

UNITED STATES DEPARTMENT OF THE INTERIOR  
GEOLOGICAL SURVEY

Principal Facts for Gravity Stations near  
Alcaparroso, Sonora, Mexico

by

Viki Bankey, Mauricio F. de la Fuente Duch<sup>1</sup>, and  
M. D. Kleinkopf

Open-File Report 82-890

1982

<sup>1</sup>Consejo de Recursos Minerales, Mexico D.F.

This report is preliminary and has not been reviewed for  
conformity with U.S. Geological Survey editorial standards.

Any use of trade names is for descriptive purposes only and does  
not imply endorsement by the USGS.

## Table of Contents

	Page
Introduction-----	1
Data Collection-----	1
Data Reduction-----	1
References-----	3
<u>List of Figures</u>	
Figure 1: Location Map of Alcaparroso Study Area, Sonora, Mexico-----	4
Figure 2: Location of Gravity Lines within the Alcaparroso Study Area-----	5
Figure 3: Bouguer Anomaly Map-----	6
<u>Appendices</u>	
Appendix A: Nogales, Sonora Base Description-----	7
Appendix B: El Rodeo Ranch Base Description-----	8
Appendix C: Principal Facts-----	9

## Introduction

During 1979, 206 gravity stations were collected near the town of Alcaparroso, in the state of Sonora, Mexico, as part of a cooperative research project involving the U.S. Geological Survey (USGS) and the Mexican Consejo de Recursos Minerales (CRM). The project was initiated for the purpose of developing new exploration techniques and new methods of data interpretation in the Sonoran environment with emphasis on a search for copper. This report complements a 1979 report (Fuente Duch and Bonilla, G., 1979) on induced polarization, resistivity, aeromagnetic, and ground magnetic surveys completed by the CRM in the Alcaparroso area.

## Data Collection

The gravity observations were made by personnel of CRM using LaCoste-Romberg gravity meter G-486. Stations were read along east-west lines shown in Figure 2. The seven lines were surveyed, with stations located approximately 75 meters apart.

These surveyed observations were referenced to the U.S. Department of Defense (DOD) gravity base in Nogales, Mexico, which is on the datum of the International Gravity Standardization Net (IGSN), 1971, established by the Defense Mapping Agency Aerospace Center (1974). A secondary base was established at El Rodeo Ranch. Gravity loops were started and closed daily at this base. Complete base descriptions are included at the end of this report.

## Data Reduction

Computer programs existing on the USGS Honeywell Multics computer system were used to obtain principal facts and terrain-corrected gravity values. A program written by D. Dansereau and R. Wahl (USGS, unpublished program, 1979)

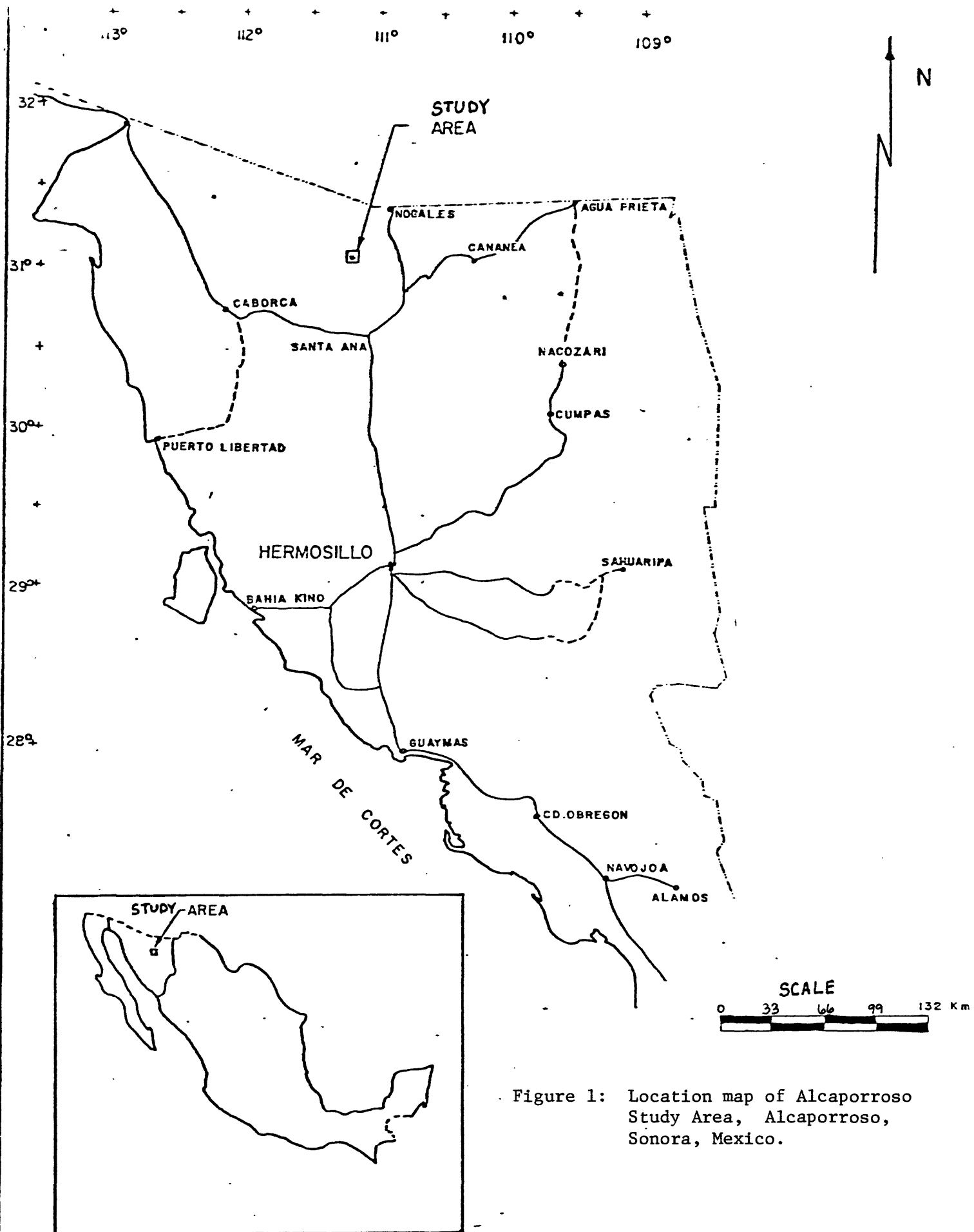
was used to reduce gravity meter readings to observed gravity values by calculating and correcting for earth-tide and linear meter drift. The theoretical gravity value was calculated using the 1967 formula of the Geodetic Reference System (International Association of Geodesy, 1967) and referenced to the IGSN-71 datum.

Complete terrain corrections were computed using a program by R. H. Godson (USGS, unpublished program, 1978), correcting for the terrain from each station out to a radius of 166.7 km from the station using the method of Plouff (1977). These computed terrain corrections are based on mean elevation data digitized on a 15-second grid for corrections from 0 to 5 km; 1-minute terrain data for corrections from 5 to 21 km; and 3-minute terrain data for corrections from 21 to 166.7 km. An assumed density of  $2.67 \text{ g/cm}^3$  was used to calculate terrain corrections. Godson's program also calculates earth curvature corrections and complete (terrain-corrected) Bouguer anomaly values. Two complete Bouguer anomaly values per station were obtained using average rock densities of  $2.67 \text{ g/cm}^3$  and  $2.45 \text{ g/cm}^3$ . The corrections and anomaly values are listed in Appendix C.

