diorite (k = $6.5x10^{-3}$) was added as an intrusive body into the Squaw Gulch. This provided the positive response in the magnetic data needed to fit the profile in the range of 0.7 to 1.6 km. Also, using the Josephine Canyon Diorite fit the aeromagnetic high located in the western portion of the profile. This model shows that the extent of the diorite to be less than 1 km where it is in contact with the intrusive granite. If the diorite was increased in horizontal extent then the response was too positive and the fit to the data was worsened, especially, in the region of 1.9 to 2.4 km (Fig. 30). The magnetic high here was difficult to model because of its intensity of 100 nT. Magnetite bearing sediments were considered (k = $2.5x10^{-3}$), however, their response was too weak and could not match the data. The diorite was extended to underlay the location of the magnetic high and the response was too positive. Since, the Squaw Gulch granite was somehow related to the large fault in the horst and graben, it seemed plausible that the sill was faulted and that remnants of it remained at the top of the fault. A thin layer of the Squaw Gulch near the surface was used to obtain a good fit to the magnetic data. The geologic map indicates large exposures of the Squaw Gulch granite just to the east of this area (Drewes, 1976) and so erosion could justify the thinness of the Squaw Gulch at the surface versus the thickness of it at depth.

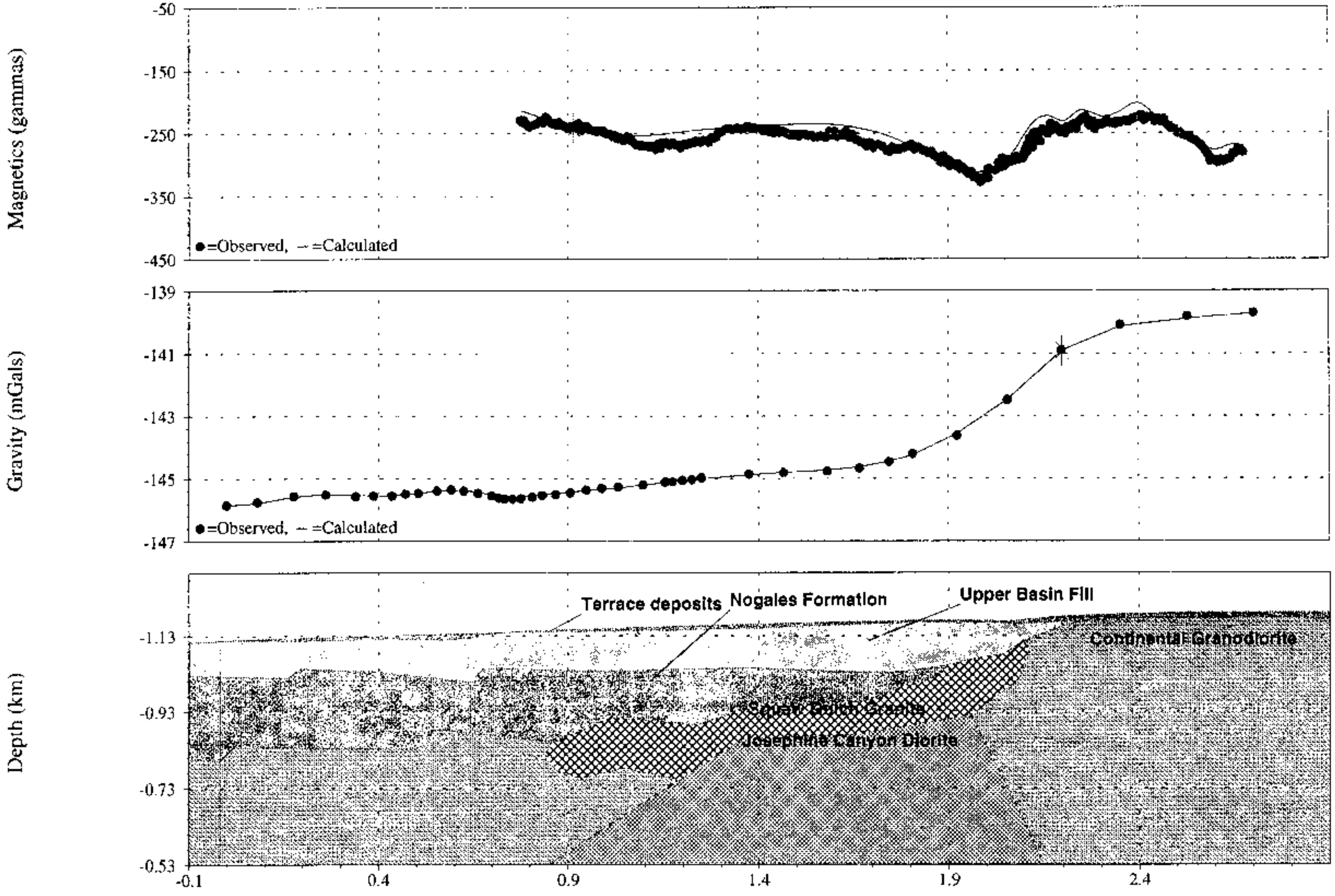


Figure 29. Southern Cottonwood Canyon Profile using truck-mounted magnetic data

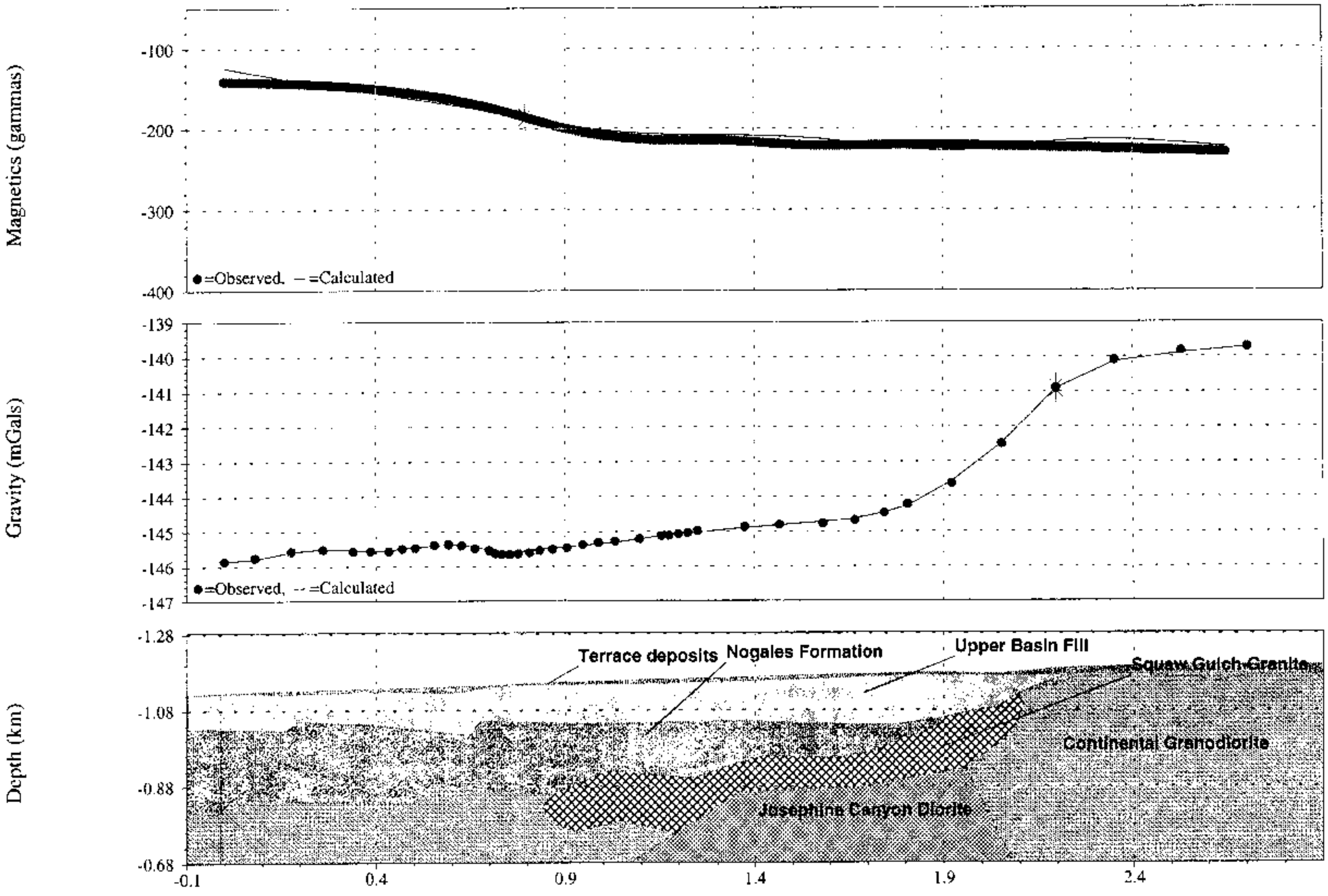


Figure 30. Southern Cottonwood Canyon Profile using aeromagnetic data

CONCLUSIONS

Gravity data collected along profiles across late Quaternary basin-bounding faults near the western flank of the Santa Rita Mountains proved to be useful in understanding the relationship of the gravity response of the faults at depth with their resulting surface fault scarps. Truck-mounted magnetic data and airborne magnetic data did not prove as useful for studying these smaller faults but rather helped in modeling the broader geological picture.

Because of the inherent nonuniqueness involved with geophysical modeling it was important to include any independent geologic knowledge. Density measurements of the upper basin fill, the Nogales Formation, and the high-density caliche layer were used to constrain to the models (Gettings and Houser, 1997). Geologic mapping by Drewes (1971a) and Houser (1997) were also used to justify the insertion of strongly magnetic bodies such as the Josephine Canyon Diorite, and reversely polarized bodies such as the Squaw Gulch Granite. Also, faults mapped out by Drewes and Houser helped to form the structural control of the models, especially in the Cottonwood Canyon area where two profiles in close vicinity to one another had to be tied together geologically.

The first profile was modeled along Rex Ranch road on the northern terrace of Montosa Canyon. The gravity data were collected over the course of several days and there was no base station control in the field. Some of the smaller gradients may not actually be due to faults but rather to the uncertainty in gravity values. The general trend of the gravity data shows bedrock dipping towards the center of the basin. The magnetic data show a large magnetic low at 1.2 km and a large magnetic high at 1.9 km. The low was modeled by emplacing a sill of the Squaw Gulch Granite, which had a remanent magnetization of $9x10^{-4}$ cgs. The magnetic high was modeled with an intrusive body with a high susceptibility of $6.5x10^{-4}$. The anomaly of the surface fault scarp was modeled as a fault in the bedrock about 100 m below. The fault plane in the bedrock was projected to the surface and shown to intersect the surface east of the present day fault. This would suggest that the upper basin fill responded in more of a brittle fashion to movement created by the fault at depth.

The gravity data for the two Cottonwood Canyon profiles suggest the presence of a large horst and graben structure. The northern profile seems to have been collected along the top of the northern footwall before going down the fault plane onto the top of the graben. The east end of the gravity profile increases again as it approaches the southern footwall. The southern profile begins along the graben surface and climbs up the southern footwall as indicated by the increasing gravity values. A thickness of 0.2 km of Nogales sediments above the graben was found through gravity modeling of the northern profile.

The Squaw Gulch Granite was modeled closer to the surface in the northern profile than in the southern profile. The depth to the sill discrepancy between the two profiles can be resolved by assuming that large scale faulting down dropped the Squaw Gulch Granite. The surface fault scarp that extends through the Cottonwood canyon postdates any of the large-scale faulting primarily because of the lack of relief at the earth’s surface that accommodate the movement. The fault planes of the faults at depth as shown in Fig. 24 and 26 were projected to the surface. And similar to the Rex Ranch profile, the overlying sediments were faulted in a manner conducive to having brittle characteristics. In each of the three profiles the surface rupture is only 10 to 20 m west of the up-dip projection of the modeled fault at depth. This might suggest brittle deformation within the consolidated sediments at greater depths followed by ductile deformation closer to the surface which coincides with unconsolidated.

Although the models shown above are the best fit of the gravity, magnetic and aeromagnetic anomaly profiles for the available constraints they are not perfect. Misfits to the data originate from the simple shapes used to model the data and from the data having some error in them. There is always a tradeoff between a perfect fit to the data and the geological soundness of the model. The latter was always opted for because of the inherent ambiguities involved in modeling. The simpler model is generally the more geologically insightful one. Although the usage of very specific rock types was used, there is always the possibility that the geophysical response might be due to something different. The usage of Squaw Gulch as the primary magnetic source for the profiles is not beyond reproach. There are several other reversely magnetized volcanic rock units within the Santa Rita Mountains that could be the source for the anomalies, however, none in as close proximity as the Squaw Gulch Granite and Josephine Canyon Diorite.

The data and conclusions from this thesis will lend insight to current and future large-scale efforts. Arizona’s number one source of income is comes from the mining industry, and the next frontier for the discovery of mineral prospects is in the study of shallow basins covered by Quaternary deposits. This project is also part of a larger project to delineate geologic form and subsurface geologic structure of the Santa Cruz basin. The location of controlling structures has important implications in many ground water issues and earthquake hazards.

The modeled faults in the three profiles offset the overlying sediments, i.e. the Nogales Formation, from 30 to 60 m with a mean of 45 m of relief and the dip of the faults at depth ranged from 40 to 58 degrees with an average of 32 degrees. The surface rupture was observed to have 2 meters of relief. If it is assumed that one seismic event caused the 2 m of relief at the surface and that the average relief of the fault at depth is 45 m then there have been 22 events. Given the age of the Nogales Formation to be approximately 16 mya then an earthquake that would cause 2 m of relief at the surface would occur about every 0.7 my. This earthquake recurrence period is possibly an overestimate due to surface erosion and the recurrence interval might be more every 1 my.

The ability to do a high precision gravity survey relies heavily on the location control especially the altitude control. The use of differential GPS in this survey made possible a high precision survey, however, careful planning was required to ensure that satellite coverage was sufficient to obtain the required elevation and location accuracy.

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APPENDIX A: GRAVITY DATA

Station ID	Lat. Deg.	Longitude Deg.	Elev. (m)	Observed Gravity (mGal)	Free Air Anomaly (mGal)	Simple Bouger Anomaly (p=2.67 g/cc)	Complete Bouger Anomaly (p=2.67 g/cc)	Inner Zone Terrain Correction (p=2.67 g/cc)	Total Terrain Correction	Uncertainty in CBGA (p=2.67 g/cc) (mGal)
rr-01	31.69673333	-111.0042667	1067.15	979106.49	-23.13	-142.55	-142.57	0.09	1.14	0.23
rr-02	31.69668333	-111.0052667	1065.81	979106.78	-23.26	-142.52	-142.55	0	1.13	0.23
rr-03	31.69661667	-111.0061667	1064.39	979107.14	-23.33	-142.43	-142.49	0	1.1	0.22
rr-04	31.69651667	-111.0071667	1062.43	979107.60	-23.47	-142.35	-142.49	0	1.02	0.21
rr-05	31.69636667	-111.0082	1059.52	979108.37	-23.58	-142.14	-142.26	0.04	1.03	0.21
rr-06	31.69641667	-111.0090833	1054.59	979109.53	-23.94	-141.95	-142.06	0.07	1.04	0.21
rr-07	31.69651667	-111.0099833	1051.53	979110.17	-24.26	-141.92	-142.1	0.02	0.97	0.2
rr-08	31.6966	-111.0104167	1049.31	979110.63	-24.49	-141.91	-142.02	0.11	1.03	0.21
rr-09	31.69668333	-111.0110333	1046.75	979111.14	-24.78	-141.91	-142.07	0.09	0.98	0.2
rr-10	31.69668333	-111.0110333	1046.73	979111.14	-24.79	-141.91	-142.12	0.05	0.94	0.19
rr-11	31.69671667	-111.0115333	1044.81	979111.48	-25.04	-141.95	-142.18	0.04	0.92	0.19
rr-12	31.69678333	-111.012	1042.95	979111.82	-25.28	-141.98	-142.21	0.04	0.91	0.19
rr-13	31.69685	-111.0125167	1040.01	979112.40	-25.6	-141.98	-142.22	0.04	0.9	0.18
rr-14	31.6969	-111.0130167	1038.41	979112.65	-25.86	-142.05	-142.34	0	0.85	0.17
rr-15	31.69695	-111.0134833	1037.24	979112.78	-26.1	-142.16	-142.45	0	0.85	0.17
rr-16	31.69696667	-111.0137167	1036.69	979112.87	-26.18	-142.18	-142.47	0	0.85	0.17
rr-17	31.69696667	-111.0139833	1036.1	979112.95	-26.28	-142.21	-142.5	0	0.85	0.17
rr-18	31.69698333	-111.01425	1035.29	979113.05	-26.42	-142.27	-142.56	0	0.85	0.17
rr-19	31.697	-111.01445	1034.95	979113.08	-26.5	-142.31	-142.6	0	0.85	0.17
rr-20	31.697	-111.0146167	1034.51	979113.12	-26.59	-142.35	-142.65	0	0.84	0.17
rr-21	31.69698333	-111.0148	1034.13	979113.14	-26.69	-142.41	-142.69	0.01	0.86	0.18
rr-22	31.69696667	-111.0149667	1032.85	979113.36	-26.87	-142.44	-142.72	0.02	0.86	0.18
rr-23	31.69696667	-111.0151333	1031.38	979113.65	-27.03	-142.44	-142.73	0	0.84	0.17
rr-24	31.69695	-111.01535	1030.63	979113.76	-27.15	-142.47	-142.76	0.01	0.85	0.17
rr-25	31.69693333	-111.0155833	1030.2	979113.75	-27.29	-142.57	-142.86	0	0.84	0.17
rr-26	31.69698333	-111.0159	1029.36	979113.78	-27.52	-142.71	-142.98	0	0.86	0.18
rr-27	31.69693333	-111.0160667	1028.82	979113.88	-27.59	-142.71	-143	0	0.84	0.17

rr-28	31.69686667	-111.0165167	1026.79	979114.24	-27.85	-142.74	-143.03	0	0.84	0.17
rr-29	31.69688333	-111.01695	1025.69	979114.30	-28.13	-142.9	-143.19	0	0.84	0.17
rr-30	31.6968	-111.0174167	1024.41	979114.34	-28.47	-143.1	-143.38	0	0.85	0.17
rr-31	31.69676667	-111.0177833	1023.64	979114.32	-28.73	-143.28	-143.55	0	0.86	0.18
rr-32	31.69675	-111.0183333	1022.93	979114.31	-28.96	-143.43	-143.7	0	0.85	0.17
rr-33	31.6967	-111.0188	1022.02	979114.34	-29.21	-143.57	-143.86	0	0.84	0.17
rr-34	31.69665	-111.0192333	1020.83	979114.42	-29.49	-143.72	-144.02	0	0.83	0.17
rr-35	31.69658333	-111.0197	1019.67	979114.55	-29.72	-143.82	-144.12	0	0.82	0.17
rr-36	31.69643333	-111.02035	1017.85	979114.71	-30.1	-143.99	-144.3	0.02	0.82	0.17
rr-37	31.69638333	-111.0214167	1015.77	979114.80	-30.65	-144.31	-144.57	0	0.86	0.18
rr-38	31.69645	-111.0224	1012.67	979115.18	-31.23	-144.55	-144.81	0	0.86	0.18
rr-39	31.6965	-111.0235333	1009.51	979115.50	-31.89	-144.85	-145.19	0	0.78	0.16
rr-40	31.69655	-111.0247667	1007.07	979115.71	-32.44	-145.13	-145.47	0	0.77	0.16
cw-01	31.64255	-110.9738167	1154.56	979081.32	-16.97	-146.16	-146.17	0.08	1.21	0.24
cw-02	31.64255	-110.9745167	1152.17	979082.82	-16.2	-145.13	-145.23	0	1.12	0.23
cw-03	31.64246667	-110.9756	1149.3	979082.33	-17.58	-146.18	-146.29	0	1.11	0.22
cw-04	31.64241667	-110.9768	1145.93	979083.19	-17.74	-145.97	-146.1	0	1.09	0.22
cw-05	31.64235	-110.9778667	1142.15	979084.31	-17.79	-145.6	-145.72	0	1.09	0.22
cw-06	31.64226667	-110.9791	1139.31	979085.44	-17.52	-145.01	-145.14	0	1.08	0.22
cw-07	31.64213333	-110.98015	1136.19	979086.54	-17.38	-144.51	-144.65	0	1.07	0.22
cw-08	31.64191667	-110.9812333	1133.03	979087.35	-17.53	-144.32	-144.46	0	1.06	0.21
cw-09	31.64166667	-110.9822333	1130.48	979087.77	-17.87	-144.37	-144.43	0.08	1.14	0.23
cw-10	31.64156667	-110.9832333	1130.14	979087.76	-17.98	-144.44	-144.48	0.08	1.16	0.23
cw-11	31.6419	-110.9840833	1127.87	979088.09	-18.38	-144.59	-144.53	0.17	1.26	0.25
cw-12	31.64211667	-110.9845667	1126.45	979088.27	-18.65	-144.7	-144.56	0.26	1.34	0.27
cw-13	31.64255	-110.9855167	1121.71	979089.15	-19.27	-144.78	-144.67	0.26	1.31	0.26
cw-14	31.64271667	-110.98605	1119.16	979089.60	-19.62	-144.85	-144.76	0.26	1.29	0.26
cw-15	31.64288333	-110.9865833	1116.88	979090.03	-19.91	-144.89	-144.84	0.22	1.24	0.25
cw-16	31.6431	-110.9871	1116.16	979090.18	-20	-144.89	-144.92	0.15	1.17	0.24
cw-17	31.64316667	-110.9873833	1115.54	979090.22	-20.15	-144.98	-145	0.15	1.18	0.24
cw-18	31.6431	-110.9876833	1115.77	979089.98	-20.32	-145.17	-145.09	0.26	1.27	0.26
cw-19	31.64306667	-110.9879833	1116.07	979089.94	-20.26	-145.15	-145.13	0.19	1.21	0.24
cw-20	31.64306667	-110.9882667	1115.99	979089.92	-20.31	-145.19	-145.16	0.2	1.22	0.25
cw-21	31.64308333	-110.98885	1115.17	979089.98	-20.51	-145.29	-145.21	0.26	1.28	0.26
cw-22	31.64325	-110.98935	1114.15	979090.14	-20.67	-145.34	-145.26	0.24	1.27	0.26
cw-23	31.64355	-110.9897667	1111.3	979090.85	-20.87	-145.22	-145.19	0.22	1.22	0.25
cw-24	31.64371667	-110.9902167	1111.27	979090.94	-20.79	-145.14	-145.17	0.17	1.16	0.23

cw-25	31.64373333	-110.9906667	1113.45	979090.53	-20.53	-145.12	-145.22	0.1	1.1	0.22
cw-26	31.64376667	-110.9911667	1115.71	979089.99	-20.38	-145.22	-145.23	0.15	1.19	0.24
cw-27	31.64386667	-110.9916167	1116.78	979089.82	-20.23	-145.2	-145.27	0.05	1.12	0.23
cw-28	31.64398333	-110.9921333	1117.16	979089.72	-20.22	-145.23	-145.3	0.05	1.12	0.23
cw-29	31.64385	-110.9933167	1119.65	979089.15	-20.01	-145.3	-145.32	0.04	1.17	0.24
cw-30	31.6439	-110.9944333	1120.9	979088.78	-20	-145.43	-145.37	0.1	1.26	0.25
cw-31	31.644	-110.9954833	1116.5	979089.79	-20.36	-145.29	-145.27	0.1	1.22	0.25
cw-32	31.64393333	-110.9965	1108.84	979091.52	-20.98	-145.06	-145.13	0.11	1.12	0.23
cw-33	31.6442	-110.99765	1098.32	979094.00	-21.77	-144.67	-144.93	0	0.92	0.19
cc-01	31.63365	-110.9666167	1194.86	979078.43	-6.7	-140.41	-140.08	0.08	1.57	0.32
cc-02	31.63386667	-110.96845	1195.26	979078.19	-6.84	-140.59	-140.09	0.02	1.74	0.35
cc-03	31.63366667	-110.9703167	1190.55	979078.77	-7.7	-140.92	-140.72	0.02	1.44	0.29
cc-04	31.63368333	-110.97195	1185.36	979079.16	-8.91	-141.55	-141.41	0.02	1.38	0.28
cc-05	31.63408333	-110.97345	1171.65	979080.61	-11.72	-142.83	-142.9	0.02	1.16	0.23
cc-06	31.63513333	-110.9754833	1173.8	979079.02	-12.74	-144.08	-144.12	0	1.19	0.24
cc-07	31.63521667	-110.9767167	1173.71	979078.68	-13.1	-144.44	-144.46	0	1.21	0.24
cc-08	31.63538333	-110.9773667	1172.53	979078.66	-13.51	-144.71	-144.23	0.51	1.71	0.34
cc-09	31.63528333	-110.9781833	1170.97	979079.03	-13.61	-144.64	-144.69	0	1.18	0.24
cc-10	31.63523333	-110.9790833	1168.94	979079.35	-13.91	-144.71	-144.78	0	1.16	0.23
cc-11	31.63513333	-110.9803	1166.11	979079.88	-14.25	-144.73	-144.82	0	1.14	0.23
cc-12	31.635	-110.9812667	1163.94	979080.23	-14.55	-144.8	-144.87	0	1.15	0.23
cc-13	31.63486667	-110.9826	1160.69	979080.75	-15.02	-144.9	-144.95	0	1.18	0.24
cc-14	31.63473333	-110.9822167	1159.5	979080.84	-15.3	-145.04	-145.08	0	1.19	0.24
cc-15	31.6347	-110.9824667	1158.81	979080.94	-15.41	-145.07	-145.08	0	1.22	0.25
cc-16	31.64663333	-110.9827333	1158.1	979081.04	-15.53	-145.12	-145.12	0	1.22	0.25
cc-17	31.6347	-110.9835833	1157.58	979081.07	-15.65	-145.19	-145.18	0	1.23	0.25
cc-18	31.63461667	-110.9842	1155.9	979081.32	-15.91	-145.25	-145.22	0	1.25	0.25
cc-19	31.63445	-110.9848833	1154	979081.57	-16.24	-145.37	-145.29	0	1.3	0.26
cc-20	31.63433333	-110.98535	1152.71	979081.75	-16.44	-145.43	-145.33	0	1.32	0.27
cc-21	31.63421667	-110.9857667	1151.45	979081.94	-16.64	-145.48	-145.39	0	1.31	0.26
cc-22	31.63416667	-110.9862167	1150.11	979082.10	-16.88	-145.58	-145.51	0	1.28	0.26
cc-23	31.63411667	-110.9866333	1148.82	979082.36	-17.02	-145.57	-145.52	0	1.27	0.26
cc-24	31.63408333	-110.9869833	1147.62	979082.54	-17.2	-145.62	-145.55	0	1.28	0.26
cc-25	31.63405	-110.98725	1146.7	979082.65	-17.37	-145.69	-145.61	0	1.29	0.26
cc-26	31.634	-110.9875833	1145.51	979082.86	-17.53	-145.71	-145.61	0.04	1.31	0.26
cc-27	31.634	-110.9878167	1143.99	979083.14	-17.72	-145.73	-145.58	0.09	1.36	0.27
cc-28	31.63396667	-110.9880333	1142.49	979083.43	-17.89	-145.73	-145.57	0.09	1.37	0.28

cc-29	31.63395	-110.9882	1141.29	979083.67	-18.01	-145.72	-145.64	0	1.29	0.26
cc-30	31.63396667	-110.9884	1141.35	979083.68	-17.99	-145.7	-145.54	0.02	1.37	0.28
cc-31	31.63395	-110.9887833	1140.42	979083.86	-18.09	-145.7	-145.49	0	1.42	0.29
cc-32	31.63391667	-110.9891667	1139.45	979084.07	-18.18	-145.68	-145.41	0	1.48	0.3
cc-33	31.6339	-110.9895333	1138.54	979084.27	-18.26	-145.66	-145.37	0	1.5	0.3
cc-34	31.63388333	-110.9899333	1137.53	979084.48	-18.36	-145.65	-145.4	0	1.46	0.29
cc-35	31.63385	-110.99045	1136.12	979084.77	-18.5	-145.63	-145.48	0	1.36	0.27
cc-36	31.63383333	-110.9908167	1135.2	979085.00	-18.55	-145.58	-145.5	0	1.29	0.26
cc-37	31.6338	-110.9911833	1134.23	979085.16	-18.69	-145.61	-145.57	0	1.24	0.25
cc-38	31.63378333	-110.9916833	1132.96	979085.43	-18.82	-145.59	-145.57	0	1.23	0.25
cc-39	31.63373333	-110.9921833	1131.74	979085.67	-18.94	-145.58	-145.58	0	1.21	0.24
cc-40	31.63363333	-110.9930167	1129.59	979086.08	-19.2	-145.59	-145.53	0	1.27	0.26
cc-41	31.6335	-110.9939	1127.35	979086.47	-19.48	-145.63	-145.57	0	1.26	0.25
cc-42	31.63338333	-110.9949	1124.72	979086.92	-19.83	-145.68	-145.76	0	1.12	0.23
cc-43	31.63328333	-110.9957667	1122.36	979087.35	-20.13	-145.72	-145.86	0	1.05	0.21

APPENDIX B: TRUCK MAGNETIC DATA

Station ID	Lat. Deg.	Long. Deg.	Elev (m)	Observed*100 (nT)	IGRF*100 (nT)	Heading Corrected Field*100 (nT)
rr-mag-01	31.69873056	-111.0254806	1007	4790837	-82656	-33282
rr-mag-02	31.69868056	-111.0253306	1007	4792418	-81073	-32435
rr-mag-03	31.69863056	-111.0251667	1008	4792836	-80656	-35513
rr-mag-04	31.69859722	-111.025	1008	4791983	-81510	-33637
rr-mag-05	31.69855	-111.0248306	1009	4790502	-82991	-34851
rr-mag-06	31.69849722	-111.0246472	1009	4793206	-80287	-32278
rr-mag-07	31.69845	-111.0244806	1009	4793260	-80233	-32093
rr-mag-08	31.69839722	-111.0242972	1010	4789451	-84043	-36034
rr-mag-09	31.69835	-111.0241306	1010	4795982	-77511	-29371
rr-mag-10	31.69829722	-111.0239472	1011	4790287	-83205	-35196
rr-mag-11	31.69825	-111.0237806	1011	4791929	-81563	-31758
rr-mag-12	31.69819722	-111.0236306	1011	4795709	-77783	-29145
rr-mag-13	31.69814722	-111.0234667	1012	4791147	-82345	-33442
rr-mag-14	31.6981	-111.0233167	1012	4793934	-79558	-33555
rr-mag-15	31.69806667	-111.0231667	1013	4791699	-81790	-32416
rr-mag-16	31.69801667	-111.0230167	1013	4791790	-81698	-32324
rr-mag-17	31.69796667	-111.0228667	1013	4792676	-80812	-34149
rr-mag-18	31.69793056	-111.0227167	1013	4792388	-81102	-35016
rr-mag-19	31.6979	-111.0225806	1014	4791264	-82225	-36223
rr-mag-20	31.69786667	-111.0224306	1014	4789553	-83937	-36126
rr-mag-21	31.69783056	-111.0223	1015	4791857	-81633	-35377
rr-mag-22	31.6978	-111.0221667	1015	4793120	-80372	-33567
rr-mag-23	31.69776667	-111.0220306	1015	4792141	-81353	-34690
rr-mag-24	31.69773056	-111.0218806	1016	4792587	-80904	-35613
rr-mag-25	31.6977	-111.0217306	1016	4792557	-80935	-33785
rr-mag-26	31.69766667	-111.0216	1017	4795209	-78284	-30647
rr-mag-27	31.69763056	-111.0214667	1017	4797938	-75554	-35350
rr-mag-28	31.69761667	-111.0213306	1017	4798070	-75424	-32748
rr-mag-29	31.6976	-111.0212167	1018	4796681	-76814	-31898
rr-mag-30	31.69758056	-111.0211167	1018	4792598	-80897	-38611
rr-mag-31	31.69756667	-111.0210167	1018	4795276	-78220	-32086
rr-mag-32	31.69754722	-111.0209306	1018	4797831	-75665	-30523
rr-mag-33	31.69753056	-111.0208472	1019	4798183	-75313	-31361
rr-mag-34	31.69751667	-111.0207667	1019	4794573	-78924	-34046
rr-mag-35	31.6975	-111.0206806	1019	4793971	-79526	-32841
rr-mag-36	31.69748056	-111.0206	1019	4793968	-79529	-37444
rr-mag-37	31.69746667	-111.0204972	1019	4800498	-73001	-28086
rr-mag-38	31.69744722	-111.0203972	1020	4798427	-75072	-43154
rr-mag-39	31.69744722	-111.0202806	1020	4795326	-78174	-29523
rr-mag-40	31.69741667	-111.0201806	1021	4794111	-79388	-36738
rr-mag-41	31.69739722	-111.0200472	1021	4801738	-71763	-29268
rr-mag-42	31.69738056	-111.0199306	1021	4795967	-77536	-37073
rr-mag-43	31.69736667	-111.0198	1022	4798875	-74630	-33099
rr-mag-44	31.69735	-111.0196667	1022	4797429	-76077	-32580
rr-mag-45	31.69733056	-111.0195472	1022	4799585	-73922	-33459
rr-mag-46	31.69731667	-111.0194167	1022	4802145	-71364	-39446
rr-mag-47	31.69731667	-111.0193	1023	4802202	-71308	-39390
rr-mag-48	31.69731667	-111.0191667	1023	4808369	-65144	-43976
rr-mag-49	31.69733056	-111.0190306	1023	4806933	-66584	-34666
rr-mag-50	31.69733056	-111.0189	1024	4806775	-66743	-49958
rr-mag-51	31.69735	-111.0187667	1024	4806125	-67397	-48443