The Bouguer gravity anomaly map (Figure 3) was hand contoured.

## References

- Defense Mapping Agency Aerospace Center, 1974, World Relative Gravity Reference Network, North America, Part 2: DMAAC Reference Publication 25, with supplement updating gravity values to the International Gravity Standardization Net 1971, 1635 p.
- Fuente D., Mauricio de la; Bonilla G., Rafael de J.; 1979, Informe final de los trabajos geofisicos llevados a cabo en el proyecto "Convenio con el Servicio Geologico Americano." Consejo de Recursos Minerales, Mexico D.F., 28 p.
- International Association of Geodesy, 1967, Geodetic Reference System 1967, International Association of Geodesy Special Publication 3, 74 p.
- Plouff, D., 1977, Preliminary documentation for a FORTRAN program to compute gravity terrain corrections based on topography digitized on a geographic grid: U.S. Geological Survey Open-File Report 77-535, 31 p.



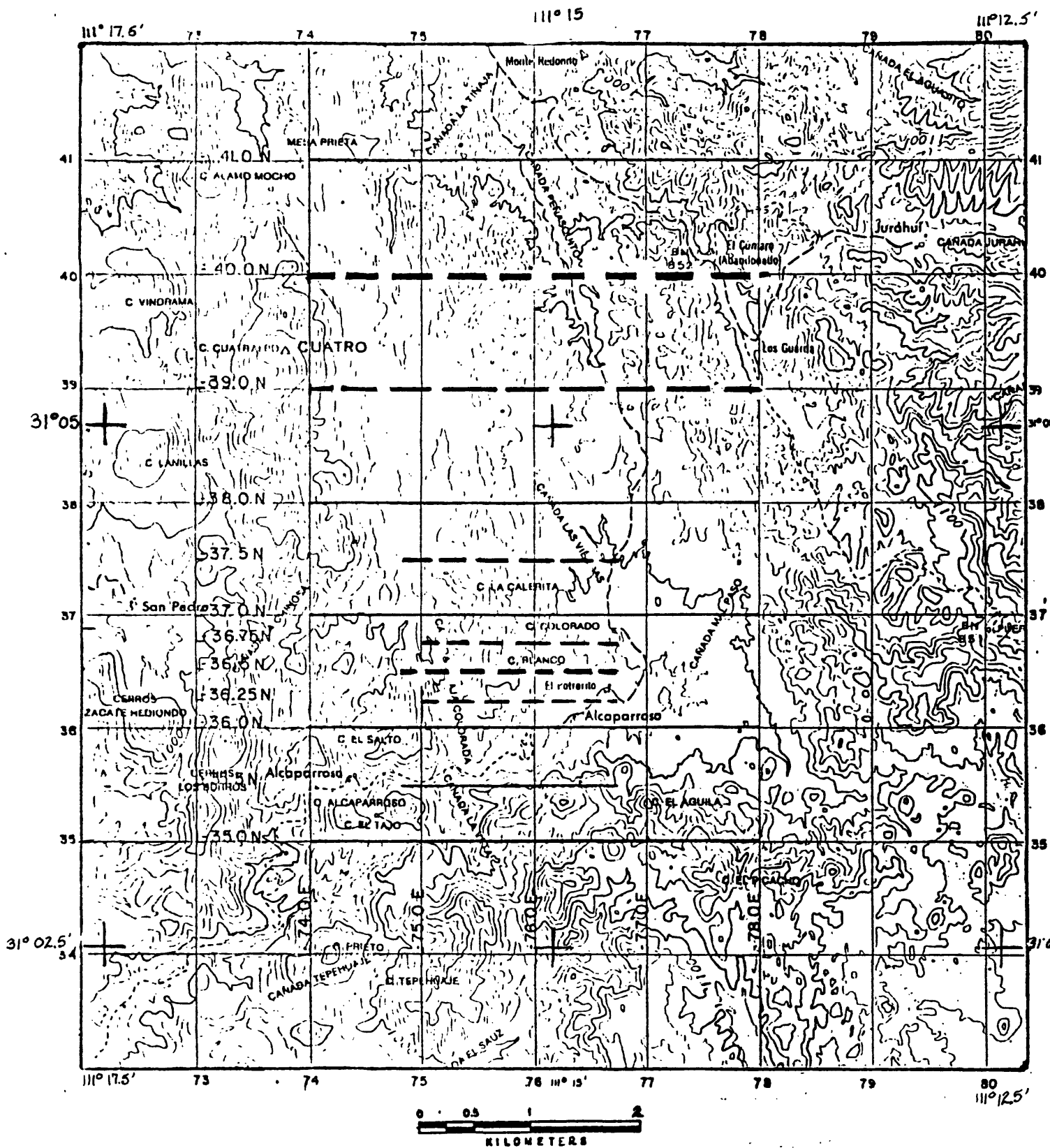
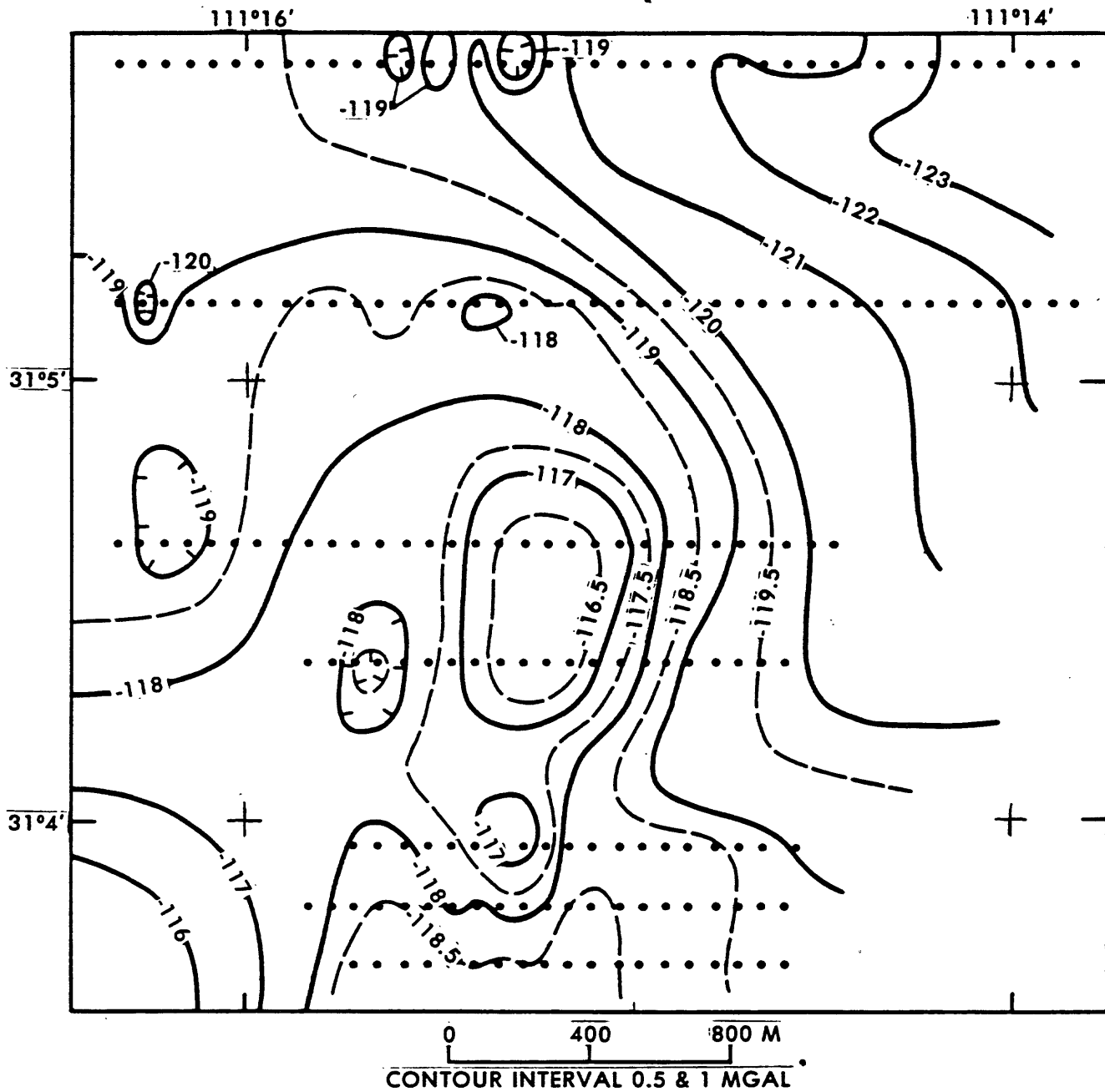