rr-mag-52	31.69736667	-111.0186306	1025	4806999	-66525	-44342
rr-mag-53	31.69738056	-111.0184806	1025	4811001	-62527	-30609
rr-mag-54	31.69738056	-111.0183472	1025	4807004	-66526	-46339
rr-mag-55	31.69739722	-111.0181972	1025	4808184	-65351	-48836
rr-mag-56	31.69741667	-111.0180667	1026	4807760	-65778	-53694
rr-mag-57	31.69744722	-111.0179167	1026	4809052	-64490	-47443
rr-mag-58	31.69746667	-111.0177806	1026	4807835	-65710	-43528
rr-mag-59	31.69748056	-111.0176306	1027	4809249	-64301	-54508
rr-mag-60	31.69751667	-111.0174806	1027	4805640	-67914	-35996
rr-mag-61	31.69751667	-111.0173306	1028	4804832	-68723	-46541
rr-mag-62	31.69753056	-111.0171806	1028	4805144	-68415	-36497
rr-mag-63	31.69753056	-111.0170472	1029	4799694	-73868	-41950
rr-mag-64	31.69753056	-111.0169	1029	4798496	-75069	-35440
rr-mag-65	31.69751667	-111.01675	1029	4795038	-78528	-32017
rr-mag-66	31.69748056	-111.0165972	1030	4796894	-76674	-36938
rr-mag-67	31.69746667	-111.01645	1030	4794386	-79184	-36534
rr-mag-68	31.69744722	-111.0163167	1030	4783328	-90242	-46560
rr-mag-69	31.69739722	-111.0160167	1031	4788979	-84593	-42098
rr-mag-70	31.69738056	-111.0159	1032	4789105	-84467	-44136
rr-mag-71	31.69736667	-111.0157667	1033	4785298	-88276	-44594
rr-mag-72	31.69735	-111.0156667	1033	4797379	-76196	-31281
rr-mag-73	31.69733056	-111.0155667	1034	4796603	-76971	-35774
rr-mag-74	31.69731667	-111.01545	1034	4795532	-78044	-34547
rr-mag-75	31.69729722	-111.0153306	1035	4799131	-74446	-32915
rr-mag-76	31.69728056	-111.0151972	1035	4794198	-79381	-38184
rr-mag-77	31.69726667	-111.0150806	1035	4797921	-75658	-34127
rr-mag-78	31.69725	-111.0149472	1036	4797565	-76014	-34228
rr-mag-79	31.69723056	-111.0147972	1036	4797217	-76365	-29216
rr-mag-80	31.69719722	-111.0146667	1036	4796602	-76980	-35591
rr-mag-81	31.69718056	-111.0145306	1037	4798829	-74753	-35125
rr-mag-82	31.69716667	-111.0143806	1037	4796432	-77153	-35475
rr-mag-83	31.69715	-111.01425	1037	4796207	-77378	-30403
rr-mag-84	31.69711667	-111.0141167	1038	4797160	-76424	-33929
rr-mag-85	31.69709722	-111.0139806	1038	4797002	-76582	-35842
rr-mag-86	31.69708056	-111.0138306	1039	4798936	-74651	-28222
rr-mag-87	31.69705	-111.0137	1039	4799215	-74371	-31721
rr-mag-88	31.69703056	-111.0135667	1040	4799150	-74439	-34235
rr-mag-89	31.69701667	-111.0134306	1040	4799120	-74470	-31661
rr-mag-90	31.69699722	-111.0133	1041	4792723	-80870	-34614
rr-mag-91	31.69696667	-111.0131667	1041	4796943	-76649	-35261
rr-mag-92	31.69695	-111.0130306	1042	4797581	-76012	-32139
rr-mag-93	31.69693056	-111.0129167	1042	4799003	-74592	-34388
rr-mag-94	31.69691667	-111.0127806	1043	4797416	-76179	-32306
rr-mag-95	31.69689722	-111.0126667	1044	4799434	-74160	-32772
rr-mag-96	31.69688056	-111.0125306	1044	4802292	-71303	-26012
rr-mag-97	31.69685	-111.0123806	1045	4800608	-72988	-30338
rr-mag-98	31.69683056	-111.0122472	1045	4801305	-72296	-32560
rr-mag-99	31.69681667	-111.0121	1046	4804986	-68617	-22106
rr-mag-100	31.69678056	-111.0119472	1046	4804551	-69051	-28589
rr-mag-101	31.69676667	-111.0118167	1047	4807473	-66129	-25389
rr-mag-102	31.69675	-111.0116667	1048	4808877	-64726	-18724
rr-mag-103	31.69671667	-111.0115167	1048	4808160	-65444	-23658
rr-mag-104	31.69669722	-111.0113667	1049	4806686	-66920	-25532
rr-mag-105	31.69668056	-111.0112306	1050	4811923	-61683	-22055
rr-mag-106	31.69666667	-111.0110806	1050	4811105	-62502	-14865
rr-mag-107	31.69663056	-111.0109472	1051	4807950	-65657	-25195
rr-mag-108	31.69661667	-111.0108167	1052	4805982	-67627	-25307

rr-mag-109	31.6966	-111.0106972	1052	4764818	-108792	-65110
rr-mag-110	31.69658056	-111.0105806	1053	4789811	-83798	-42438
rr-mag-111	31.69656667	-111.0104667	1053	4808018	-65592	-20677
rr-mag-112	31.69654722	-111.0103667	1054	4806844	-66767	-24447
rr-mag-113	31.69653056	-111.0102472	1054	4804352	-69262	-37344
rr-mag-114	31.69653056	-111.0101472	1055	4804850	-68765	-19877
rr-mag-115	31.6965	-111.01005	1055	4809666	-63947	-20451
rr-mag-116	31.69648056	-111.0099306	1056	4808338	-65278	-23918
rr-mag-117	31.69646667	-111.0098167	1056	4810979	-62639	-30721
rr-mag-118	31.69646667	-111.0096806	1057	4814389	-59230	-27312
rr-mag-119	31.69646667	-111.0095667	1057	4818316	-55306	-23388
rr-mag-120	31.69646667	-111.00945	1058	4819185	-54439	-33500
rr-mag-121	31.69648056	-111.0093167	1058	4822776	-50851	-33803
rr-mag-122	31.6965	-111.0091806	1059	4821917	-51712	-33268
rr-mag-123	31.69651667	-111.00905	1060	4822069	-51564	-30625
rr-mag-124	31.69653056	-111.0089167	1060	4823272	-50364	-41828
rr-mag-125	31.69656667	-111.0087806	1060	4821755	-51885	-29702
rr-mag-126	31.69658056	-111.0086306	1061	4820797	-52846	-34588
rr-mag-127	31.6966	-111.0084806	1061	4820638	-53009	-32822
rr-mag-128	31.69661667	-111.0083306	1062	4818810	-54840	-31823
rr-mag-129	31.69663056	-111.0081667	1062	4823066	-50589	-18671
rr-mag-130	31.69663056	-111.0080167	1062	4817546	-56112	-36529
rr-mag-131	31.69665	-111.00785	1063	4823819	-49839	-28275
rr-mag-132	31.69666667	-111.0076806	1063	4815194	-58469	-26551
rr-mag-133	31.69666667	-111.0075167	1064	4815085	-58581	-35414
rr-mag-134	31.69668056	-111.00735	1064	4814952	-58719	-37155
rr-mag-135	31.69669722	-111.0071806	1064	4814834	-58841	-26923
rr-mag-136	31.69669722	-111.0070167	1065	4813840	-59837	-27919
rr-mag-137	31.69669722	-111.0068306	1065	4813806	-59875	-39141
rr-mag-138	31.69671667	-111.0066472	1065	4810505	-63179	-31261
rr-mag-139	31.69671667	-111.0064667	1066	4813806	-59883	-35824
rr-mag-140	31.69673056	-111.0062806	1066	4810367	-63326	-31408
rr-mag-141	31.69673056	-111.0060806	1066	4810066	-63631	-31713
rr-mag-142	31.69673056	-111.0058972	1067	4811677	-62022	-41464
cw-mag-01	31.64266667	-110.9755472	1154	4787165	-85750	-28180
cw-mag-02	31.64264722	-110.9755472	1154	4787221	-85692	-33956
cw-mag-03	31.64264722	-110.9755667	1154	4783299	-89615	-37879
cw-mag-04	31.64264722	-110.9756167	1154	4786730	-86183	-62962
cw-mag-05	31.64266667	-110.9756667	1153	4789235	-83679	-31943
cw-mag-06	31.64266667	-110.9757	1153	4790253	-82660	-30924
cw-mag-07	31.64266667	-110.9757806	1153	4788557	-84355	-27297
cw-mag-08	31.64264722	-110.9758972	1153	4789114	-83793	-32057
cw-mag-09	31.64264722	-110.9759472	1153	4788172	-84734	-32998
cw-mag-10	31.64264722	-110.9759972	1153	4790231	-82675	-30939
cw-mag-11	31.64264722	-110.97605	1153	4789369	-83537	-26934
cw-mag-12	31.64263056	-110.9761667	1152	4791996	-80906	-29170
cw-mag-13	31.64263056	-110.9762	1152	4793488	-79413	-27677
cw-mag-14	31.64263056	-110.9762306	1152	4793912	-78989	-58841
cw-mag-15	31.64264722	-110.9762667	1152	4792143	-80758	-22530
cw-mag-16	31.64263056	-110.9763306	1152	4786740	-86158	-29639
cw-mag-17	31.64261667	-110.9764306	1152	4795015	-77879	-26143
cw-mag-18	31.64261667	-110.9764667	1151	4795380	-77515	-25779
cw-mag-19	31.64261667	-110.9765	1151	4794854	-78040	-26304
cw-mag-20	31.64261667	-110.9765306	1151	4792615	-80278	-28542
cw-mag-21	31.64261667	-110.9765806	1151	4793602	-79290	-27554
cw-mag-22	31.64261667	-110.9766167	1151	4790101	-82791	-31055
cw-mag-23	31.64261667	-110.97665	1151	4787100	-85792	-34056

cw-mag-24	31.64261667	-110.9766972	1151	4786671	-86220	-34484
cw-mag-25	31.64261667	-110.9767806	1150	4783232	-89658	-37922
cw-mag-26	31.64261667	-110.9768306	1150	4777542	-95348	-37858
cw-mag-27	31.6426	-110.9769167	1150	4792139	-80748	-29012
cw-mag-28	31.6426	-110.9769806	1150	4796142	-76745	-25009
cw-mag-29	31.6426	-110.9770667	1150	4791117	-81767	-30031
cw-mag-30	31.6426	-110.9770972	1149	4792240	-80644	-21687
cw-mag-31	31.64258056	-110.9771306	1149	4789679	-83203	-31467
cw-mag-32	31.64258056	-110.9771806	1149	4787641	-85240	-33504
cw-mag-33	31.64258056	-110.9772667	1149	4786717	-86163	-34427
cw-mag-34	31.64258056	-110.9772972	1149	4788720	-84159	-27101
cw-mag-35	31.64256667	-110.9773806	1148	4790086	-82793	-31057
cw-mag-36	31.64256667	-110.97745	1148	4789438	-83439	-25378
cw-mag-37	31.64254722	-110.9775306	1148	4794544	-78330	-26594
cw-mag-38	31.64254722	-110.9775667	1148	4787985	-84889	-33153
cw-mag-39	31.64254722	-110.9775972	1147	4786262	-86611	-34875
cw-mag-40	31.64254722	-110.9776472	1147	4786034	-86839	-28791
cw-mag-41	31.64253056	-110.9777167	1147	4787277	-85593	-33857
cw-mag-42	31.64253056	-110.9777667	1147	4794209	-78660	-20850
cw-mag-43	31.64251667	-110.9778306	1147	4788239	-84627	-32891
cw-mag-44	31.64251667	-110.9779	1147	4793555	-79309	-27573
cw-mag-45	31.64251667	-110.9779306	1146	4794458	-78406	-26670
cw-mag-46	31.64251667	-110.9779806	1146	4795449	-77414	-53975
cw-mag-47	31.64253056	-110.9780167	1146	4797420	-75443	-23707
cw-mag-48	31.64253056	-110.9780972	1146	4800082	-72781	-21045
cw-mag-49	31.64253056	-110.9781667	1145	4796266	-76595	-57778
cw-mag-50	31.64254722	-110.9782	1145	4795605	-77257	-25521
cw-mag-51	31.64254722	-110.9782806	1145	4793247	-79614	-21566
cw-mag-52	31.64253056	-110.97835	1145	4786275	-86581	-34845
cw-mag-53	31.64253056	-110.9783806	1145	4791597	-81259	-29523
cw-mag-54	31.64253056	-110.9784306	1145	4787031	-85824	-27024
cw-mag-55	31.64251667	-110.9784667	1145	4785749	-87105	-35369
cw-mag-56	31.64251667	-110.9785667	1144	4787213	-85640	-26831
cw-mag-57	31.64249722	-110.9786167	1144	4790066	-82785	-31049
cw-mag-58	31.64249722	-110.9786667	1144	4794644	-78207	-26471
cw-mag-59	31.64249722	-110.9787167	1144	4789796	-83055	-31319
cw-mag-60	31.64249722	-110.9788	1144	4789532	-83316	-26175
cw-mag-61	31.64248056	-110.9788972	1144	4791682	-81162	-29426
cw-mag-62	31.64248056	-110.9789306	1144	4793365	-79479	-21128
cw-mag-63	31.64246667	-110.9789806	1144	4789133	-83710	-31974
cw-mag-64	31.64246667	-110.9790306	1144	4788273	-84568	-32832
cw-mag-65	31.64246667	-110.9791167	1143	4793366	-79473	-20831
cw-mag-66	31.64245	-110.9791667	1143	4786322	-86515	-34779
cw-mag-67	31.64245	-110.9792167	1143	4788144	-84692	-32956
cw-mag-68	31.64245	-110.9792667	1143	4786489	-86347	-34611
cw-mag-69	31.64245	-110.9793667	1142	4788159	-84674	-26613
cw-mag-70	31.64243056	-110.9794472	1142	4787433	-85398	-33662
cw-mag-71	31.64243056	-110.9795	1142	4789503	-83326	-26168
cw-mag-72	31.64241667	-110.9795806	1142	4788429	-84399	-32663
cw-mag-73	31.64241667	-110.97965	1142	4784577	-88249	-36513
cw-mag-74	31.64241667	-110.9796972	1142	4781749	-91077	-32120
cw-mag-75	31.64239722	-110.9797306	1142	4796788	-76037	-24301
cw-mag-76	31.64239722	-110.9797667	1142	4789850	-82975	-25299
cw-mag-77	31.64238056	-110.9798472	1141	4786883	-85938	-27076
cw-mag-78	31.64236667	-110.9798806	1141	4786727	-86094	-34358
cw-mag-79	31.64236667	-110.97995	1141	4788306	-84514	-26838
cw-mag-80	31.64235	-110.9800306	1141	4787121	-85697	-33961

cw-mag-81	31.64235	-110.9800667	1140	4787057	-85761	-34025
cw-mag-82	31.64235	-110.9801167	1140	4782884	-89933	-38197
cw-mag-83	31.64235	-110.9801472	1140	4773503	-99313	-41330
cw-mag-84	31.64233056	-110.9802306	1140	4790376	-82437	-30701
cw-mag-85	31.64233056	-110.9803306	1140	4780799	-92012	-33661
cw-mag-86	31.64231667	-110.9803806	1139	4783707	-89103	-31600
cw-mag-87	31.64229722	-110.9804806	1139	4782977	-89829	-38093
cw-mag-88	31.64229722	-110.9805806	1139	4780032	-92774	-34132
cw-mag-89	31.64228056	-110.9806306	1139	4783122	-89682	-37946
cw-mag-90	31.64228056	-110.9806806	1139	4783663	-89139	-37403
cw-mag-91	31.64228056	-110.9807306	1138	4775299	-97502	-41485
cw-mag-92	31.64226667	-110.98085	1138	4767672	-105126	-46389
cw-mag-93	31.64223056	-110.98095	1137	4771951	-100845	-43151
cw-mag-94	31.64221667	-110.9810167	1137	4780331	-92461	-33889
cw-mag-95	31.64218056	-110.9811306	1137	4781491	-91297	-34778
cw-mag-96	31.64216667	-110.9812306	1136	4779908	-92878	-34237
cw-mag-97	31.64215	-110.9812806	1136	4781234	-91549	-32740
cw-mag-98	31.64213056	-110.9813306	1136	4779283	-93498	-41762
cw-mag-99	31.64213056	-110.9813806	1136	4779027	-93754	-35113
cw-mag-100	31.64209722	-110.9814806	1136	4781171	-91605	-35072
cw-mag-101	31.64208056	-110.9816	1135	4783152	-89621	-31927
cw-mag-102	31.64206667	-110.9816667	1135	4774820	-97952	-41742
cw-mag-103	31.64205	-110.9818	1135	4779447	-93320	-34918
cw-mag-104	31.64201667	-110.9819167	1135	4779298	-93465	-34656
cw-mag-105	31.64199722	-110.9819667	1134	4780462	-92301	-34017
cw-mag-106	31.64196667	-110.9820806	1134	4779356	-93402	-35140
cw-mag-107	31.64193056	-110.9822167	1134	4778027	-94727	-36376
cw-mag-108	31.64191667	-110.9822667	1134	4779820	-92932	-34423
cw-mag-109	31.64189722	-110.9823306	1134	4777457	-95292	-37153
cw-mag-110	31.64188056	-110.9823972	1134	4777377	-95372	-38934
cw-mag-111	31.64186667	-110.9825	1133	4776024	-96722	-38186
cw-mag-112	31.64183056	-110.9826167	1133	4775864	-96878	-38527
cw-mag-113	31.64181667	-110.9826667	1133	4773793	-98947	-40375
cw-mag-114	31.64178056	-110.9827806	1133	4776509	-96226	-40810
cw-mag-115	31.64176667	-110.9829306	1133	4785777	-86955	-35219
cw-mag-116	31.64176667	-110.9830167	1133	4783759	-88972	-37236
cw-mag-117	31.64176667	-110.9830806	1133	4782793	-89937	-38201
cw-mag-118	31.64176667	-110.9831667	1133	4783984	-88745	-32429
cw-mag-119	31.64174722	-110.9833167	1133	4785883	-86843	-35107
cw-mag-120	31.64174722	-110.9833806	1133	4796694	-76030	-24294
cw-mag-121	31.64174722	-110.9835306	1133	4803556	-69165	-36306
cw-mag-122	31.64178056	-110.9836667	1133	4805544	-67176	-35529
cw-mag-123	31.64179722	-110.9837306	1132	4813026	-59694	-48592
cw-mag-124	31.64183056	-110.9837667	1132	4801129	-71593	-19857
cw-mag-125	31.64183056	-110.9838	1132	4811355	-61366	-42549
cw-mag-126	31.64188056	-110.9839	1132	4809213	-63509	-42077
cw-mag-127	31.64193056	-110.9840167	1131	4810180	-62545	-41898
cw-mag-128	31.64196667	-110.9840972	1130	4809635	-63090	-43568
cw-mag-129	31.64203056	-110.9842306	1130	4810501	-62227	-45131
cw-mag-130	31.64209722	-110.98435	1130	4806133	-66596	-44450
cw-mag-131	31.64211667	-110.9843972	1129	4805844	-66884	-47392
cw-mag-132	31.64215	-110.9844667	1129	4808697	-64033	-32387
cw-mag-133	31.64216667	-110.9845306	1129	4805280	-67451	-47586
cw-mag-134	31.64223056	-110.9846667	1129	4803936	-68795	-49979
cw-mag-135	31.64228056	-110.9847667	1128	4809963	-62771	-49123
cw-mag-136	31.64231667	-110.9848167	1128	4808472	-64261	-43253
cw-mag-137	31.64236667	-110.9849306	1128	4807363	-65372	-47629

cw-mag-138	31.64243056	-110.98505	1127	4808013	-64724	-51076
cw-mag-139	31.64246667	-110.9851	1127	4800798	-71939	-43581
cw-mag-140	31.64249722	-110.9852	1127	4803875	-68863	-53281
cw-mag-141	31.64254722	-110.9852806	1126	4802500	-70240	-49750
cw-mag-142	31.6426	-110.9853972	1126	4803354	-69388	-41726
cw-mag-143	31.64261667	-110.98545	1125	4803360	-69383	-50567
cw-mag-144	31.64266667	-110.98555	1125	4804153	-68590	-42511
cw-mag-145	31.64271667	-110.9856972	1124	4796857	-75888	-39415
cw-mag-146	31.64273056	-110.9857667	1123	4794581	-78164	-54211
cw-mag-147	31.64278056	-110.9859	1123	4790506	-82238	-55737
cw-mag-148	31.64283056	-110.98605	1122	4787371	-85374	-52906
cw-mag-149	31.64284722	-110.9861167	1122	4796972	-75775	-43711
cw-mag-150	31.64288056	-110.9862472	1121	4798234	-74513	-50561
cw-mag-151	31.64293056	-110.9863806	1120	4798020	-74727	-41549
cw-mag-152	31.64296667	-110.9865306	1119	4803503	-69243	-50427
cw-mag-153	31.643	-110.9865972	1119	4800389	-72360	-40334
cw-mag-154	31.64303056	-110.9867167	1119	4797716	-75033	-43387
cw-mag-155	31.64304722	-110.9867806	1118	4797149	-75600	-52381
cw-mag-156	31.64306667	-110.9868306	1118	4799349	-73401	-53909
cw-mag-157	31.6431	-110.9869	1118	4803264	-69487	-44255
cw-mag-158	31.64311667	-110.9869472	1118	4801315	-71435	-41078
cw-mag-159	31.64313056	-110.9869972	1118	4803977	-68774	-46926
cw-mag-160	31.64318056	-110.9871167	1118	4800993	-71758	-50522
cw-mag-161	31.64321667	-110.9872	1118	4808330	-64422	-40897
cw-mag-162	31.64326667	-110.9873306	1118	4812062	-60691	-40827
cw-mag-163	31.64333056	-110.9874667	1117	4796480	-76274	-47833
cw-mag-164	31.64335	-110.9875306	1117	4787267	-85487	-33751
cw-mag-165	31.64335	-110.9876167	1117	4783230	-89523	-37787
cw-mag-166	31.64335	-110.9876806	1117	4780022	-92729	-36126
cw-mag-167	31.64333056	-110.9878167	1117	4780287	-92461	-33819
cw-mag-168	31.64329722	-110.9879167	1118	4779030	-93715	-35487
cw-mag-169	31.64328056	-110.9879806	1118	4781151	-91593	-35074
cw-mag-170	31.64326667	-110.9880806	1118	4785190	-87550	-35814
cw-mag-171	31.64326667	-110.9882	1118	4786136	-86602	-34866
cw-mag-172	31.64326667	-110.9882472	1118	4782455	-90282	-38546
cw-mag-173	31.64326667	-110.9883167	1118	4789915	-82821	-31085
cw-mag-174	31.64326667	-110.9883806	1118	4787866	-84868	-33132
cw-mag-175	31.64326667	-110.9884806	1118	4786602	-86131	-27765
cw-mag-176	31.64324722	-110.98855	1118	4780314	-92417	-40681
cw-mag-177	31.64324722	-110.9885667	1118	4786756	-85974	-34238
cw-mag-178	31.64324722	-110.9886167	1118	4793081	-79647	-27911
cw-mag-179	31.64324722	-110.9886806	1117	4786171	-86556	-34820
cw-mag-180	31.64324722	-110.9887306	1117	4785785	-86941	-35205
cw-mag-181	31.64324722	-110.9888472	1117	4787689	-85036	-47613
cw-mag-182	31.64326667	-110.98895	1117	4790783	-81943	-30207
cw-mag-183	31.64326667	-110.9890167	1117	4788341	-84381	-54023
cw-mag-184	31.64328056	-110.9890667	1117	4786870	-85851	-46375
cw-mag-185	31.64329722	-110.9891667	1117	4786673	-86050	-34314
cw-mag-186	31.64329722	-110.9892667	1117	4792851	-79870	-56650
cw-mag-187	31.64331667	-110.9893167	1117	4795969	-76751	-54080
cw-mag-188	31.64335	-110.9894	1117	4797974	-74746	-46390
cw-mag-189	31.64338056	-110.9895	1116	4800977	-71744	-62585
cw-mag-190	31.64341667	-110.9895306	1117	4810523	-62201	-26442
cw-mag-191	31.64343056	-110.9895972	1116	4812566	-60155	-46508
cw-mag-192	31.64346667	-110.9896472	1116	4817391	-55333	-39772
cw-mag-193	31.64353056	-110.98975	1115	4818685	-54041	-40648
cw-mag-194	31.64361667	-110.9898667	1115	4823944	-48787	-34152

cw-mag-195	31.64365	-110.9899167	1114	4816820	-55912	-43763
cw-mag-196	31.64371667	-110.9899972	1114	4825783	-46952	-39240
cw-mag-197	31.64376667	-110.9900306	1114	4826226	-46511	-23073
cw-mag-198	31.64378056	-110.9900667	1113	4816824	-55914	-46755
cw-mag-199	31.64381667	-110.9900972	1113	4818364	-54376	-40692
cw-mag-200	31.64386667	-110.9901667	1112	4807437	-65307	-40890
cw-mag-201	31.64389722	-110.99025	1112	4793960	-78783	-27047
cw-mag-202	31.64389722	-110.99035	1113	4779829	-92912	-41176
cw-mag-203	31.64389722	-110.9904167	1113	4798743	-73998	-22262
cw-mag-204	31.64389722	-110.9905472	1114	4793854	-78883	-27147
cw-mag-205	31.64389722	-110.9906	1114	4792758	-79980	-50644
cw-mag-206	31.64391667	-110.9906667	1114	4789384	-83352	-31616
cw-mag-207	31.64391667	-110.9907306	1114	4790049	-82686	-30950
cw-mag-208	31.64391667	-110.9908472	1115	4788001	-84732	-32996
cw-mag-209	31.64391667	-110.9909806	1116	4787877	-84852	-33116
cw-mag-210	31.64391667	-110.9910306	1116	4793014	-79715	-33753
cw-mag-211	31.64393056	-110.9911806	1116	4787420	-85306	-33570
cw-mag-212	31.64393056	-110.9913167	1118	4805371	-67354	-38914
cw-mag-213	31.64395	-110.9913806	1118	4808338	-64387	-27352
cw-mag-214	31.64396667	-110.9914667	1118	4805118	-67606	-28130
cw-mag-215	31.64398056	-110.99155	1118	4809648	-63076	-26605
cw-mag-216	31.64401667	-110.9917306	1118	4809857	-62865	-36365
cw-mag-217	31.64406667	-110.9918806	1118	4808465	-64257	-24293
cw-mag-218	31.64408056	-110.9919667	1118	4801208	-71514	-38337
cw-mag-219	31.64411667	-110.9921167	1119	4799328	-73392	-17729
cw-mag-220	31.6441	-110.9922806	1119	4799689	-73028	-21292
cw-mag-221	31.6441	-110.9923667	1119	4792197	-80518	-28782
cw-mag-222	31.6441	-110.9924667	1119	4794696	-78017	-20514
cw-mag-223	31.64408056	-110.9925667	1119	4797167	-75543	-20634
cw-mag-224	31.64406667	-110.99275	1120	4796049	-76658	-21040
cw-mag-225	31.64405	-110.9929167	1120	4795733	-76970	-25234
cw-mag-226	31.64405	-110.9930167	1120	4793888	-78813	-27077
cw-mag-227	31.64405	-110.9931806	1120	4791853	-80846	-29110
cw-mag-228	31.64405	-110.9933306	1121	4800315	-72381	-20645
cw-mag-229	31.64405	-110.9934167	1121	4794077	-78617	-23073
cw-mag-230	31.64403056	-110.9936167	1122	4795350	-77339	-20701
cw-mag-231	31.64399722	-110.9938472	1122	4794899	-77784	-22415
cw-mag-232	31.64398056	-110.9940306	1122	4803617	-69062	-35113
cw-mag-233	31.64403056	-110.9942472	1123	4805367	-67310	-28884
cw-mag-234	31.64406667	-110.99445	1123	4807229	-65447	-13711
cw-mag-235	31.64406667	-110.99455	1123	4803494	-69180	-29917
cw-mag-236	31.6441	-110.9947472	1122	4811880	-60793	-15285
cw-mag-237	31.64411667	-110.9949167	1121	4803748	-68922	-17186
cw-mag-238	31.64411667	-110.995	1121	4803907	-68762	-23025
cw-mag-239	31.64413056	-110.9951667	1120	4813208	-59461	-16187
cw-mag-240	31.64414722	-110.9953	1120	4804981	-67684	-15948
cw-mag-241	31.64414722	-110.9954167	1119	4800960	-71704	-19968
cw-mag-242	31.64414722	-110.9954806	1119	4813564	-59099	-24483
cw-mag-243	31.64418056	-110.9956306	1118	4810767	-61896	-32560
cw-mag-244	31.6442	-110.9956972	1118	4805250	-67413	-15677
cw-mag-245	31.6442	-110.9957667	1117	4802801	-69861	-18125
cw-mag-246	31.6442	-110.9958306	1117	4798011	-74649	-22913
cw-mag-247	31.6442	-110.9959306	1117	4799386	-73273	-15770
cw-mag-248	31.64418056	-110.9960306	1116	4800315	-72341	-20605
cw-mag-249	31.64418056	-110.9960972	1116	4795040	-77615	-19255
cw-mag-250	31.64414722	-110.9962167	1115	4795514	-77137	-19555
cw-mag-251	31.64413056	-110.9963	1115	4801326	-71324	-12973

cw-mag-252	31.64411667	-110.99635	1114	4803604	-69043	-17307
cw-mag-253	31.64411667	-110.9964167	1113	4803109	-69538	-17802
cw-mag-254	31.64411667	-110.9964806	1112	4800056	-72590	-20854
cw-mag-255	31.64411667	-110.9966167	1112	4808007	-64636	-12900
cw-mag-256	31.64411667	-110.99675	1110	4811268	-61373	-9637
cw-mag-257	31.64411667	-110.9967972	1110	4801580	-71061	-29050
cw-mag-258	31.64413056	-110.9968972	1109	4800406	-72234	-20498
cw-mag-259	31.64413056	-110.9970306	1108	4814958	-57681	-5945
cw-mag-260	31.64413056	-110.9971	1107	4824919	-47719	-15252
cw-mag-261	31.64414722	-110.9971667	1107	4825486	-47152	-32517
cw-mag-262	31.64418056	-110.9972167	1106	4828554	-44087	-28506
cw-mag-263	31.64423056	-110.9972972	1105	4828534	-44108	-25294
cw-mag-264	31.64428056	-110.9973972	1104	4803763	-68879	-17143
cw-mag-265	31.64428056	-110.99745	1103	4808489	-64153	-23063
cw-mag-266	31.6443	-110.9975806	1102	4814470	-58171	-23733
cw-mag-267	31.64433056	-110.9977167	1101	4815308	-57332	-25688
cw-mag-268	31.64434722	-110.9977806	1100	4816211	-56428	-31132
cw-mag-269	31.6444	-110.9979306	1100	4813955	-58685	-25451
cw-mag-270	31.64441667	-110.998	1099	4815137	-57503	-21747
cw-mag-271	31.64443056	-110.9980667	1099	4816947	-55694	-32169
cw-mag-272	31.64448056	-110.9981972	1098	4805376	-67266	-37076
cw-mag-273	31.6445	-110.9982667	1097	4809137	-63504	-35780
cw-mag-274	31.64454722	-110.9984167	1096	4823097	-49545	-29466
cw-mag-275	31.6446	-110.9985306	1096	4820560	-52086	-19621
cw-mag-276	31.64461667	-110.9985972	1096	4827795	-44851	-23004
cw-mag-277	31.64466667	-110.9987167	1095	4806486	-66160	-48030
cw-mag-278	31.6447	-110.9987806	1095	4810843	-61803	-28570
cw-mag-279	31.64471667	-110.99885	1094	4813911	-58736	-28380
cw-mag-280	31.64473056	-110.9989	1094	4788949	-83698	-31962
cw-mag-281	31.64473056	-110.9989972	1094	4784521	-88125	-29230
cw-mag-282	31.6447	-110.9990667	1094	4777971	-94670	-35938
cw-mag-283	31.64468056	-110.9990806	1093	4777511	-95130	-95023
cc-mag-01	31.63396667	-110.98845	1150	4845615	-24428	-21604
cc-mag-02	31.63396667	-110.9884306	1150	4842411	-27631	24105
cc-mag-03	31.63394722	-110.9884167	1151	4832846	-37196	-29100
cc-mag-04	31.63396667	-110.9884306	1150	4826881	-43161	12739
cc-mag-05	31.63396667	-110.9884167	1150	4820963	-49081	2655
cc-mag-06	31.63396667	-110.9883972	1150	4810333	-59711	-7975
cc-mag-07	31.63396667	-110.9883806	1150	4797728	-72316	-20580
cc-mag-08	31.63398056	-110.9883472	1150	4786920	-83124	-24262
cc-mag-09	31.634	-110.9883306	1150	4781386	-88661	-29835
cc-mag-10	31.63401667	-110.9882972	1150	4778246	-91803	-32859
cc-mag-11	31.63403056	-110.9882667	1151	4771624	-98425	-39514
cc-mag-12	31.63404722	-110.9882306	1151	4776199	-93852	-34934
cc-mag-13	31.63404722	-110.9882167	1151	4794651	-75401	-23665
cc-mag-14	31.63403056	-110.9882	1151	4802162	-67889	-57469
cc-mag-15	31.63403056	-110.9881806	1151	4805155	-64896	-13160
cc-mag-16	31.63403056	-110.9881667	1151	4805297	-64754	-13018
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cc-mag-18	31.63401667	-110.9881	1151	4807329	-62722	-42306
cc-mag-19	31.63401667	-110.98805	1151	4808231	-61821	-10085
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cc-mag-21	31.63401667	-110.9879167	1153	4794967	-75087	-16860
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cc-mag-25	31.6341	-110.98765	1153	4786305	-83762	-25702

cc-mag-26	31.63411667	-110.9876	1154	4781615	-88453	-29812
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cc-mag-28	31.63415	-110.9874972	1154	4779706	-90365	-31556
cc-mag-29	31.63416667	-110.9874667	1155	4775444	-94628	-35671
cc-mag-30	31.63418056	-110.9873972	1155	4780652	-89424	-31843
cc-mag-31	31.63419722	-110.98735	1155	4787051	-83025	-24314
cc-mag-32	31.63419722	-110.9873	1155	4792398	-77678	-25942
cc-mag-33	31.63421667	-110.9872306	1155	4790852	-79226	-20861
cc-mag-34	31.63421667	-110.9871667	1156	4792451	-77628	-25892
cc-mag-35	31.63421667	-110.9870972	1156	4784226	-85854	-34118
cc-mag-36	31.63421667	-110.9870306	1156	4802203	-67878	-16142
cc-mag-37	31.63423056	-110.9869667	1156	4796021	-74063	-16255
cc-mag-38	31.63425	-110.9869	1157	4787799	-82288	-23850
cc-mag-39	31.63426667	-110.98685	1157	4785510	-84579	-25938
cc-mag-40	31.63428056	-110.9867806	1157	4784144	-85947	-28366
cc-mag-41	31.63429722	-110.9867167	1157	4793605	-76487	-18260
cc-mag-42	31.63429722	-110.9866472	1157	4802178	-67916	-16180
cc-mag-43	31.63429722	-110.9865806	1157	4804784	-65311	-13575
cc-mag-44	31.63428056	-110.9865167	1158	4800441	-69654	-38001
cc-mag-45	31.63426667	-110.9864306	1159	4795361	-74734	-34763
cc-mag-46	31.63426667	-110.9863667	1159	4819397	-50700	1036
cc-mag-47	31.63426667	-110.9862806	1159	4804525	-65574	-13838
cc-mag-48	31.63426667	-110.9862167	1159	4797842	-72258	-20522
cc-mag-49	31.63428056	-110.9861306	1159	4790287	-79817	-22857
cc-mag-50	31.63429722	-110.9860667	1159	4790785	-79319	-21092
cc-mag-51	31.63433056	-110.9859806	1159	4788982	-81127	-22322
cc-mag-52	31.63435	-110.9859	1160	4787706	-82405	-24345
cc-mag-53	31.63438056	-110.9858167	1160	4781244	-88871	-30118
cc-mag-54	31.63439722	-110.9857472	1160	4784783	-85334	-27287
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cc-mag-56	31.63445	-110.9856	1161	4784571	-85552	-27114
cc-mag-57	31.63448056	-110.9855167	1161	4786911	-83216	-24463
cc-mag-58	31.63451667	-110.98545	1161	4785093	-85036	-26080
cc-mag-59	31.63453056	-110.9853667	1162	4795705	-74427	-17370
cc-mag-60	31.63456667	-110.9852972	1162	4785478	-84657	-25705
cc-mag-61	31.63459722	-110.9852167	1162	4788546	-81592	-22806
cc-mag-62	31.63461667	-110.9851306	1162	4784242	-85898	-27994
cc-mag-63	31.63465	-110.98505	1163	4784354	-85791	-26934
cc-mag-64	31.63468056	-110.9849806	1163	4775459	-94688	-35793
cc-mag-65	31.63469722	-110.9848972	1163	4786740	-83407	-25826
cc-mag-66	31.63473056	-110.9848167	1164	4785829	-84322	-25465
cc-mag-67	31.63476667	-110.9847306	1164	4785339	-84816	-25950
cc-mag-68	31.63479722	-110.98465	1164	4781721	-88435	-29649
cc-mag-69	31.63481667	-110.9845667	1165	4782996	-87165	-29183
cc-mag-70	31.63485	-110.9844972	1165	4782399	-87766	-28834
cc-mag-71	31.63488056	-110.9844306	1165	4779109	-91058	-32143
cc-mag-72	31.63489722	-110.98435	1165	4786684	-83485	-25810
cc-mag-73	31.63494722	-110.9842667	1165	4788484	-81689	-22734
cc-mag-74	31.63498056	-110.9841806	1165	4803645	-66531	-7726
cc-mag-75	31.63501667	-110.9840972	1165	4760156	-110024	-51137
cc-mag-76	31.63504722	-110.9840167	1165	4780186	-89999	-31213
cc-mag-77	31.63508056	-110.9839306	1166	4780198	-89990	-31185
cc-mag-78	31.63511667	-110.98385	1166	4762703	-107488	-48583
cc-mag-79	31.63513056	-110.9837806	1166	4777107	-93087	-35506
cc-mag-80	31.63516667	-110.9837167	1166	4780773	-89422	-30464
cc-mag-81	31.6352	-110.9836472	1166	4784367	-85832	-26900
cc-mag-82	31.63523056	-110.9835667	1167	4778832	-91370	-32584