Figure 2: Location of Gravity Lines within the Alcaporoso Study Area, Alcaporoso, Sonora, Mexico.

--- : Surveyed gravity lines

— : Surveyed electromagnetic lines

FIGURE 3



BOUGUER GRAVITY MAP, ALCAPORROSO AREA  
SONORA, MEXICO

• = gravity station

— = contour interval, 1 mgal  
--- = low gravity anomaly

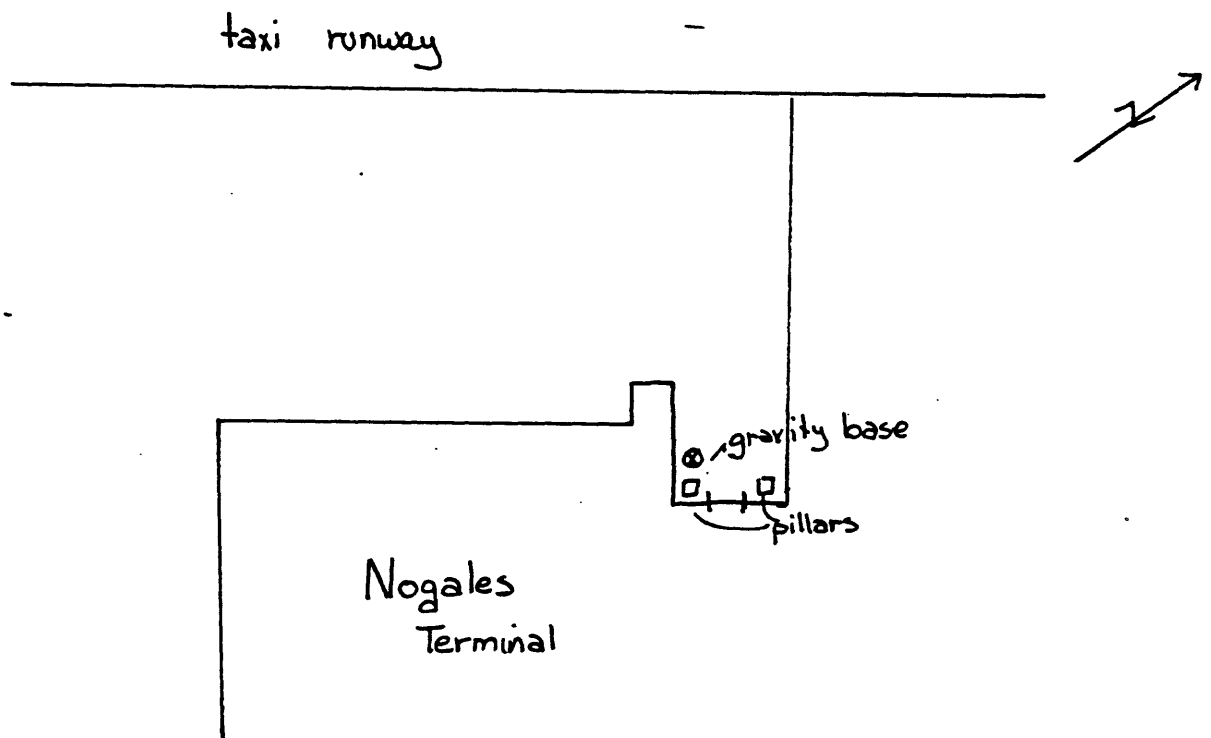
## APPENDIX A

U.S. GEOLOGICAL SURVEY  
GRAVITY BASE STATION

STATE/COUNTRY Sonora/Mexico		STATION DESIGNATION Nogales Airport (0559-1)		OBSERVED GRAVITY 979027.95 mgal
NEAREST TOWN Nogales		LONGITUDE 110°58.80'		LATITUDE 31°14.30'
ELEVATION 1329 m.		TOPOGRAPHIC MAP(S)		
DATE	OBSERVER	METER	REFERENCE STATION	REFERENCE VALUE
4/69	Flora/Mena	g-130 g-115		

## DESCRIPTION/SKETCH

The station is located in front of the Nogales Airport terminal, behind the left pillar at the side of the main door, facing the runway. The station is marked with a disk with the I.A.G.S. stamp "Gravity 1962".