cc-mag-83	31.63526667	-110.9834667	1167	4789594	-80612	-21875
cc-mag-84	31.6353	-110.9833806	1167	4783936	-86274	-27469
cc-mag-85	31.63531667	-110.9832972	1168	4780136	-90078	-32499
cc-mag-86	31.63534722	-110.9832167	1168	4780749	-89468	-30682
cc-mag-87	31.63538056	-110.9831472	1168	4779889	-90331	-31399
cc-mag-88	31.6354	-110.9830806	1168	4782949	-87274	-28836
cc-mag-89	31.63543056	-110.9830167	1168	4781561	-88666	-29735
cc-mag-90	31.63546667	-110.98295	1168	4786227	-84003	-25047
cc-mag-91	31.63548056	-110.9828806	1168	4788555	-81676	-24095
cc-mag-92	31.63551667	-110.9828167	1168	4780264	-89969	-31011
cc-mag-93	31.63553056	-110.9827472	1168	4778672	-91563	-33982
cc-mag-94	31.63556667	-110.9826806	1169	4783670	-86570	-27614
cc-mag-95	31.63558056	-110.9826167	1169	4786849	-83393	-25584
cc-mag-96	31.6356	-110.9825306	1169	4783285	-86959	-29055
cc-mag-97	31.63563056	-110.9824667	1169	4785121	-85127	-26196
cc-mag-98	31.63566667	-110.9823806	1169	4784696	-85555	-26689
cc-mag-99	31.63568056	-110.9823167	1169	4786340	-83912	-26103
cc-mag-100	31.63571667	-110.9822472	1169	4784586	-85671	-26719
cc-mag-101	31.63573056	-110.9821806	1170	4785385	-84874	-27180
cc-mag-102	31.63575	-110.9821167	1170	4785853	-84407	-25898
cc-mag-103	31.63576667	-110.9820306	1170	4789270	-80992	-23503
cc-mag-104	31.63576667	-110.9819667	1170	4795354	-74909	-23173
cc-mag-105	31.63576667	-110.9818972	1170	4794016	-76249	-24513
cc-mag-106	31.63576667	-110.9818167	1170	4794159	-76107	-24371
cc-mag-107	31.63576667	-110.9817306	1170	4796039	-74229	-22493
cc-mag-108	31.63576667	-110.98165	1170	4800384	-69885	-18149
cc-mag-109	31.63578056	-110.9815667	1170	4783369	-86903	-29846
cc-mag-110	31.63578056	-110.9814806	1171	4783990	-86285	-34549
cc-mag-111	31.63579722	-110.9814306	1171	4789005	-81271	-22630
cc-mag-112	31.63581667	-110.9813667	1172	4789343	-80935	-22426
cc-mag-113	31.63583056	-110.9813167	1172	4791753	-78527	-20176
cc-mag-114	31.63585	-110.98125	1172	4781899	-88384	-29946
cc-mag-115	31.63586667	-110.9811806	1173	4791647	-78636	-20589
cc-mag-116	31.63586667	-110.9811167	1173	4799986	-70300	-18564
cc-mag-117	31.63586667	-110.9810306	1173	4797474	-72813	-21077
cc-mag-118	31.63585	-110.9809667	1173	4800101	-70186	-38534
cc-mag-119	31.63585	-110.9808806	1173	4801564	-68724	-16988
cc-mag-120	31.63585	-110.9808	1173	4791318	-78972	-27236
cc-mag-121	31.63586667	-110.9807167	1174	4796279	-74011	-16430
cc-mag-122	31.63586667	-110.9806306	1174	4796662	-73630	-21894
cc-mag-123	31.63588056	-110.9805667	1174	4787581	-82714	-24906
cc-mag-124	31.63588056	-110.9804806	1174	4793221	-77076	-25340
cc-mag-125	31.63588056	-110.9804	1174	4797245	-73054	-21318
cc-mag-126	31.63589722	-110.9803167	1174	4792786	-77516	-19935
cc-mag-127	31.63589722	-110.9802306	1175	4797821	-72483	-20747
cc-mag-128	31.63591667	-110.9801667	1175	4793455	-76850	-18341
cc-mag-129	31.63591667	-110.9800972	1175	4790997	-79309	-27573
cc-mag-130	31.63591667	-110.9800167	1175	4788338	-81970	-30234
cc-mag-131	31.63591667	-110.9799306	1175	4799391	-70918	-19182
cc-mag-132	31.63593056	-110.9798667	1175	4788971	-81340	-23531
cc-mag-133	31.63593056	-110.9797806	1176	4778351	-91962	-40226
cc-mag-134	31.63593056	-110.9796806	1176	4793408	-76905	-25169
cc-mag-135	31.63593056	-110.9796	1176	4798343	-71972	-20236
cc-mag-136	31.63591667	-110.9795167	1176	4800686	-69630	-30148
cc-mag-137	31.63589722	-110.9794306	1176	4810170	-60146	-25804
cc-mag-138	31.63586667	-110.9793472	1177	4803667	-66647	-42220
cc-mag-139	31.63585	-110.9792472	1177	4805594	-64722	-25240

cc-mag-140	31.63581667	-110.9791667	1177	4817300	-53014	-30951
cc-mag-141	31.63579722	-110.9791	1177	4810089	-60226	-30881
cc-mag-142	31.63576667	-110.9790167	1177	4812946	-57369	-32943
cc-mag-143	31.63575	-110.9789306	1178	4811298	-59018	-21975
cc-mag-144	31.63571667	-110.9788667	1178	4811319	-58996	-40859
cc-mag-145	31.63569722	-110.9787806	1178	4808206	-62109	-27766
cc-mag-146	31.63568056	-110.9787167	1178	4810296	-60020	-28368
cc-mag-147	31.63566667	-110.9786306	1178	4806612	-63705	-23735
cc-mag-148	31.63564722	-110.9785472	1179	4812135	-58182	-24425
cc-mag-149	31.63561667	-110.9784667	1179	4813369	-56948	-33220
cc-mag-150	31.6356	-110.9783806	1179	4811273	-59044	-22001
cc-mag-151	31.63556667	-110.9782806	1180	4803145	-67172	-40662
cc-mag-152	31.63554722	-110.9781806	1180	4801025	-69294	-32330
cc-mag-153	31.63553056	-110.9780806	1180	4809648	-60670	-21188
cc-mag-154	31.63553056	-110.9779806	1180	4797338	-72982	-21246
cc-mag-155	31.63551667	-110.9778806	1180	4803402	-66918	-24901
cc-mag-156	31.63551667	-110.9777806	1180	4796911	-73409	-21673
cc-mag-157	31.6355	-110.9776667	1180	4787892	-82429	-41095
cc-mag-158	31.63548056	-110.9775472	1181	4804343	-65980	-26146
cc-mag-159	31.63546667	-110.9774306	1181	4799754	-70569	-26774
cc-mag-160	31.63544722	-110.9773306	1181	4793232	-77092	-40128
cc-mag-161	31.63544722	-110.9772667	1181	4798702	-71624	-19888
cc-mag-162	31.63543056	-110.9771667	1181	4804648	-65677	-26195
cc-mag-163	31.63543056	-110.97705	1182	4800532	-69793	-18057
cc-mag-164	31.63543056	-110.97695	1182	4805198	-65128	-13392
cc-mag-165	31.63543056	-110.9768306	1182	4792894	-77436	-25700
cc-mag-166	31.63544722	-110.9767306	1182	4794694	-75640	-18583
cc-mag-167	31.63544722	-110.9766306	1182	4794687	-75648	-23912
cc-mag-168	31.63543056	-110.9765306	1182	4795064	-75272	-35790
cc-mag-169	31.63543056	-110.9764306	1182	4803721	-66617	-14881
cc-mag-170	31.63541667	-110.9763472	1182	4813673	-56665	-17183
cc-mag-171	31.63541667	-110.9762667	1182	4798576	-71763	-20027
cc-mag-172	31.6354	-110.9761806	1181	4790056	-80286	-43243
cc-mag-173	31.6354	-110.9761	1181	4799975	-70368	-18632
cc-mag-174	31.63538056	-110.9760167	1181	4795911	-74432	-40675
cc-mag-175	31.63536667	-110.9759306	1181	4798971	-71373	-31402
cc-mag-176	31.63534722	-110.9758472	1181	4793568	-76776	-43018
cc-mag-177	31.63533056	-110.9757667	1181	4789904	-80441	-44553
cc-mag-178	31.63533056	-110.9757167	1181	4794737	-75608	-23872
cc-mag-179	31.63531667	-110.9756667	1181	4799336	-71010	-40643
cc-mag-180	31.63531667	-110.9756167	1181	4796197	-74149	-22413
cc-mag-181	31.6353	-110.9755472	1180	4805430	-64917	-31675
cc-mag-182	31.63528056	-110.9754972	1180	4802682	-67667	-44439
cc-mag-183	31.63526667	-110.9754306	1180	4799812	-70534	-34768
cc-mag-184	31.63526667	-110.9753806	1180	4804446	-65902	-14166
cc-mag-185	31.63524722	-110.9753167	1180	4800420	-69928	-41479
cc-mag-186	31.63523056	-110.97525	1179	4796071	-74277	-41801
cc-mag-187	31.63523056	-110.9752	1179	4797979	-72370	-20634
cc-mag-188	31.63523056	-110.9751472	1179	4814666	-55683	-3947
cc-mag-189	31.63521667	-110.9750806	1179	4799135	-71214	-35448
cc-mag-190	31.63521667	-110.9750306	1179	4790807	-79544	-27808
cc-mag-191	31.63521667	-110.9749806	1179	4788380	-81972	-30236
cc-mag-192	31.6352	-110.9749306	1179	4793295	-77054	-50544
cc-mag-193	31.6352	-110.9748806	1179	4793501	-76849	-25113
cc-mag-194	31.63518056	-110.9748167	1179	4787925	-82425	-53976
cc-mag-195	31.63518056	-110.97475	1179	4797732	-72620	-20884
cc-mag-196	31.63516667	-110.9746972	1179	4793204	-77147	-45666

cc-mag-197	31.63514722	-110.9746472	1179	4795053	-75298	-52070
cc-mag-198	31.63513056	-110.9746306	1179	4802888	-67463	-57044
cc-mag-199	31.63513056	-110.9746167	1178	4804595	-65757	-14021
cc-mag-200	31.63511667	-110.9745972	1178	4806091	-64261	-50477
cc-mag-201	31.63503056	-110.9744167	1179	4806283	-64066	-44461
cc-mag-202	31.635	-110.9743306	1179	4811823	-58522	-33398
cc-mag-203	31.63498056	-110.9742806	1179	4812469	-57877	-34649
cc-mag-204	31.63494722	-110.9742306	1179	4813030	-57315	-42674
cc-mag-205	31.63493056	-110.9741667	1180	4809469	-60876	-29223
cc-mag-206	31.63491667	-110.9741306	1180	4815497	-54848	-31400
cc-mag-207	31.63488056	-110.9740806	1181	4816499	-53845	-40192
cc-mag-208	31.63486667	-110.97405	1181	4817568	-52776	-32361
cc-mag-209	31.63483056	-110.974	1181	4817690	-52653	-39000
cc-mag-210	31.63481667	-110.9739667	1182	4817673	-52668	-30729
cc-mag-211	31.63479722	-110.9739167	1183	4824668	-45673	-22444
cc-mag-212	31.63478056	-110.9738806	1183	4823686	-46654	-26498
cc-mag-213	31.63475	-110.9738472	1183	4821031	-49308	-38140
cc-mag-214	31.63473056	-110.9738167	1184	4823189	-47149	-31896
cc-mag-215	31.63471667	-110.9737806	1184	4823902	-46437	-22988
cc-mag-216	31.63469722	-110.9737472	1185	4824308	-46031	-29576
cc-mag-217	31.63468056	-110.9737167	1185	4830313	-40024	-22575
cc-mag-218	31.63466667	-110.9736806	1186	4820941	-49396	-25948
cc-mag-219	31.63465	-110.97365	1186	4816735	-53601	-36152
cc-mag-220	31.63465	-110.9736167	1187	4816628	-53708	-1972
cc-mag-221	31.63463056	-110.9736	1187	4821098	-49238	-39986
cc-mag-222	31.63461667	-110.9735806	1187	4824114	-46220	-32436
cc-mag-223	31.63459722	-110.97355	1187	4828336	-41999	-26746
cc-mag-224	31.63458056	-110.9735306	1187	4827522	-42813	-31011
cc-mag-225	31.63458056	-110.9735167	1188	4821797	-48538	3198
cc-mag-226	31.63456667	-110.9735	1188	4820422	-49913	-37829
cc-mag-227	31.63456667	-110.9734806	1188	4821733	-48602	3134
cc-mag-228	31.63455	-110.9734667	1188	4821770	-48563	-39505
cc-mag-229	31.63453056	-110.9734306	1188	4821777	-48556	-30910
cc-mag-230	31.63451667	-110.9734167	1188	4821009	-49324	-38904
cc-mag-231	31.63451667	-110.9733806	1189	4821594	-48740	2996
cc-mag-232	31.63449722	-110.9733667	1189	4821801	-48530	-40434
cc-mag-233	31.63448056	-110.9733472	1189	4822632	-47699	-35896
cc-mag-234	31.63446667	-110.9733167	1189	4825986	-44345	-23929
cc-mag-235	31.63446667	-110.9732972	1189	4820557	-49774	1962
cc-mag-236	31.63445	-110.9732806	1190	4819787	-50544	-40124
cc-mag-237	31.63445	-110.9732667	1190	4821157	-49173	2563
cc-mag-238	31.63443056	-110.9732306	1190	4815091	-55239	-37593
cc-mag-239	31.63441667	-110.9732167	1190	4806796	-63533	-53113
cc-mag-240	31.63441667	-110.9731806	1191	4804782	-65548	-13812
cc-mag-241	31.63439722	-110.97315	1191	4806715	-63614	-48361
cc-mag-242	31.63438056	-110.9731	1191	4809015	-61314	-34803
cc-mag-243	31.63436667	-110.9730306	1191	4810366	-59963	-23482
cc-mag-244	31.63435	-110.9729472	1191	4810069	-60261	-23781
cc-mag-245	31.63431667	-110.9728806	1192	4814293	-56035	-37212
cc-mag-246	31.63428056	-110.9728	1192	4813911	-56416	-35762
cc-mag-247	31.63426667	-110.9727306	1193	4814670	-55657	-19176
cc-mag-248	31.63425	-110.9726667	1193	4798434	-71893	-40239
cc-mag-249	31.63425	-110.9725972	1193	4800109	-70220	-18484
cc-mag-250	31.63425	-110.9725167	1193	4800525	-69805	-18069
cc-mag-251	31.63426667	-110.9724667	1194	4793990	-76343	-17702
cc-mag-252	31.63426667	-110.9723972	1194	4780511	-89824	-38088
cc-mag-253	31.63426667	-110.9723167	1195	4792078	-78258	-26522