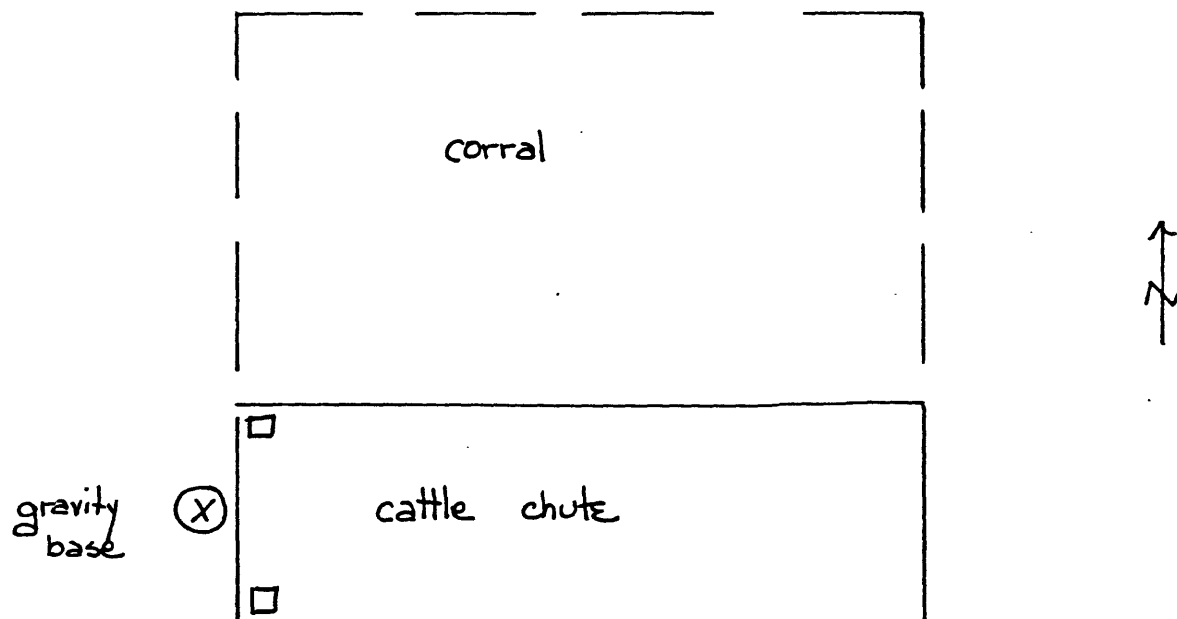
## APPENDIX B

U.S. GEOLOGICAL SURVEY  
GRAVITY BASE STATION

STATE/COUNTRY		STATION DESIGNATION		OBSERVED GRAVITY
Sonora/Mexico		El Rodeo Ranch (So 147)		979119.49 mgal
NEAREST TOWN		LONGITUDE		LATITUDE
El Correo		111°16.75'		31°08.28'
ELEVATION		TOPOGRAPHIC MAP(S)		
875 m.		El Correo 1/50,000		
DATE	OBSERVER	METER	REFERENCE STATION	REFERENCE VALUE
3/19/78	Kleinkopf	G-486	Saric	979142.71 mgal

## DESCRIPTION/SKETCH

The El Rodeo base is located approximately 9 km. SW of the pueblo of El Correo along the Planchas de Plata River on the El Rodeo Ranch. The base was read on ground at the base of the cattle chute located at the SW corner of corral.



## Appendix C: Principal Facts of Gravity Data

### Explanation of headings

#### Identification

proj	Project name.
sta id	Gravity identification.

#### Location

latitude	North latitude in degrees minutes and hundredths of minutes.
longitude	West longitude in degrees, minutes, and hundredths of minutes.
ele	Station elevation in feet.
st	State where station is located.

#### Gravity

observed	Observed gravity in milligals.
theoretical	Theoretical gravity.

#### Corrections

terrain	Terrain correction out to 166.7km in milligals.
Bouguer	Elevation correction in milligals.
curv	Curvature correction in milligals.
special	Not used.

#### Anomalies

free-air	Free-air anomaly in milligals.
complete-Bouguer	Complete Bouguer anomaly in milligals for designated densities.
spec fields	Not used.

# ROUGHER GRAVITY DATA

page C-1

alcaparrosa-sonora gravity survey  
consejo de recursos minerales 1979  
Meter 1U: α-486 Date: 02/11/80

STATION		L O C A T I O N S		G R A V I T Y		C O R R E C T I O N S		A N O M A L I E S								
IDENTIFICATION	sta-id	LATITUDE	LONGITUDE	ELE	ST	ORSERVED	THREORETICAL	TERRAIN	BOUGUER	CURV	SPECIAL	FREE	COMPLTF	ROUGHER	SPEC	
		deg	min	deg	min	(in ft)						AIR	d1=2.67	d2=2.45	FIELDS	
:	a161	31	5.71	-111	14.91	3238.1	mx	979095.15	979410.61	0.64	-110.44	-1.10	0.00	-10.90	-121.80	-112.66
:	a162	31	5.71	-111	14.85	3217.5	mx	979096.27	979410.61	0.74	-109.74	-1.10	0.00	-11.71	-121.80	-112.73
:	a163	31	5.71	-111	14.78	3257.6	mx	979093.80	979410.61	0.58	-111.11	-1.11	0.00	-10.41	-122.05	-112.85
:	a164	31	5.71	-111	14.72	3302.7	mx	979091.14	979410.61	0.58	-112.65	-1.12	0.00	-8.82	-122.01	-112.68
:	a165	31	5.71	-111	14.66	3337.9	mx	979089.05	979410.61	0.70	-113.84	-1.12	0.00	-7.62	-121.88	-112.47
:	a166	31	5.71	-111	14.60	3350.5	mx	979088.25	979410.61	0.78	-114.28	-1.13	0.00	-7.23	-121.85	-112.40
:	a167	31	5.71	-111	14.53	3335.8	mx	979089.15	979410.61	0.66	-113.77	-1.12	0.00	-7.71	-121.95	-112.54
:	a168	31	5.71	-111	14.47	3346.6	mx	979088.50	979410.61	0.71	-114.14	-1.13	0.00	-7.34	-121.90	-112.46
:	a169	31	5.71	-111	14.41	3389.0	mx	979085.53	979410.61	1.05	-115.59	-1.14	0.00	-6.33	-122.00	-112.47
:	a170	31	5.71	-111	14.35	3378.2	mx	979086.06	979410.61	0.99	-115.22	-1.13	0.00	-6.81	-122.17	-112.67
:	a171	31	5.71	-111	14.28	3377.2	mx	979085.73	979410.61	0.87	-115.19	-1.13	0.00	-7.23	-122.68	-113.17
:	a172	31	5.71	-111	14.22	3327.1	mx	979088.69	979410.61	0.70	-113.48	-1.12	0.00	-8.99	-122.89	-113.50
:	a173	31	5.71	-111	14.16	3291.7	mx	979090.09	979410.61	0.69	-112.27	-1.11	0.00	-10.91	-123.61	-114.32
:	a174	31	5.71	-111	14.10	3260.7	mx	979092.24	979410.61	0.77	-111.21	-1.11	0.00	-11.68	-123.23	-114.04
:	a175	31	5.71	-111	14.04	3246.1	mx	979093.20	979410.61	0.87	-110.71	-1.10	0.00	-12.09	-123.04	-113.90
:	a176	31	5.71	-111	13.97	3241.7	mx	979093.31	979410.61	0.97	-110.56	-1.10	0.00	-12.40	-123.09	-113.97
:	a177	31	5.71	-111	13.91	3255.6	mx	979092.36	979410.61	1.01	-111.04	-1.10	0.00	-12.04	-123.17	-114.02
:	a178	31	5.71	-111	13.85	3284.2	mx	979090.48	979410.61	0.98	-112.01	-1.11	0.00	-11.23	-123.37	-114.13
:	a179	31	5.71	-111	14.78	3257.6	mx	979093.39	979410.61	0.58	-111.11	-1.11	0.00	-10.82	-122.45	-113.25
:	a181	31	5.71	-111	14.91	3238.1	mx	979094.95	979410.61	0.64	-110.44	-1.10	0.00	-11.09	-122.00	-112.86
:	a180	31	5.71	-111	14.85	3217.5	mx	979096.01	979410.61	0.74	-109.74	-1.10	0.00	-11.97	-122.07	-113.00
:	a182	31	5.71	-111	14.78	3257.6	mx	979093.80	979410.61	0.58	-111.11	-1.11	0.00	-10.41	-122.05	-112.85
:	a183	31	5.71	-111	14.85	3217.5	mx	979096.30	979410.61	0.74	-109.74	-1.10	0.00	-11.69	-121.78	-112.71
:	a184	31	5.71	-111	14.91	3238.1	mx	979095.16	979410.61	0.64	-110.44	-1.10	0.00	-10.88	-121.79	-112.65
:	a185	31	5.71	-111	14.97	3249.9	mx	979094.58	979410.61	0.58	-110.84	-1.10	0.00	-10.36	-121.73	-112.55
:	a186	31	5.71	-111	15.03	3272.7	mx	979093.06	979410.61	0.55	-111.62	-1.11	0.00	-9.73	-121.91	-112.67
:	a187	31	5.71	-111	15.10	3319.2	mx	979090.63	979410.61	0.60	-113.21	-1.12	0.00	-7.79	-121.52	-112.14
:	a188	31	5.71	-111	15.16	3392.0	mx	979086.18	979410.61	1.03	-115.69	-1.14	0.00	-5.39	-121.19	-111.65
:	a189	31	5.71	-111	15.22	3509.6	mx	979078.95	979410.61	2.09	-119.70	-1.16	0.00	-1.56	-120.34	-110.55
:	a190	31	5.71	-111	15.28	3611.6	mx	979072.29	979410.61	3.66	-123.18	-1.18	0.00	1.37	-119.34	-109.39
:	a191	31	5.71	-111	15.34	3566.2	mx	979075.65	979410.61	3.38	-121.63	-1.17	0.00	0.45	-118.97	-109.13
:	a192	31	5.71	-111	15.41	3452.9	mx	979082.93	979410.61	1.59	-117.77	-1.15	0.00	-2.91	-120.24	-110.57
:	a193	31	5.71	-111	15.47	3526.8	mx	979078.87	979410.61	2.19	-120.29	-1.17	0.00	-0.03	-119.30	-109.47
:	a194	31	5.71	-111	15.53	3601.2	mx	979073.77	979410.61	3.29	-122.83	-1.18	0.00	1.87	-118.85	-108.90
:	a195	31	5.71	-111	15.59	3451.1	mx	979083.17	979410.61	1.44	-117.71	-1.15	0.00	-2.84	-120.26	-110.58
:	a196	31	5.71	-111	15.66	3417.5	mx	979085.84	979410.61	1.09	-116.56	-1.14	0.00	-3.33	-119.94	-110.33
:	a197	31	5.71	-111	15.72	3372.8	mx	979089.00	979410.61	0.72	-115.04	-1.13	0.00	-4.38	-119.83	-110.31
:	a198	31	5.71	-111	15.78	3355.0	mx	979090.19	979410.61	0.67	-114.43	-1.13	0.00	-4.87	-119.75	-110.29
:	a199	31	5.71	-111	15.84	3348.3	mx	979090.50	979410.61	0.68	-114.20	-1.13	0.00	-5.18	-119.83	-110.38
:	a1100	31	5.71	-111	15.90	3366.2	mx	979089.68	979410.61	0.75	-114.81	-1.13	0.00	-4.32	-119.51	-110.02