cc-mag-254	31.63425	-110.9722306	1195	4802387	-67949	-30905
cc-mag-255	31.63425	-110.9721472	1195	4804289	-66047	-14311
cc-mag-256	31.63423056	-110.9720667	1195	4804267	-66069	-32932
cc-mag-257	31.63423056	-110.9719806	1195	4792561	-77778	-26042
cc-mag-258	31.63421667	-110.9719	1196	4796747	-73591	-34633
cc-mag-259	31.63421667	-110.9718	1196	4800980	-69360	-17624
cc-mag-260	31.63421667	-110.9717167	1196	4789586	-80756	-29020
cc-mag-261	31.63423056	-110.9716472	1196	4787022	-83323	-25742
cc-mag-262	31.63423056	-110.9715806	1196	4786600	-83747	-32011
cc-mag-263	31.63425	-110.9715306	1197	4792561	-77787	-18978
cc-mag-264	31.63425	-110.9714667	1197	4798925	-71424	-19688
cc-mag-265	31.63425	-110.9714	1197	4799804	-70547	-18811
cc-mag-266	31.63425	-110.9713167	1197	4797810	-72542	-20806
cc-mag-267	31.63425	-110.9712306	1197	4796552	-73802	-22066
cc-mag-268	31.63425	-110.9711667	1197	4800949	-69405	-17669
cc-mag-269	31.63425	-110.9710806	1197	4795733	-74622	-22886
cc-mag-270	31.63428056	-110.9710167	1197	4787695	-82665	-23734
cc-mag-271	31.63429722	-110.9709306	1197	4778776	-91585	-34096
cc-mag-272	31.63429722	-110.9708472	1197	4791489	-78874	-27138
cc-mag-273	31.63431667	-110.9707667	1198	4796588	-73777	-15717
cc-mag-274	31.63433056	-110.9706806	1198	4791162	-79205	-22245
cc-mag-275	31.63435	-110.9706	1198	4800692	-69677	-11617
cc-mag-276	31.63436667	-110.9705167	1199	4800902	-69469	-11888
cc-mag-277	31.63436667	-110.9704306	1199	4797468	-72904	-21168
cc-mag-278	31.63436667	-110.9703472	1199	4807885	-62489	-10753
cc-mag-279	31.63438056	-110.9702667	1199	4810484	-59892	-2736
cc-mag-280	31.63439722	-110.9702	1199	4809451	-60926	-2788
cc-mag-281	31.63441667	-110.97015	1199	4773062	-97317	-38508
cc-mag-282	31.63443056	-110.9700806	1200	4783891	-86491	-28910
cc-mag-283	31.63443056	-110.9700306	1200	4783208	-87175	-35439
cc-mag-284	31.63445	-110.9699667	1200	4779197	-91189	-32680
cc-mag-285	31.63446667	-110.9698806	1201	4782763	-87624	-30135
cc-mag-286	31.63448056	-110.9698	1201	4786210	-84179	-27023
cc-mag-287	31.63448056	-110.9697167	1201	4783090	-87301	-35565
cc-mag-288	31.63451667	-110.96965	1201	4788393	-82001	-23045
cc-mag-289	31.63455	-110.9695667	1202	4788159	-82239	-23407
cc-mag-290	31.63458056	-110.9694972	1202	4781537	-88864	-29969
cc-mag-291	31.63459722	-110.9694167	1202	4779478	-90924	-33250
cc-mag-292	31.63461667	-110.9693306	1202	4785575	-84831	-26927
cc-mag-293	31.63463056	-110.96925	1202	4791907	-78503	-21347
cc-mag-294	31.63463056	-110.9691667	1202	4791665	-78745	-27009
cc-mag-295	31.63463056	-110.9690806	1203	4791948	-78465	-26729
cc-mag-296	31.63463056	-110.9689972	1202	4794590	-75824	-24088
cc-mag-297	31.63463056	-110.9689306	1202	4799172	-71243	-19507
cc-mag-298	31.63463056	-110.96885	1202	4803294	-67123	-15387
cc-mag-299	31.63461667	-110.9687667	1202	4807178	-63239	-23756
cc-mag-300	31.63459722	-110.9686972	1202	4822794	-47623	-17422
cc-mag-301	31.63459722	-110.9686472	1203	4801314	-69105	-17369
cc-mag-302	31.63458056	-110.9685806	1203	4808858	-61561	-29085
cc-mag-303	31.63461667	-110.9685	1203	4794012	-76412	-17507
cc-mag-304	31.63463056	-110.96845	1203	4787648	-82776	-24426
cc-mag-305	31.63465	-110.9683806	1203	4788527	-81899	-23534
cc-mag-306	31.63465	-110.9683167	1204	4791480	-78946	-27210
cc-mag-307	31.63463056	-110.9682306	1204	4793193	-77235	-42891
cc-mag-308	31.63461667	-110.9681472	1204	4795898	-74531	-35048
cc-mag-309	31.63458056	-110.9680806	1204	4806529	-63898	-46343
cc-mag-310	31.63455	-110.9680167	1204	4811449	-58977	-39418

cc-mag-311	31.63451667	-110.96795	1203	4808598	-61828	-43005
cc-mag-312	31.63448056	-110.9678806	1203	4811913	-58512	-40321
cc-mag-313	31.63443056	-110.9677972	1203	4820616	-49808	-33752
cc-mag-314	31.63439722	-110.9677306	1203	4821502	-48920	-30097
cc-mag-315	31.63435	-110.9676667	1203	4825803	-44619	-31236
cc-mag-316	31.63429722	-110.9676167	1202	4829748	-40670	-30682
cc-mag-317	31.63426667	-110.9675667	1202	4817740	-52679	-36878
cc-mag-318	31.63423056	-110.9675306	1201	4814612	-55803	-45383
cc-mag-319	31.63419722	-110.9675	1201	4829442	-40973	-31236
cc-mag-320	31.63416667	-110.9674667	1202	4827732	-42681	-31513
cc-mag-321	31.63413056	-110.9674167	1202	4823518	-46894	-33241
cc-mag-322	31.6341	-110.9673472	1203	4827467	-42943	-21966
cc-mag-323	31.63406667	-110.9672806	1204	4824795	-45613	-26790
cc-mag-324	31.63401667	-110.9672	1204	4823656	-46750	-31162
cc-mag-325	31.63396667	-110.9671	1205	4818641	-51763	-32940
cc-mag-326	31.63391667	-110.9669972	1204	4814158	-56246	-36970
cc-mag-327	31.63386667	-110.9668972	1204	4812092	-58310	-39487
cc-mag-328	31.63381667	-110.9668	1203	4816121	-54279	-35911
cc-mag-329	31.63376667	-110.9667	1202	4809936	-60465	-41642
cc-mag-330	31.63371667	-110.9666306	1201	4817496	-52903	-39216
cc-mag-331	31.63364722	-110.9665472	1201	4826320	-44075	-31991
cc-mag-332	31.63358056	-110.9664806	1201	4829747	-40646	-30226
cc-mag-333	31.63353056	-110.9663972	1200	4826329	-44063	-28006
cc-mag-334	31.6335	-110.9663306	1198	4805878	-64513	-44238
cc-mag-335	31.6335	-110.9662667	1198	4804839	-65554	-13818
cc-mag-336	31.63351667	-110.9661806	1197	4800001	-70394	-12905
cc-mag-337	31.63354722	-110.9661306	1197	4798464	-71935	-12982
cc-mag-338	31.6336	-110.9660972	1196	4798204	-72199	-13552
cc-mag-339	31.63364722	-110.9660806	1195	4793247	-77158	-18896
cc-mag-340	31.6337	-110.9660667	1194	4777032	-93379	-35274
cc-mag-341	31.63374722	-110.9660667	1193	4784274	-86141	-28571

APPENDIX C: AEROMAGNETIC DATA

ID	Easting (km)	Northing (km)	Elev. (m)	Basemag IGRF Corrected (nT)
cw-a-1	500.00699	3500.96	1312	-195.73
cw-a-2	500.01599	3500.96	1312	-195.73
cw-a-3	500.02399	3500.96	1312	-195.73
cw-a-4	500.03299	3500.96	1312	-195.74001
cw-a-5	500.04001	3500.96	1312	-195.75999
cw-a-6	500.04901	3500.96	1312	-195.75
cw-a-7	500.05701	3500.96	1312	-195.75999
cw-a-8	500.06601	3500.96	1312	-195.75
cw-a-9	500.07401	3500.96	1312	-195.74001
cw-a-10	500.082	3500.96	1312	-195.73
cw-a-11	500.091	3500.96	1312	-195.73
cw-a-12	500.099	3500.96	1312	-195.74001
cw-a-13	500.108	3500.96	1312	-195.73
cw-a-14	500.116	3500.96	1312	-195.75999
cw-a-15	500.12399	3500.96	1312	-195.75999
cw-a-16	500.13199	3500.96	1312	-195.75999
cw-a-17	500.14099	3500.96	1313	-195.78999
cw-a-18	500.14899	3500.96	1313	-195.8
cw-a-19	500.15799	3500.96	1313	-195.8
cw-a-20	500.16599	3500.96	1313	-195.78999
cw-a-21	500.17401	3500.96	1313	-195.78999
cw-a-22	500.18301	3500.96	1313	-195.81
cw-a-23	500.19101	3500.97	1313	-195.81
cw-a-24	500.20001	3500.97	1313	-195.78999
cw-a-25	500.207	3500.97	1313	-195.78
cw-a-26	500.216	3500.97	1313	-195.75999
cw-a-27	500.224	3500.97	1313	-195.77
cw-a-28	500.233	3500.97	1314	-195.77
cw-a-29	500.241	3500.96	1314	-195.7
cw-a-30	500.24899	3500.96	1315	-195.67999
cw-a-31	500.25699	3500.96	1315	-195.66
cw-a-32	500.26599	3500.96	1315	-195.67
cw-a-33	500.27399	3500.96	1316	-195.64999
cw-a-34	500.28299	3500.96	1316	-195.66
cw-a-35	500.29001	3500.96	1317	-195.64999
cw-a-36	500.29901	3500.96	1317	-195.60001
cw-a-37	500.30701	3500.96	1317	-195.50999
cw-a-38	500.31601	3500.96	1318	-195.39999
cw-a-39	500.32401	3500.96	1318	-195.28999
cw-a-40	500.332	3500.96	1319	-195.22
cw-a-41	500.34	3500.96	1319	-195.14
cw-a-42	500.349	3500.96	1319	-195.05
cw-a-43	500.35699	3500.96	1320	-194.97
cw-a-44	500.366	3500.96	1320	-194.87
cw-a-45	500.37299	3500.96	1320	-194.77
cw-a-46	500.38199	3500.96	1321	-194.67999
cw-a-47	500.39001	3500.96	1321	-194.56
cw-a-48	500.39899	3500.96	1322	-194.41
cw-a-51	500.423	3500.96	1324	-193.98
cw-a-52	500.431	3500.96	1324	-193.84
cw-a-53	500.44	3500.96	1325	-193.69
cw-a-54	500.448	3500.96	1325	-193.56
cw-a-55	500.45599	3500.96	1326	-193.47
cw-a-56	500.46399	3500.96	1327	-193.34
cw-a-57	500.47198	3500.96	1327	-193.24001
cw-a-58	500.48001	3500.95	1328	-193.13
cw-a-59	500.48901	3500.95	1328	-193.02
cw-a-60	500.496	3500.95	1329	-192.95
cw-a-61	500.505	3500.95	1330	-192.84
cw-a-62	500.513	3500.95	1330	-192.8
cw-a-63	500.521	3500.95	1331	-192.75
cw-a-64	500.53	3500.95	1331	-192.71001
cw-a-65	500.53699	3500.95	1332	-192.64999
cw-a-66	500.54599	3500.95	1333	-192.64
cw-a-67	500.55399	3500.95	1333	-192.64
cw-a-68	500.56201	3500.95	1334	-192.63
cw-a-69	500.57001	3500.95	1335	-192.66
cw-a-70	500.578	3500.95	1335	-192.69
cw-a-71	500.586	3500.95	1336	-192.69
cw-a-72	500.59399	3500.95	1337	-192.72
cw-a-73	500.60199	3500.95	1337	-192.77
cw-a-74	500.61099	3500.95	1338	-192.82001
cw-a-75	500.61801	3500.95	1339	-192.89
cw-a-76	500.62601	3500.95	1339	-192.96001
cw-a-77	500.63501	3500.95	1340	-193
cw-a-78	500.64301	3500.95	1341	-193.10001
cw-a-79	500.651	3500.95	1342	-193.25
cw-a-80	500.659	3500.95	1342	-193.38
cw-a-81	500.66699	3500.95	1343	-193.53
cw-a-82	500.67499	3500.95	1344	-193.69
cw-a-83	500.68301	3500.95	1344	-193.89
cw-a-84	500.69101	3500.95	1345	-194.06
cw-a-85	500.69901	3500.95	1346	-194.3
cw-a-86	500.707	3500.95	1346	-194.53999
cw-a-87	500.715	3500.95	1347	-194.82001
cw-a-88	500.72299	3500.95	1348	-195.12
cw-a-89	500.73099	3500.95	1349	-195.42999
cw-a-90	500.73901	3500.95	1349	-195.78
cw-a-91	500.74701	3500.95	1350	-196.13
cw-a-92	500.755	3500.95	1351	-196.53999
cw-a-93	500.763	3500.95	1352	-196.94
cw-a-94	500.771	3500.95	1353	-197.36
cw-a-95	500.77802	3500.95	1353	-197.78999
cw-a-96	500.78699	3500.95	1354	-198.25
cw-a-97	500.79501	3500.95	1355	-198.69
cw-a-98	500.80301	3500.95	1356	-199.14

cw-a-49	500.40701	3500.96	1322	-194.27	cw-a-99	500.811	3500.95	1356	-199.63
cw-a-50	500.41501	3500.96	1323	-194.11	cw-a-100	500.81799	3500.95	1357	-200.12
cw-a-101	500.82599	3500.95	1358	-200.63	cw-a-156	501.25699	3500.97	1383	-223.46001
cw-a-102	500.83401	3500.95	1359	-201.13	cw-a-157	501.26501	3500.97	1383	-223.71001
cw-a-103	500.84201	3500.95	1360	-201.67	cw-a-158	501.27301	3500.97	1383	-223.91
cw-a-104	500.85001	3500.95	1360	-202.17	cw-a-159	501.28101	3500.97	1384	-224.17999
cw-a-105	500.858	3500.95	1361	-202.7	cw-a-160	501.28799	3500.97	1384	-224.41
cw-a-106	500.866	3500.95	1362	-203.28999	cw-a-161	501.29599	3500.97	1384	-224.64999
cw-a-107	500.87399	3500.95	1363	-203.86	cw-a-162	501.30399	3500.97	1385	-224.88
cw-a-108	500.88199	3500.95	1363	-204.41	cw-a-163	501.31201	3500.97	1385	-225.13
cw-a-109	500.89001	3500.95	1364	-204.98	cw-a-164	501.32001	3500.97	1385	-225.36
cw-a-110	500.897	3500.95	1364	-205.56	cw-a-165	501.327	3500.97	1385	-225.61
cw-a-111	500.905	3500.95	1365	-206.09	cw-a-166	501.33499	3500.97	1386	-225.84
cw-a-112	500.91299	3500.95	1366	-206.64999	cw-a-167	501.34299	3500.97	1386	-226.03999
cw-a-113	500.92099	3500.96	1366	-207.19	cw-a-168	501.35101	3500.97	1386	-226.21001
cw-a-114	500.92899	3500.96	1367	-207.73	cw-a-169	501.35901	3500.97	1387	-226.42
cw-a-115	500.936	3500.96	1367	-208.25	cw-a-170	501.366	3500.97	1387	-226.60001
cw-a-116	500.944	3500.96	1368	-208.75	cw-a-171	501.37399	3500.97	1387	-226.78
cw-a-117	500.952	3500.96	1369	-209.27	cw-a-172	501.38199	3500.97	1387	-226.96001
cw-a-118	500.95999	3500.96	1369	-209.78	cw-a-173	501.39001	3500.97	1387	-227.16
cw-a-119	500.96799	3500.96	1370	-210.27	cw-a-174	501.39801	3500.97	1388	-227.34
cw-a-120	500.97501	3500.96	1370	-210.77	cw-a-175	501.405	3500.97	1388	-227.53999
cw-a-121	500.983	3500.96	1371	-211.24001	cw-a-176	501.41299	3500.97	1388	-227.74001
cw-a-122	500.991	3500.96	1372	-211.73	cw-a-177	501.42099	3500.97	1388	-227.96001
cw-a-123	500.99899	3500.96	1372	-212.19	cw-a-178	501.42899	3500.97	1388	-228.16
cw-a-124	501.00699	3500.96	1373	-212.63	cw-a-179	501.43701	3500.97	1389	-228.38
cw-a-125	501.01501	3500.96	1373	-213.09	cw-a-180	501.444	3500.97	1389	-228.58
cw-a-126	501.022	3500.96	1374	-213.50999	cw-a-181	501.452	3500.97	1389	-228.78
cw-a-127	501.03	3500.96	1375	-213.97	cw-a-182	501.45999	3500.97	1389	-228.98
cw-a-128	501.03799	3500.96	1375	-214.42	cw-a-183	501.46799	3500.97	1389	-229.16
cw-a-129	501.04599	3500.96	1375	-214.81	cw-a-184	501.47601	3500.97	1390	-229.34
cw-a-130	501.05399	3500.96	1375	-215.2	cw-a-185	501.483	3500.97	1390	-229.53999
cw-a-131	501.06201	3500.96	1376	-215.63	cw-a-186	501.491	3500.97	1390	-229.72
cw-a-132	501.069	3500.96	1376	-216.03	cw-a-187	501.49899	3500.97	1390	-229.91
cw-a-133	501.077	3500.97	1376	-216.41	cw-a-188	501.50699	3500.97	1390	-230.08
cw-a-134	501.08499	3500.97	1376	-216.78	cw-a-189	501.51501	3500.97	1390	-230.25
cw-a-135	501.09299	3500.97	1377	-217.16	cw-a-190	501.52301	3500.97	1390	-230.45
cw-a-136	501.10101	3500.97	1377	-217.52	cw-a-191	501.53101	3500.97	1390	-230.63
cw-a-137	501.10901	3500.97	1377	-217.88	cw-a-192	501.539	3500.97	1390	-230.8
cw-a-138	501.116	3500.97	1377	-218.24001	cw-a-193	501.547	3500.97	1390	-230.96001
cw-a-139	501.12399	3500.97	1378	-218.60001	cw-a-194	501.55499	3500.97	1390	-231.09
cw-a-140	501.13199	3500.97	1378	-218.94	cw-a-195	501.56201	3500.97	1390	-231.27
cw-a-141	501.14001	3500.97	1378	-219.27	cw-a-196	501.57001	3500.97	1390	-231.42
cw-a-142	501.14801	3500.97	1378	-219.59	cw-a-197	501.578	3500.97	1390	-231.61
cw-a-143	501.155	3500.97	1379	-219.91	cw-a-198	501.586	3500.97	1390	-231.78
cw-a-144	501.16299	3500.97	1379	-220.28	cw-a-199	501.59399	3500.97	1390	-231.92999
cw-a-145	501.17099	3500.97	1379	-220.58	cw-a-200	501.60101	3500.97	1390	-232.12
cw-a-146	501.17899	3500.97	1379	-220.86	cw-a-201	501.60901	3500.97	1390	-232.3
cw-a-147	501.18701	3500.97	1380	-221.13	cw-a-202	501.617	3500.97	1390	-232.48
cw-a-148	501.19501	3500.97	1380	-221.39999	cw-a-203	501.625	3500.97	1390	-232.66
cw-a-149	501.202	3500.97	1380	-221.67	cw-a-204	501.633	3500.97	1390	-232.8
cw-a-150	501.20999	3500.97	1381	-221.91	cw-a-205	501.64001	3500.97	1390	-232.99001
cw-a-151	501.21799	3500.97	1381	-222.17999	cw-a-206	501.64801	3500.97	1390	-233.12
cw-a-152	501.22601	3500.97	1381	-222.42999	cw-a-207	501.65601	3500.97	1391	-233.27
cw-a-153	501.23401	3500.97	1382	-222.73	cw-a-208	501.664	3500.97	1390	-233.42
cw-a-154	501.242	3500.97	1382	-222.98	cw-a-209	501.672	3500.97	1390	-233.53
cw-a-155	501.24899	3500.97	1382	-223.23	cw-a-210	501.67999	3500.97	1390	-233.69