# ROUGHER GRAVITY DATA

page C-2

alcaparrosa-sonora gravity survey  
consejo de recursos minerales 1979  
Meter ID: q-486 Date: 02/11/80

STATION		L O C A T I O N S		G R A V I T Y		C O R R E C T I O N S		A N O M A L I E S								
IDENTIFICATION		LATITUDE		LONGITUDE		ELE		ST								
proj	sta-id	deg	min	deg	min	(in ft)	ST	TERRAIN	BOURGUER	CURV	SPECIAL	FREE	COMPLETE-ROUGHER	SPEC		
												air	d1=2.67	d2=2.45	FIELDS	
:	a1101	31	5.71	-111	15.97	3411.5	mx	979087.07	979410.61	0.87	-116.36	-1.14	0.00	-2.67	-119.30	-109.69
:	a1102	31	5.71	-111	16.03	3428.7	mx	979086.05	979410.61	0.92	-116.94	-1.14	0.00	-2.07	-119.24	-109.59
:	a1103	31	5.71	-111	16.09	3416.3	mx	979086.82	979410.61	0.88	-116.52	-1.14	0.00	-2.47	-119.25	-109.63
:	a1104	31	5.71	-111	16.15	3430.4	mx	979085.89	979410.61	0.96	-117.00	-1.14	0.00	-2.07	-119.26	-109.60
:	a1105	31	5.71	-111	16.22	3440.4	mx	979085.17	979410.61	1.04	-117.34	-1.15	0.00	-1.84	-119.29	-109.62
:	a1106	31	5.71	-111	16.28	3470.0	mx	979083.27	979410.61	1.13	-118.35	-1.15	0.00	-0.96	-119.34	-109.58
:	a1107	31	5.71	-111	16.34	3515.3	mx	979080.29	979410.61	1.23	-119.90	-1.16	0.00	0.31	-119.52	-109.65
:	a1110	31	5.17	-111	14.60	3355.8	mx	979088.34	979409.89	0.80	-114.46	-1.13	0.00	-5.91	-120.70	-111.24
:	a1111	31	5.17	-111	14.66	3316.8	mx	979090.74	979409.89	0.62	-113.13	-1.12	0.00	-7.18	-120.81	-111.44
:	a1112	31	5.17	-111	14.72	3339.4	mx	979089.74	979409.89	0.68	-113.90	-1.12	0.00	-6.05	-120.40	-110.98
:	a1113	31	5.17	-111	14.78	3321.8	mx	979090.95	979409.89	0.61	-113.30	-1.12	0.00	-6.50	-120.31	-110.93
:	a1114	31	5.17	-111	14.85	3343.7	mx	979079.90	979409.89	0.70	-114.05	-1.13	0.00	-15.49	-129.96	-120.53
:	a1115	31	5.17	-111	14.91	3359.3	mx	979089.17	979409.89	0.76	-114.58	-1.13	0.00	-4.75	-119.70	-110.23
:	a1116	31	5.17	-111	14.97	3351.5	mx	979089.78	979409.89	0.69	-114.31	-1.13	0.00	-4.88	-119.63	-110.17
:	a1117	31	5.17	-111	15.03	3367.4	mx	979088.99	979409.89	0.74	-114.85	-1.13	0.00	-4.17	-119.41	-109.92
:	a1118	31	5.17	-111	15.10	3388.0	mx	979088.12	979409.89	0.87	-115.55	-1.14	0.00	-3.12	-118.93	-109.39
:	a1119	31	5.17	-111	15.16	3389.8	mx	979088.51	979409.89	0.85	-115.62	-1.14	0.00	-2.55	-118.45	-109.90
:	a1120	31	5.17	-111	15.22	3384.8	mx	979088.80	979409.89	0.75	-115.44	-1.13	0.00	-2.74	-118.56	-109.02
:	a1121	31	5.17	-111	15.28	3398.9	mx	979088.28	979409.89	0.77	-115.93	-1.14	0.00	-1.92	-118.21	-108.63
:	a1122	31	5.17	-111	15.34	3433.1	mx	979086.33	979409.89	0.95	-117.09	-1.15	0.00	-0.66	-117.95	-108.28
:	a1123	31	5.17	-111	15.41	3503.8	mx	979081.58	979409.89	1.61	-119.50	-1.16	0.00	1.24	-117.82	-108.01
:	a1124	31	5.17	-111	15.47	3462.0	mx	979084.24	979409.89	1.04	-118.08	-1.15	0.00	-0.03	-118.22	-108.48
:	a1125	31	5.17	-111	15.53	3453.0	mx	979084.75	979409.89	0.91	-117.77	-1.15	0.00	-0.36	-118.38	-108.65
:	a1126	31	5.17	-111	15.59	3447.3	mx	979084.89	979409.89	0.85	-117.58	-1.15	0.00	-0.76	-118.64	-108.93
:	a1127	31	5.17	-111	15.66	3449.4	mx	979084.67	979409.89	0.84	-117.65	-1.15	0.00	-0.78	-118.74	-109.02
:	a1128	31	5.17	-111	15.72	3452.0	mx	979084.82	979409.89	0.81	-117.74	-1.15	0.00	-0.39	-118.47	-108.74
:	a1129	31	5.17	-111	15.78	3455.1	mx	979084.72	979409.89	0.81	-117.85	-1.15	0.00	-0.20	-118.38	-108.64
:	a1130	31	5.17	-111	15.84	3453.6	mx	979084.75	979409.89	0.80	-117.79	-1.15	0.00	-0.31	-118.45	-108.72
:	a1131	31	5.17	-111	15.90	3467.2	mx	979083.82	979409.89	0.86	-118.26	-1.15	0.00	0.04	-118.51	-108.74
:	a1132	31	5.17	-111	15.97	3483.2	mx	979082.71	979409.89	0.90	-118.80	-1.16	0.00	0.43	-118.63	-108.82
:	a1133	31	5.17	-111	16.03	3404.6	mx	979081.86	979409.89	0.94	-119.19	-1.16	0.00	0.66	-118.75	-108.92
:	a1134	31	5.17	-111	16.09	3510.8	mx	979080.76	979409.89	1.00	-119.74	-1.16	0.00	1.08	-118.83	-108.95
:	a1135	31	5.17	-111	16.15	3537.5	mx	979078.92	979409.89	1.16	-120.66	-1.17	0.00	1.75	-118.91	-108.97
:	a1136	31	5.17	-111	16.22	3578.3	mx	979076.09	979409.89	1.37	-122.04	-1.18	0.00	2.76	-119.09	-109.05
:	a1137	31	5.17	-111	16.28	3616.0	mx	979072.12	979409.89	1.48	-123.33	-1.18	0.00	2.32	-120.71	-110.57
:	a1138	31	5.17	-111	16.34	3744.3	mx	979065.83	979409.89	2.08	-127.71	-1.21	0.00	8.10	-118.74	-108.29
:	a1139	31	5.17	-111	14.66	3316.8	mx	979090.78	979409.89	0.62	-113.13	-1.12	0.00	-7.14	-120.77	-111.40
:	a1140	31	5.17	-111	14.69	3355.8	mx	979088.37	979409.89	0.75	-114.46	-1.13	0.00	-5.89	-120.72	-111.26
:	a1144	31	5.17	-111	14.35	3362.8	mx	979087.28	979409.89	0.86	-114.70	-1.13	0.00	-6.32	-121.28	-111.81
:	a1145	31	5.17	-111	14.28	3369.3	mx	979086.88	979409.89	0.85	-114.92	-1.13	0.00	-6.11	-121.30	-111.81

# BOUGUER GRAVITY DATA

page C-3

alcanarrosa-sonora gravity survey  
consejo de recursos minerales 1979  
Meter ID: G-486 Date: 02/11/80

STATION IDENTIFICATION	LATITUDE deg min	LONGITUDE deg min	ELEVATION (in ft)	GRAVITY OBSERVED	TERRAIN BOUGUER CURV	SPECIAL	ANOMALIES	
							FREE AIR	COMPLETE-BOUGUER SPEC FIELDS
: a1141	31 5.17	-111 14.53	3370.6 mx	979087.48	979409.89	0.00	-5.38	-120.61 -111.12
: a1142	31 5.17	-111 14.47	3384.5 mx	979086.52	979409.89	0.00	-5.03	-120.65 -111.13
: a1143	31 5.17	-111 14.41	3399.5 mx	979085.33	979409.89	0.00	-4.82	-120.77 -111.22
: a1146	31 5.17	-111 14.22	3425.3 mx	979083.43	979409.89	0.00	-4.29	-121.00 -111.38
: a1147	31 5.17	-111 14.16	3389.5 mx	979085.35	979409.89	0.00	-5.74	-121.47 -111.93
: a1148	31 5.17	-111 14.10	3430.9 mx	979082.76	979409.89	0.00	-4.43	-121.20 -111.58
: a1149	31 5.17	-111 14.04	3433.9 mx	979082.32	979409.89	0.00	-4.59	-121.55 -111.91
: a1150	31 5.17	-111 13.97	3414.8 mx	979082.81	979409.89	0.00	-5.90	-122.35 -112.75
: a1151	31 5.17	-111 13.91	3393.7 mx	979084.04	979409.89	0.00	-6.66	-122.47 -112.93
: a1152	31 5.17	-111 13.85	3309.8 mx	979088.95	979409.89	0.00	-9.63	-122.80 -113.48
: a1153	31 5.17	-111 14.35	3362.8 mx	979087.30	979409.89	0.00	-6.30	-121.27 -111.79
: a1154	31 5.17	-111 14.60	3355.8 mx	979088.37	979409.89	0.00	-5.89	-120.67 -111.21
: a1155	31 4.63	-111 14.47	3329.5 mx	979089.77	979409.17	0.00	-6.24	-120.27 -110.87
: a1156	31 4.63	-111 14.53	3340.9 mx	979089.17	979409.17	0.00	-5.77	-120.14 -110.72
: a1157	31 4.63	-111 14.60	3338.1 mx	979089.75	979409.17	0.00	-5.45	-119.72 -110.30
: a1158	31 4.63	-111 14.66	3327.2 mx	979090.63	979409.17	0.00	-5.60	-119.54 -110.15
: a1159	31 4.63	-111 14.72	3317.7 mx	979091.58	979409.17	0.00	-5.54	-119.20 -109.83
: a1160	31 4.63	-111 14.78	3324.8 mx	979091.53	979409.17	0.00	-4.93	-118.80 -109.42
: a1161	31 4.63	-111 14.85	3348.1 mx	979090.53	979409.17	0.00	-3.73	-118.32 -108.88
: a1162	31 4.63	-111 14.91	3310.3 mx	979092.97	979409.17	0.00	-4.85	-118.28 -108.94
: a1163	31 4.63	-111 14.97	3335.1 mx	979092.32	979409.17	0.00	-3.16	-117.41 -107.99
: a1164	31 4.63	-111 15.03	3357.6 mx	979091.44	979409.17	0.00	-1.93	-116.90 -107.42
: a1165	31 4.63	-111 15.10	3369.0 mx	979091.10	979409.17	0.00	-1.20	-116.55 -107.05
: a1166	31 4.63	-111 15.16	3419.9 mx	979088.06	979409.17	0.00	0.55	-116.27 -106.65
: a1167	31 4.63	-111 15.22	3445.2 mx	979086.64	979409.17	0.00	1.51	-116.04 -106.36
: a1168	31 4.63	-111 15.28	3427.0 mx	979087.79	979409.17	0.00	0.95	-116.23 -106.58
: a1169	31 4.63	-111 15.34	3428.0 mx	979087.60	979409.17	0.00	0.85	-116.43 -106.77
: a1170	31 4.63	-111 15.41	3481.9 mx	979083.85	979409.17	0.00	2.18	-116.63 -106.84
: a1171	31 4.63	-111 15.47	3438.4 mx	979086.30	979409.17	0.00	0.53	-117.13 -107.44
: a1172	31 4.63	-111 15.53	3424.4 mx	979086.27	979409.17	0.00	-0.82	-118.07 -108.40
: a1173	31 4.63	-111 15.59	3405.8 mx	979087.66	979409.17	0.00	-1.17	-117.76 -108.15
: a1174	31 4.63	-111 15.66	3408.9 mx	979087.38	979409.17	0.00	-1.17	-117.84 -108.23
: a1175	31 4.63	-111 15.72	3411.6 mx	979087.10	979409.17	0.00	-1.19	-117.88 -108.26
: a1176	31 4.63	-111 15.78	3405.7 mx	979087.54	979409.17	0.00	-1.30	-117.67 -108.08
: a1177	31 4.63	-111 15.84	3420.2 mx	979086.63	979409.17	0.00	-0.85	-117.70 -108.07
: a1178	31 4.63	-111 15.90	3415.1 mx	979086.52	979409.17	0.00	-1.44	-118.01 -108.41
: a1179	31 4.63	-111 15.97	3445.3 mx	979084.56	979409.17	0.00	-0.56	-118.21 -108.51
: a1180	31 4.63	-111 16.03	3441.6 mx	979084.35	979409.17	0.00	-1.12	-118.46 -108.79
: a1181	31 4.36	-111 15.03	3327.0 mx	979092.42	979408.81	0.00	-3.47	-117.46 -108.07
: a1182	31 4.63	-111 16.09	3532.8 mx	979078.64	979409.17	0.00	1.74	-118.97 -109.02