cw-a-211	501.68799	3500.97	1390	-233.8
cw-a-212	501.69601	3500.97	1390	-233.92999
cw-a-213	501.70401	3500.97	1390	-234.05
cw-a-214	501.71201	3500.97	1390	-234.14999
cw-a-215	501.71899	3500.97	1390	-234.27
cw-a-216	501.72699	3500.97	1390	-234.35001
cw-a-217	501.73499	3500.97	1390	-234.41
cw-a-218	501.74301	3500.97	1390	-234.49001
cw-a-219	501.75101	3500.97	1390	-234.57001
cw-a-220	501.759	3500.97	1390	-234.59
cw-a-221	501.767	3500.97	1390	-234.64999
cw-a-222	501.77499	3500.97	1390	-234.67
cw-a-223	501.78299	3500.97	1390	-234.67
cw-a-224	501.79099	3500.97	1390	-234.67
cw-a-225	501.798	3500.97	1390	-234.7
cw-a-226	501.806	3500.97	1390	-234.67
cw-a-227	501.814	3500.97	1390	-234.66
cw-a-228	501.82199	3500.97	1390	-234.59
cw-a-229	501.82999	3500.96	1390	-234.53999
cw-a-230	501.83801	3500.96	1390	-234.47
cw-a-231	501.84601	3500.96	1390	-234.36
cw-a-232	501.854	3500.96	1390	-234.27
cw-a-233	501.862	3500.96	1390	-234.17
cw-a-234	501.87	3500.96	1390	-234.05
cw-a-235	501.87799	3500.96	1390	-233.92
cw-a-236	501.88599	3500.96	1391	-233.78
cw-a-237	501.89401	3500.96	1391	-233.63
cw-a-238	501.90201	3500.96	1391	-233.52
cw-a-239	501.91	3500.96	1391	-233.37
cw-a-240	501.91699	3500.96	1391	-233.23
cw-a-241	501.92599	3500.96	1391	-233.05
cw-a-242	501.93399	3500.96	1391	-232.92
cw-a-243	501.94199	3500.96	1391	-232.73
cw-a-244	501.95001	3500.96	1391	-232.55
cw-a-245	501.957	3500.96	1392	-232.34
cw-a-246	501.965	3500.96	1392	-232.14999
cw-a-247	501.97299	3500.96	1392	-231.92999
cw-a-248	501.98199	3500.96	1392	-231.74001
cw-a-249	501.98999	3500.96	1392	-231.5
cw-a-250	501.99701	3500.96	1393	-231.28
cw-a-251	502.005	3500.96	1393	-231.05
cw-a-252	502.013	3500.96	1393	-230.86
cw-a-253	502.021	3500.96	1393	-230.62
cw-a-254	502.03	3500.96	1393	-230.42999
cw-a-255	502.03699	3500.96	1394	-230.25
cw-a-256	502.04501	3500.96	1394	-230.03999
cw-a-257	502.05301	3500.96	1394	-229.89
cw-a-258	502.061	3500.96	1394	-229.7
cw-a-259	502.069	3500.96	1395	-229.52
cw-a-260	502.077	3500.96	1395	-229.38
cw-a-261	502.08499	3500.95	1395	-229.25
cw-a-262	502.09299	3500.95	1395	-229.12
cw-a-263	502.10101	3500.95	1396	-229
cw-a-264	502.10901	3500.95	1396	-228.91
cw-a-265	502.117	3500.95	1396	-228.82001
cw-a-266	502.125	3500.95	1396	-228.78999
cw-a-267	502.133	3500.95	1397	-228.78999
cw-a-268	502.14099	3500.95	1397	-228.75999
cw-a-269	502.14899	3500.95	1398	-228.78
cw-a-270	502.15701	3500.95	1398	-228.8
cw-a-271	502.16501	3500.95	1398	-228.88
cw-a-272	502.173	3500.95	1399	-229
cw-a-273	502.181	3500.95	1399	-229.11
cw-a-274	502.189	3500.95	1400	-229.21001
cw-a-275	502.19699	3500.96	1400	-229.37
cw-a-276	502.20499	3500.96	1401	-229.5
cw-a-277	502.21301	3500.96	1401	-229.72
cw-a-278	502.22101	3500.96	1402	-229.94
cw-a-279	502.229	3500.96	1402	-230.19
cw-a-280	502.237	3500.96	1403	-230.45
cw-a-281	502.245	3500.96	1403	-230.67999
cw-a-282	502.25299	3500.96	1404	-230.97
cw-a-283	502.26099	3500.96	1404	-231.25
cw-a-284	502.26901	3500.96	1405	-231.57001
cw-a-285	502.276	3500.96	1405	-231.89
cw-a-286	502.285	3500.96	1406	-232.19
cw-a-287	502.293	3500.96	1406	-232.53
cw-a-288	502.30099	3500.96	1407	-232.85001
cw-a-289	502.30899	3500.96	1407	-233.25
cw-a-290	502.31601	3500.96	1407	-233.59
cw-a-291	502.32401	3500.96	1408	-233.96001
cw-a-292	502.332	3500.96	1408	-234.36
cw-a-293	502.341	3500.96	1409	-234.78
cw-a-294	502.349	3500.96	1409	-235.2
cw-a-295	502.35599	3500.96	1409	-235.61
cw-a-296	502.36401	3500.96	1410	-236.03999
cw-a-297	502.37201	3500.96	1410	-236.48
cw-a-298	502.38	3500.96	1411	-236.89999
cw-a-299	502.38901	3500.96	1411	-237.34
cw-a-300	502.396	3500.96	1411	-237.77
cw-a-301	502.40399	3500.96	1412	-238.21001
cw-a-302	502.41199	3500.97	1412	-238.62
cw-a-303	502.42001	3500.97	1413	-239.07001
cw-a-304	502.42801	3500.97	1413	-239.5
cw-a-305	502.436	3500.97	1413	-239.91
cw-a-306	502.444	3500.97	1414	-240.36
cw-a-307	502.452	3500.97	1414	-240.77
cw-a-308	502.45999	3500.97	1415	-241.21001
cw-a-309	502.46799	3500.97	1415	-241.62
cw-a-310	502.47601	3500.97	1416	-242.02
cw-a-311	502.48401	3500.97	1416	-242.46001
cw-a-312	502.492	3500.97	1417	-242.88

rr-a-1	499.53601	3506.8799	1369	-119.23
rr-a-2	499.52499	3506.8799	1368	-119.75
rr-a-3	499.51401	3506.8799	1366	-120.31
rr-a-56	498.94601	3506.9299	1311	-171.55
rr-a-57	498.935	3506.9299	1310	-171.73
rr-a-58	498.92401	3506.9299	1309	-171.89999

rr-a-4	499.504	3506.8799	1365	-120.91	rr-a-59	498.914	3506.9299	1309	-172.00999
rr-a-5	499.49301	3506.8799	1364	-121.58	rr-a-60	498.90302	3506.9299	1308	-172.09
rr-a-6	499.48199	3506.8799	1363	-122.25	rr-a-61	498.892	3506.9299	1307	-172.11
rr-a-7	499.47101	3506.8899	1362	-123.04	rr-a-62	498.88101	3506.9299	1306	-172.12
rr-a-8	499.461	3506.8899	1361	-123.84	rr-a-63	498.87	3506.9299	1305	-172.07001
rr-a-9	499.45001	3506.8899	1360	-124.72	rr-a-64	498.85999	3506.9299	1304	-172.00999
rr-a-10	499.44	3506.8899	1359	-125.63	rr-a-65	498.849	3506.9299	1303	-171.97
rr-a-11	499.42899	3506.8899	1358	-126.59	rr-a-66	498.83801	3506.9299	1302	-171.89
rr-a-12	499.418	3506.8899	1357	-127.62	rr-a-67	498.827	3506.9299	1302	-171.73
rr-a-13	499.40701	3506.8899	1356	-128.59	rr-a-68	498.81699	3506.9299	1301	-171.53
rr-a-14	499.397	3506.8899	1355	-129.67	rr-a-69	498.80701	3506.9299	1301	-171.28
rr-a-15	499.38599	3506.8899	1354	-130.72	rr-a-70	498.79599	3506.9299	1300	-171
rr-a-16	499.375	3506.8899	1353	-131.84	rr-a-71	498.785	3506.9299	1300	-170.67999
rr-a-17	499.36401	3506.8999	1351	-132.97	rr-a-72	498.77399	3506.9299	1299	-170.36
rr-a-18	499.353	3506.8999	1350	-134.12	rr-a-73	498.763	3506.9299	1299	-170.00999
rr-a-19	499.34299	3506.8999	1349	-135.34	rr-a-74	498.75299	3506.9299	1298	-169.73
rr-a-20	499.332	3506.8999	1348	-136.53999	rr-a-75	498.742	3506.9299	1298	-169.47
rr-a-21	499.32101	3506.8999	1347	-137.77	rr-a-76	498.73199	3506.9199	1297	-169.21001
rr-a-22	499.31	3506.8999	1346	-139.02	rr-a-77	498.72101	3506.9199	1296	-168.95
rr-a-23	499.29901	3506.8999	1345	-140.3	rr-a-78	498.70999	3506.9199	1296	-168.7
rr-a-24	499.289	3506.8999	1344	-141.53999	rr-a-79	498.70001	3506.9199	1295	-168.45
rr-a-25	499.27802	3506.8999	1343	-142.82001	rr-a-80	498.689	3506.9199	1295	-168.24001
rr-a-26	499.26801	3506.9099	1342	-144.07001	rr-a-81	498.67801	3506.9199	1294	-168.05
rr-a-27	499.25699	3506.9099	1341	-145.34	rr-a-82	498.668	3506.9199	1294	-167.86
rr-a-28	499.246	3506.9099	1340	-146.61	rr-a-83	498.65701	3506.9199	1293	-167.66
rr-a-29	499.23599	3506.9099	1339	-147.85001	rr-a-84	498.647	3506.9199	1293	-167.45
rr-a-30	499.22501	3506.9099	1338	-149.12	rr-a-85	498.63599	3506.9199	1292	-167.25
rr-a-31	499.21399	3506.9099	1337	-150.36	rr-a-86	498.625	3506.9199	1292	-167.07001
rr-a-32	499.203	3506.9099	1335	-151.63	rr-a-87	498.61401	3506.9199	1291	-166.89
rr-a-33	499.19199	3506.9099	1334	-152.89	rr-a-88	498.604	3506.9199	1291	-166.67999
rr-a-34	499.18201	3506.9099	1333	-154.16	rr-a-89	498.59399	3506.9199	1291	-166.5
rr-a-35	499.17099	3506.9099	1332	-155.38	rr-a-90	498.58301	3506.9199	1291	-166.35001
rr-a-36	499.16	3506.9099	1331	-156.59	rr-a-91	498.573	3506.9099	1291	-166.13
rr-a-37	499.14899	3506.9099	1330	-157.75	rr-a-92	498.56201	3506.9099	1290	-165.92999
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rr-a-39	499.12799	3506.9199	1328	-160	rr-a-94	498.54099	3506.9099	1290	-165.53
rr-a-40	499.117	3506.9199	1327	-161.08	rr-a-95	498.53101	3506.9099	1290	-165.3
rr-a-41	499.10599	3506.9199	1326	-162.10001	rr-a-96	498.51999	3506.9099	1290	-165.10001
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rr-a-43	499.08499	3506.9199	1323	-164.05	rr-a-98	498.49899	3506.9099	1289	-164.63
rr-a-44	499.07501	3506.9199	1322	-164.99001	rr-a-99	498.48901	3506.9099	1289	-164.37
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rr-a-46	499.05301	3506.9199	1320	-166.67	rr-a-101	498.46799	3506.8999	1289	-163.92999
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rr-a-49	499.021	3506.9199	1318	-168.75	rr-a-104	498.43701	3506.8999	1288	-163.25999
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rr-a-51	498.99899	3506.9199	1316	-169.83	rr-a-106	498.41501	3506.8999	1288	-162.83
rr-a-52	498.98801	3506.9199	1315	-170.25	rr-a-107	498.405	3506.8999	1288	-162.61
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rr-a-54	498.96701	3506.9299	1313	-171	rr-a-109	498.38501	3506.8999	1288	-162.17
rr-a-55	498.95599	3506.9299	1312	-171.32001	rr-a-110	498.37399	3506.8899	1288	-161.91
rr-a-111	498.36401	3506.8899	1288	-161.67999	rr-a-166	497.80701	3506.8601	1289	-158.56
rr-a-112	498.353	3506.8899	1288	-161.44	rr-a-167	497.797	3506.8601	1289	-158.71001
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rr-a-114	498.33301	3506.8899	1288	-161.00999	rr-a-169	497.77701	3506.8601	1289	-158.96001
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rr-a-116	498.31201	3506.8899	1288	-160.55	rr-a-171	497.75699	3506.8601	1289	-159.28
rr-a-117	498.302	3506.8899	1288	-160.32001	rr-a-172	497.74799	3506.8601	1289	-159.39999
rr-a-118	498.29099	3506.8899	1288	-160.08	rr-a-173	497.73801	3506.8601	1289	-159.59
rr-a-119	498.28201	3506.8799	1288	-159.88	rr-a-174	497.728	3506.8601	1289	-159.75
rr-a-120	498.271	3506.8799	1288	-159.67	rr-a-175	497.71799	3506.8601	1289	-159.94
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rr-a-122	498.25	3506.8799	1288	-159.36	rr-a-177	497.698	3506.8601	1289	-160.25
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rr-a-124	498.23001	3506.8799	1288	-159.07001	rr-a-179	497.67899	3506.8601	1289	-160.63
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rr-a-127	498.19901	3506.8799	1288	-158.78	rr-a-182	497.64899	3506.8601	1289	-161.22
rr-a-128	498.189	3506.8701	1288	-158.66	rr-a-183	497.63901	3506.8601	1289	-161.39999
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rr-a-132	498.14801	3506.8701	1288	-158.44	rr-a-187	497.60001	3506.8601	1289	-162.22
rr-a-133	498.138	3506.8701	1287	-158.36	rr-a-188	497.591	3506.8601	1289	-162.41
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rr-a-136	498.108	3506.8701	1287	-158.14999	rr-a-191	497.56201	3506.8601	1288	-163.09
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rr-a-140	498.06699	3506.8601	1287	-157.73					
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rr-a-148	497.98599	3506.8601	1286	-157.45					
rr-a-149	497.97699	3506.8601	1287	-157.44					
rr-a-150	497.96701	3506.8601	1287	-157.45					
rr-a-151	497.95599	3506.8601	1287	-157.44					
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rr-a-160	497.867	3506.8601	1288	-157.89					
rr-a-161	497.85599	3506.8601	1288	-157.97					
rr-a-162	497.84601	3506.8601	1288	-158.07001					
rr-a-163	497.836	3506.8601	1288	-158.17					
rr-a-164	497.827	3506.8601	1289	-158.31					
rr-a-165	497.81699	3506.8601	1289	-158.44					
cc-a-1	500.24701	3499.95	1356	-140.85001	cc-a-56	500.67001	3499.95	1380	-151.45
cc-a-2	500.254	3499.95	1356	-140.97	cc-a-57	500.677	3499.95	1380	-151.85001
cc-a-3	500.26199	3499.95	1357	-141.09	cc-a-58	500.685	3499.96	1381	-152.27
cc-a-4	500.26999	3499.95	1358	-141.21001	cc-a-59	500.69199	3499.96	1381	-152.7
cc-a-5	500.27802	3499.95	1358	-141.33	cc-a-60	500.70001	3499.96	1381	-153.14
cc-a-6	500.28601	3499.95	1359	-141.42999	cc-a-61	500.70801	3499.96	1381	-153.55
cc-a-7	500.293	3499.95	1360	-141.56	cc-a-62	500.715	3499.96	1382	-154