alcanarrosa-sonora gravity survey  
 conselho de recursos minerales 1979  
 Meter ID: a-486 Date: 02/11/80

# ROUGHER GRAVITY DATA

page C-4

STATION IDENTIFICATION		I U C A T I O N S		G R A V I T Y		C O R R E C T I O N S		A N O M A L I E S			
proj	sta-ia	LATITUDE deg min	LONGITUDE deg min	ELE (in ft)	ST	THEORETICAL	TERRAIN BOUGUER CURV	SPECIAL	FREE AIR	COMPLETE-BOUGUER SPEC	FIELDS
:	a1194	31	4.36	-111 15.10	3366.8 m	779090.38	779408.81	0.00	0.73	-114.83	-1.13
:	a1182	31	4.63	-111 16.15	3555.3 m	779077.04	779409.17	0.00	0.97	-121.26	-1.17
:	a1195	31	4.36	-111 15.16	3371.6 m	779090.76	779408.81	0.00	0.74	-115.00	-1.13
:	a1183	31	4.63	-111 16.22	3602.0 m	779074.04	779409.17	0.00	1.12	-122.85	-1.18
:	a1196	31	4.36	-111 15.22	3425.4 m	779087.26	779408.81	0.00	1.05	-116.83	-1.14
:	a1197	31	4.36	-111 15.28	3485.8 m	779083.41	779408.81	0.00	1.56	-118.89	-1.16
:	a1184	31	4.63	-111 16.28	3678.5 m	779069.11	779409.17	0.00	1.70	-125.46	-1.20
:	a1198	31	4.36	-111 15.34	3473.2 m	779084.22	779408.81	0.00	1.30	-118.46	-1.15
:	a1185	31	4.63	-111 16.34	3763.3 m	779063.19	779409.17	0.00	2.86	-128.35	-1.21
:	a1200	31	4.36	-111 15.47	3455.0 m	779084.66	779408.81	0.00	0.98	-117.84	-1.15
:	a1199	31	4.36	-111 15.41	3457.9 m	779084.84	779408.81	0.00	1.09	-117.94	-1.15
:	a1201	31	4.36	-111 15.53	3440.6 m	779085.19	779408.81	0.00	0.82	-117.35	-1.15
:	a1202	31	4.36	-111 15.59	3407.1 m	779087.00	779408.81	0.00	0.70	-116.21	-1.14
:	a1203	31	4.36	-111 15.66	3372.0 m	779088.44	779408.81	0.00	0.76	-115.01	-1.13
:	a1204	31	4.36	-111 15.72	3364.7 m	779088.57	779408.81	0.00	0.88	-114.76	-1.13
:	a1205	31	4.36	-111 15.78	3375.0 m	779089.32	779408.81	0.00	0.96	-115.11	-1.13
:	a1206	31	4.36	-111 15.84	3378.0 m	779088.64	779408.81	0.00	1.03	-115.21	-1.13
:	a1186	31	4.36	-111 14.60	3281.9 m	779092.61	779408.81	0.00	0.61	-111.93	-1.11
:	a1187	31	4.36	-111 14.66	3275.6 m	779093.38	779408.81	0.00	0.60	-111.72	-1.11
:	a1188	31	4.36	-111 14.72	3259.3 m	779094.68	779408.81	0.00	0.62	-111.17	-1.11
:	a1189	31	4.36	-111 14.78	3282.9 m	779093.38	779408.81	0.00	0.58	-111.97	-1.11
:	a1190	31	4.36	-111 14.85	3302.4 m	779091.63	779408.81	0.00	0.59	-112.63	-1.12
:	a1191	31	4.36	-111 14.91	3296.6 m	779093.13	779408.81	0.00	0.58	-112.44	-1.11
:	a1192	31	4.36	-111 14.97	3310.9 m	779092.68	779408.81	0.00	0.59	-112.93	-1.12
:	a11	31	3.81	-111 14.85	3197.0 m	779098.56	779408.08	0.00	0.95	-109.04	-1.09
:	a12	31	3.81	-111 14.78	3204.6 m	779097.92	779408.08	0.00	0.85	-109.30	-1.09
:	a13	31	3.81	-111 14.72	3217.6 m	779096.88	779408.08	0.00	0.79	-109.74	-1.10
:	a14	31	3.81	-111 14.66	3217.1 m	779096.91	779408.08	0.00	0.83	-109.72	-1.10
:	a15	31	3.81	-111 14.60	3197.9 m	779097.79	779408.08	0.00	0.98	-109.07	-1.09
:	a16	31	3.95	-111 14.60	3239.4 m	779095.45	779408.27	0.00	0.71	-110.49	-1.10
:	a17	31	3.95	-111 14.66	3216.9 m	779096.93	779408.27	0.00	0.81	-109.72	-1.10
:	a18	31	3.95	-111 14.72	3246.4 m	779095.46	779408.27	0.00	0.65	-110.72	-1.10
:	a19	31	3.95	-111 14.78	3238.5 m	779096.37	779408.27	0.00	0.67	-110.46	-1.10
:	a110	31	3.95	-111 14.85	3236.9 m	779096.32	779408.27	0.00	0.69	-110.40	-1.10
:	a111	31	3.95	-111 14.91	3210.6 m	779097.76	779408.27	0.00	0.82	-109.50	-1.09
:	a112	31	3.95	-111 14.97	3226.8 m	779096.97	779408.27	0.00	0.70	-110.06	-1.10
:	a113	31	3.95	-111 15.03	3244.5 m	779095.94	779408.27	0.00	0.64	-110.66	-1.10
:	a114	31	3.95	-111 15.10	3291.0 m	779093.12	779408.27	0.00	0.58	-112.25	-1.11
:	a115	31	3.95	-111 15.16	3301.7 m	779092.28	779408.27	0.00	0.59	-112.61	-1.12
:	a116	31	3.95	-111 15.22	3423.9 m	779085.59	779408.27	0.00	1.17	-116.78	-1.14