cc-a-8	500.30099	3499.95	1360	-141.64	cc-a-63	500.72299	3499.96	1382	-154.46001
cc-a-9	500.30899	3499.95	1361	-141.75	cc-a-64	500.73099	3499.96	1382	-154.92
cc-a-10	500.31699	3499.95	1362	-141.85001	cc-a-65	500.73801	3499.96	1382	-155.42
cc-a-11	500.32401	3499.95	1362	-141.97	cc-a-66	500.746	3499.96	1382	-155.89999
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cc-a-13	500.33899	3499.95	1363	-142.16	cc-a-68	500.76099	3499.96	1383	-156.89999
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cc-a-15	500.35501	3499.95	1364	-142.38	cc-a-70	500.77701	3499.96	1383	-157.94
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cc-a-17	500.37	3499.95	1365	-142.59	cc-a-72	500.79199	3499.96	1383	-159.06
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cc-a-19	500.38599	3499.95	1367	-142.82001	cc-a-74	500.80801	3499.96	1383	-160.21001
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cc-a-21	500.401	3499.95	1368	-143.07001	cc-a-76	500.823	3499.96	1382	-161.47
cc-a-22	500.40799	3499.95	1368	-143.16	cc-a-77	500.83099	3499.96	1382	-162.07001
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cc-a-24	500.42401	3499.95	1369	-143.45	cc-a-79	500.84601	3499.96	1382	-163.38
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cc-a-27	500.44699	3499.95	1371	-143.87	cc-a-82	500.86899	3499.96	1382	-165.48
cc-a-28	500.45499	3499.95	1372	-144	cc-a-83	500.87701	3499.96	1382	-166.24001
cc-a-29	500.46301	3499.95	1372	-144.16	cc-a-84	500.88501	3499.96	1382	-166.98
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cc-a-31	500.478	3499.95	1373	-144.50999	cc-a-86	500.901	3499.96	1382	-168.59
cc-a-32	500.48499	3499.95	1373	-144.7	cc-a-87	500.90799	3499.96	1382	-169.38
cc-a-33	500.49301	3499.95	1373	-144.88	cc-a-88	500.91599	3499.96	1381	-170.23
cc-a-34	500.50101	3499.95	1374	-145.06	cc-a-89	500.92401	3499.97	1381	-171.11
cc-a-35	500.509	3499.95	1374	-145.25999	cc-a-90	500.93201	3499.97	1381	-171.99001
cc-a-36	500.51599	3499.95	1374	-145.5	cc-a-91	500.94	3499.97	1380	-172.89
cc-a-37	500.52399	3499.95	1375	-145.73	cc-a-92	500.94699	3499.97	1380	-173.82001
cc-a-38	500.53101	3499.95	1375	-145.92999	cc-a-93	500.95499	3499.97	1379	-174.73
cc-a-39	500.539	3499.95	1375	-146.16	cc-a-94	500.96301	3499.97	1378	-175.7
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cc-a-42	500.56201	3499.95	1376	-146.92999	cc-a-97	500.98599	3499.97	1376	-178.63
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cc-a-48	500.608	3499.95	1378	-148.64	cc-a-103	501.034	3499.97	1372	-184.96001
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cc-a-50	500.62399	3499.95	1379	-149.32001	cc-a-105	501.04999	3499.97	1371	-187.14
cc-a-51	500.63101	3499.95	1379	-149.63	cc-a-106	501.05801	3499.97	1371	-188.24001
cc-a-52	500.638	3499.95	1379	-149.96001	cc-a-107	501.065	3499.97	1370	-189.34
cc-a-53	500.646	3499.95	1380	-150.31	cc-a-108	501.073	3499.97	1369	-190.42999
cc-a-54	500.65399	3499.95	1380	-150.71001	cc-a-109	501.08099	3499.97	1369	-191.49001
cc-a-55	500.66199	3499.95	1380	-151.10001	cc-a-110	501.08899	3499.97	1368	-192.58
cc-a-111	501.09799	3499.97	1367	-193.64999	cc-a-166	501.548	3499.97	1362	-215.03999
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cc-a-114	501.12201	3499.97	1365	-196.73	cc-a-169	501.573	3499.97	1364	-215.27
cc-a-115	501.13	3499.97	1365	-197.73	cc-a-170	501.58099	3499.97	1364	-215.45
cc-a-116	501.138	3499.97	1364	-198.7	cc-a-171	501.58899	3499.97	1365	-215.56
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cc-a-118	501.15399	3499.97	1363	-200.53999	cc-a-173	501.60501	3499.97	1366	-215.92
cc-a-119	501.16199	3499.97	1362	-201.39	cc-a-174	501.61301	3499.97	1366	-216.11

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cc-a-121	501.17899	3499.97	1361	-203.07001
cc-a-122	501.186	3499.97	1360	-203.86
cc-a-123	501.194	3499.97	1360	-204.62
cc-a-124	501.203	3499.97	1359	-205.32001
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cc-a-126	501.21899	3499.97	1358	-206.7
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cc-a-130	501.25201	3499.97	1356	-209.06
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cc-a-133	501.276	3499.97	1356	-210.53
cc-a-134	501.284	3499.97	1356	-210.98
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cc-a-138	501.31699	3499.97	1355	-212.48
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cc-a-141	501.34201	3499.97	1355	-213.39
cc-a-142	501.35001	3499.97	1355	-213.64
cc-a-143	501.35901	3499.97	1355	-213.84
cc-a-144	501.367	3499.97	1355	-214.05
cc-a-145	501.375	3499.97	1355	-214.21001
cc-a-146	501.384	3499.97	1355	-214.35001
cc-a-147	501.39099	3499.97	1355	-214.47
cc-a-148	501.39999	3499.97	1354	-214.56
cc-a-149	501.40799	3499.97	1354	-214.64999
cc-a-150	501.41599	3499.97	1355	-214.67999
cc-a-151	501.42499	3499.97	1355	-214.7
cc-a-152	501.43301	3499.97	1356	-214.74001
cc-a-153	501.44101	3499.97	1356	-214.81
cc-a-154	501.44901	3499.97	1357	-214.81
cc-a-155	501.45801	3499.97	1357	-214.84
cc-a-156	501.466	3499.97	1358	-214.82001
cc-a-157	501.474	3499.97	1358	-214.82001
cc-a-158	501.48199	3499.97	1359	-214.81
cc-a-159	501.48999	3499.97	1359	-214.82001
cc-a-160	501.49899	3499.97	1360	-214.77
cc-a-161	501.50699	3499.97	1360	-214.78
cc-a-162	501.51501	3499.97	1361	-214.8
cc-a-163	501.52301	3499.97	1361	-214.85001
cc-a-164	501.53101	3499.97	1362	-214.89
cc-a-165	501.54001	3499.97	1362	-214.96001
cc-a-175	501.62201	3499.97	1367	-216.3
cc-a-176	501.63	3499.97	1367	-216.53999
cc-a-177	501.638	3499.97	1368	-216.8
cc-a-178	501.646	3499.97	1368	-217.03
cc-a-179	501.65399	3499.97	1369	-217.31
cc-a-180	501.66199	3499.97	1369	-217.56
cc-a-181	501.67099	3499.97	1370	-217.85001
cc-a-182	501.67801	3499.97	1370	-218.14
cc-a-183	501.68701	3499.97	1371	-218.41
cc-a-184	501.69501	3499.97	1371	-218.67999
cc-a-185	501.703	3499.97	1372	-218.95
cc-a-186	501.711	3499.97	1373	-219.23
cc-a-187	501.71899	3499.97	1373	-219.50999
cc-a-188	501.72699	3499.97	1373	-219.75
cc-a-189	501.73599	3499.97	1374	-220.03999
cc-a-190	501.74399	3499.97	1375	-220.28999
cc-a-191	501.75201	3499.96	1375	-220.52
cc-a-192	501.76001	3499.96	1376	-220.7
cc-a-193	501.76801	3499.96	1376	-220.92999
cc-a-194	501.776	3499.96	1377	-221.11
cc-a-195	501.784	3499.96	1378	-221.27
cc-a-196	501.79199	3499.96	1378	-221.46001
cc-a-197	501.79999	3499.96	1379	-221.57001
cc-a-198	501.80801	3499.96	1379	-221.66
cc-a-199	501.81601	3499.96	1380	-221.73
cc-a-200	501.82401	3499.96	1381	-221.82001
cc-a-201	501.83301	3499.96	1381	-221.82001
cc-a-202	501.84	3499.96	1382	-221.84
cc-a-203	501.84799	3499.96	1383	-221.87
cc-a-204	501.85699	3499.96	1383	-221.86
cc-a-205	501.86499	3499.96	1384	-221.85001
cc-a-206	501.87299	3499.96	1384	-221.84
cc-a-207	501.88101	3499.96	1385	-221.77
cc-a-208	501.88901	3499.96	1386	-221.73
cc-a-209	501.897	3499.96	1386	-221.69
cc-a-210	501.905	3499.96	1387	-221.61
cc-a-211	501.91299	3499.96	1388	-221.53
cc-a-212	501.92001	3499.96	1389	-221.49001
cc-a-213	501.92801	3499.96	1389	-221.42
cc-a-214	501.93701	3499.96	1390	-221.34
cc-a-215	501.94501	3499.95	1391	-221.28999
cc-a-216	501.953	3499.95	1392	-221.17
cc-a-217	501.95999	3499.95	1393	-221.09
cc-a-218	501.96799	3499.95	1393	-221.02
cc-a-219	501.97601	3499.95	1394	-221
cc-a-220	501.98401	3499.95	1395	-220.97
cc-a-221	501.992	3499.95	1396	-220.96001
cc-a-222	502	3499.95	1397	-220.92999
cc-a-223	502.008	3499.95	1397	-220.91
cc-a-224	502.01599	3499.95	1398	-220.92
cc-a-225	502.02399	3499.95	1399	-220.88
cc-a-226	502.03201	3499.95	1400	-220.86
cc-a-227	502.039	3499.95	1401	-220.88
cc-a-228	502.047	3499.95	1401	-220.88
cc-a-229	502.05499	3499.95	1402	-220.89999
cc-a-230	502.06299	3499.95	1403	-220.92
cc-a-231	502.07101	3499.95	1404	-220.92999
cc-a-276	502.41699	3499.95	1440	-223.81
cc-a-277	502.42401	3499.95	1441	-223.88
cc-a-278	502.431	3499.95	1441	-223.95
cc-a-279	502.439	3499.95	1442	-223.99001
cc-a-280	502.44699	3499.96	1443	-224.07001
cc-a-281	502.45401	3499.96	1444	-224.16
cc-a-282	502.461	3499.96	1444	-224.25
cc-a-283	502.46899	3499.96	1445	-224.33
cc-a-284	502.47699	3499.96	1446	-224.39
cc-a-285	502.48401	3499.96	1446	-224.5
cc-a-286	502.492	3499.96	1447	-224.60001

cc-a-232	502.078	3499.95	1405	-220.92999
cc-a-233	502.086	3499.95	1406	-220.96001
cc-a-234	502.09399	3499.95	1407	-220.94
cc-a-235	502.10199	3499.95	1407	-220.98
cc-a-236	502.10999	3499.95	1408	-221.00999
cc-a-237	502.117	3499.95	1409	-221.03999
cc-a-238	502.125	3499.95	1410	-221.06
cc-a-239	502.133	3499.95	1411	-221.10001
cc-a-240	502.14099	3499.95	1412	-221.09
cc-a-241	502.14899	3499.95	1413	-221.13
cc-a-242	502.15601	3499.95	1413	-221.17
cc-a-243	502.164	3499.95	1414	-221.21001
cc-a-244	502.172	3499.95	1415	-221.27
cc-a-245	502.17999	3499.95	1416	-221.31
cc-a-246	502.18799	3499.95	1417	-221.37
cc-a-247	502.19501	3499.95	1418	-221.41
cc-a-248	502.203	3499.95	1419	-221.48
cc-a-249	502.211	3499.95	1420	-221.55
cc-a-250	502.21899	3499.95	1420	-221.64
cc-a-251	502.22601	3499.95	1421	-221.69
cc-a-252	502.23401	3499.95	1422	-221.78999
cc-a-253	502.241	3499.95	1423	-221.86
cc-a-254	502.24899	3499.95	1423	-221.97
cc-a-255	502.25699	3499.95	1424	-222.03999
cc-a-256	502.26501	3499.95	1425	-222.13
cc-a-257	502.272	3499.95	1426	-222.23
cc-a-258	502.28	3499.95	1427	-222.32001
cc-a-259	502.28699	3499.95	1427	-222.42
cc-a-260	502.29501	3499.95	1428	-222.5
cc-a-261	502.30301	3499.95	1429	-222.57001
cc-a-262	502.31	3499.95	1430	-222.64999
cc-a-263	502.31799	3499.95	1430	-222.7
cc-a-264	502.32599	3499.95	1431	-222.8
cc-a-265	502.33301	3499.95	1432	-222.89999
cc-a-266	502.341	3499.95	1433	-222.99001
cc-a-267	502.34799	3499.95	1434	-223.07001
cc-a-268	502.35599	3499.95	1434	-223.2
cc-a-269	502.36401	3499.95	1435	-223.31
cc-a-270	502.371	3499.95	1436	-223.41
cc-a-271	502.379	3499.95	1437	-223.50999
cc-a-272	502.38599	3499.95	1437	-223.61
cc-a-273	502.39401	3499.95	1438	-223.66
cc-a-274	502.401	3499.95	1439	-223.73
cc-a-275	502.409	3499.95	1439	-223.8
cc-a-331	502.83401	3499.97	1446	-229.72
cc-a-332	502.84201	3499.97	1446	-229.83
cc-a-333	502.849	3499.97	1445	-229.92999
cc-a-334	502.85699	3499.97	1445	-230.00999
cc-a-335	502.86499	3499.97	1444	-230.13
cc-a-336	502.87299	3499.97	1444	-230.25
cc-a-337	502.88101	3499.97	1443	-230.34
cc-a-338	502.88901	3499.97	1443	-230.42999
cc-a-339	502.896	3499.97	1442	-230.55
cc-a-340	502.90399	3499.97	1442	-230.64999
cc-a-341	502.91199	3499.98	1442	-230.75999
cc-a-342	502.92001	3499.98	1441	-230.89
cc-a-343	502.92801	3499.98	1441	-230.97
cc-a-287	502.49899	3499.96	1448	-224.67
cc-a-288	502.50699	3499.96	1448	-224.75
cc-a-289	502.51401	3499.96	1449	-224.84
cc-a-290	502.522	3499.96	1449	-224.94
cc-a-291	502.53	3499.96	1449	-225.03
cc-a-292	502.53699	3499.96	1450	-225.12
cc-a-293	502.54401	3499.96	1450	-225.24001
cc-a-294	502.552	3499.96	1450	-225.28999
cc-a-295	502.56	3499.96	1450	-225.39
cc-a-296	502.56699	3499.96	1450	-225.49001
cc-a-297	502.57401	3499.96	1450	-225.60001
cc-a-298	502.582	3499.96	1450	-225.7
cc-a-299	502.59	3499.96	1450	-225.84
cc-a-300	502.59698	3499.96	1450	-225.92999
cc-a-301	502.60501	3499.96	1450	-226.03
cc-a-302	502.612	3499.96	1451	-226.14
cc-a-303	502.62	3499.96	1451	-226.25
cc-a-304	502.62799	3499.96	1451	-226.37
cc-a-305	502.63501	3499.96	1451	-226.47
cc-a-306	502.64301	3499.96	1451	-226.60001
cc-a-307	502.64999	3499.96	1451	-226.71001
cc-a-308	502.65799	3499.96	1451	-226.82001
cc-a-309	502.66501	3499.96	1451	-226.95
cc-a-310	502.673	3499.96	1451	-227.03999
cc-a-311	502.681	3499.97	1451	-227.17999
cc-a-312	502.68799	3499.97	1451	-227.34
cc-a-313	502.69601	3499.97	1450	-227.46001
cc-a-314	502.70401	3499.97	1450	-227.59
cc-a-315	502.711	3499.97	1450	-227.73
cc-a-316	502.71899	3499.97	1450	-227.84
cc-a-317	502.72601	3499.97	1450	-227.98
cc-a-318	502.73401	3499.97	1449	-228.09
cc-a-319	502.742	3499.97	1449	-228.2
cc-a-320	502.75	3499.97	1449	-228.33
cc-a-321	502.75699	3499.97	1449	-228.42
cc-a-322	502.76501	3499.97	1449	-228.53999
cc-a-323	502.772	3499.97	1448	-228.7
cc-a-324	502.78	3499.97	1448	-228.84
cc-a-325	502.78799	3499.97	1448	-228.99001
cc-a-326	502.79599	3499.97	1448	-229.14999
cc-a-327	502.80301	3499.97	1447	-229.3
cc-a-328	502.811	3499.97	1447	-229.37
cc-a-329	502.81799	3499.97	1447	-229.49001
cc-a-330	502.82599	3499.97	1447	-229.61

cc-a-344	502.936	3499.98	1440	-231.06
cc-a-345	502.94299	3499.98	1440	-231.14999
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cc-a-347	502.95901	3499.98	1439	-231.28999
cc-a-348	502.96701	3499.98	1438	-231.36
cc-a-349	502.97501	3499.98	1438	-231.42999
cc-a-350	502.983	3499.98	1438	-231.52
cc-a-351	502.991	3499.98	1437	-231.57001
cc-a-352	502.99799	3499.98	1437	-231.62
cc-a-353	503.00699	3499.98	1436	-231.61
cc-a-354	503.01501	3499.98	1436	-231.63
cc-a-355	503.02301	3499.98	1436	-231.64
cc-a-356	503.03101	3499.98	1435	-231.67
cc-a-357	503.03799	3499.98	1435	-231.7
cc-a-358	503.047	3499.98	1434	-231.72
cc-a-359	503.05499	3499.98	1434	-231.75
cc-a-360	503.06299	3499.98	1434	-231.82001
cc-a-361	503.07101	3499.98	1433	-231.88
cc-a-362	503.078	3499.98	1433	-231.91
cc-a-363	503.08701	3499.98	1432	-231.91
cc-a-364	503.095	3499.98	1432	-231.92999
cc-a-365	503.103	3499.98	1432	-231.92999
cc-a-366	503.11099	3499.98	1431	-231.98
cc-a-367	503.11899	3499.98	1431	-232.02
cc-a-368	503.12701	3499.98	1430	-232.03999
cc-a-369	503.13501	3499.98	1430	-232.08
cc-a-370	503.14301	3499.98	1430	-232.14
cc-a-371	503.151	3499.98	1430	-232.17
cc-a-372	503.159	3499.98	1430	-232.22
cc-a-373	503.16699	3499.98	1430	-232.24001
cc-a-374	503.17499	3499.98	1429	-232.25999
cc-a-375	503.18399	3499.98	1429	-232.25
cc-a-376	503.19199	3499.98	1429	-232.23
cc-a-377	503.20001	3499.98	1429	-232.23
cc-a-378	503.20801	3499.98	1429	-232.24001
cc-a-379	503.216	3499.98	1429	-232.22
cc-a-380	503.224	3499.98	1429	-232.24001
cc-a-381	503.233	3499.98	1429	-232.22
cc-a-382	503.23999	3499.98	1428	-232.17999
cc-a-383	503.24899	3499.98	1428	-232.14