ROUGUER GRAVITY DATA

page C-5

STATION IDENTIFICATION		LATITUDE		C A T I O N S		G R A V I T Y		C O R R E C T I O N S		A N O M A L I E S			
prof	sta-id	den	min	LONGITUDE	ELE (in ft)	ST	OPSERVED	THEORETICAL	TERRAIN BOUGUER CURV	SPECIAL	FREE AIR	COMPLETE-ROUGHER	SPEC FIELDS
:	a117	31	3.95	-111 15.28	3468.3	mx	979083.10	979408.27	1.58 -118.29 -1.15	0.00	1.05	-116.82	-107.11
:	a118	31	3.95	-111 15.34	3477.7	mx	979082.37	979408.27	2.00 -118.61 -1.15	0.00	1.19	-116.58	-106.87
:	a142	31	3.95	-111 15.41	3375.3	mx	979088.69	979408.27	0.89 -115.12 -1.13	0.00	-2.11	-117.47	-107.97
:	a143	31	3.95	-111 15.47	3380.0	mx	979088.31	979408.27	0.83 -115.28 -1.13	0.00	-2.04	-117.63	-108.10
:	a144	31	3.95	-111 15.53	3438.3	mx	979084.54	979408.27	1.25 -117.27 -1.15	0.00	-0.34	-117.50	-107.85
:	a145	31	3.95	-111 15.59	3343.5	mx	979089.90	979408.27	0.71 -114.04 -1.13	0.00	-3.89	-118.35	-108.91
:	a146	31	3.95	-111 15.60	3303.5	mx	979092.56	979408.27	0.60 -112.67 -1.12	0.00	-4.99	-118.18	-108.85
:	a147	31	3.95	-111 15.72	3334.7	mx	979090.73	979408.27	0.65 -113.74 -1.12	0.00	-3.88	-118.09	-108.68
:	a148	31	3.61	-111 15.84	3357.4	mx	979090.59	979408.08	0.83 -114.51 -1.13	0.00	-1.70	-116.51	-107.05
:	a149	31	3.81	-111 15.78	3328.1	mx	979090.73	979408.08	0.65 -113.51 -1.12	0.00	-4.32	-118.30	-108.91
:	a150	31	3.81	-111 15.72	3267.5	mx	979094.44	979408.08	0.59 -111.44 -1.11	0.00	-6.31	-118.28	-109.05
:	a151	31	3.81	-111 15.66	3249.9	mx	979095.20	979408.08	0.62 -110.85 -1.10	0.00	-7.20	-118.53	-109.35
:	a152	31	3.81	-111 15.59	3289.4	mx	979093.03	979408.08	0.58 -112.19 -1.11	0.00	-5.66	-118.38	-109.10
:	a153	31	3.81	-111 15.53	3370.6	mx	979087.85	979408.08	0.82 -114.96 -1.13	0.00	-3.21	-118.48	-108.98
:	a154	31	3.81	-111 15.47	3398.3	mx	979086.81	979408.08	1.01 -115.91 -1.14	0.00	-1.64	-117.67	-108.11
:	a155	31	3.81	-111 15.41	3362.3	mx	979088.66	979408.08	0.84 -114.68 -1.13	0.00	-3.17	-118.14	-108.66
:	a156	31	3.81	-111 15.34	3439.3	mx	979083.63	979408.08	1.57 -117.30 -1.15	0.00	-0.96	-117.84	-108.21
:	a157	31	3.81	-111 15.28	3521.4	mx	979077.92	979408.08	2.41 -120.11 -1.16	0.00	1.05	-117.81	-108.02
:	a158	31	3.81	-111 15.22	3461.3	mx	979081.96	979408.08	1.62 -118.06 -1.15	0.00	-0.56	-118.15	-108.46
:	a159	31	3.81	-111 15.16	3375.7	mx	979087.39	979408.08	0.95 -115.14 -1.13	0.00	-3.18	-118.50	-109.00
:	a160	31	3.81	-111 15.10	3317.6	mx	979091.03	979408.08	0.64 -113.16 -1.12	0.00	-5.00	-118.64	-109.27
:	a119	31	3.81	-111 15.03	3252.1	mx	979095.10	979408.08	0.63 -110.92 -1.10	0.00	-7.09	-118.49	-109.31
:	a120	31	3.81	-111 14.97	3214.4	mx	979097.60	979408.08	0.78 -109.64 -1.10	0.00	-8.14	-118.09	-109.03
:	a121	31	3.81	-111 14.91	3198.3	mx	979098.47	979408.08	0.93 -109.08 -1.09	0.00	-8.79	-118.03	-109.03
:	a122	31	3.81	-111 14.85	3197.0	mx	979098.52	979408.08	0.95 -109.04 -1.09	0.00	-8.85	-118.04	-109.04
:	a123	31	3.81	-111 14.78	3204.6	mx	979097.97	979408.08	0.85 -109.30 -1.09	0.00	-8.69	-118.24	-109.21
:	a124	31	3.68	-111 14.60	3180.9	mx	979098.92	979407.91	1.18 -108.49 -1.09	0.00	-9.79	-118.19	-109.26
:	a125	31	3.68	-111 14.60	3186.6	mx	979098.36	979407.91	1.11 -108.69 -1.09	0.00	-9.82	-118.49	-109.53
:	a126	31	3.68	-111 14.72	3201.2	mx	979097.51	979407.91	0.94 -109.18 -1.09	0.00	-9.31	-118.64	-109.63
:	a127	31	3.68	-111 14.78	3168.3	mx	979099.45	979407.91	1.19 -108.06 -1.08	0.00	-10.45	-118.41	-109.51
:	a128	31	3.68	-111 14.85	3167.3	mx	979099.56	979407.91	1.29 -108.03 -1.08	0.00	-10.44	-118.26	-109.37
:	a129	31	3.68	-111 14.91	3177.0	mx	979099.19	979407.91	1.18 -108.36 -1.09	0.00	-9.90	-118.16	-109.24
:	a130	31	3.68	-111 15.03	3196.3	mx	979097.98	979407.91	0.94 -109.02 -1.09	0.00	-9.29	-118.46	-109.46
:	a131	31	3.68	-111 15.10	3201.5	mx	979097.55	979407.91	0.94 -109.19 -1.09	0.00	-9.24	-118.58	-109.57
:	a132	31	3.68	-111 15.16	3248.7	mx	979094.65	979407.91	0.67 -110.80 -1.10	0.00	-7.69	-118.93	-109.77
:	a133	31	3.68	-111 15.22	3184.9	mx	979098.54	979407.91	0.99 -108.63 -1.09	0.00	-9.81	-118.53	-109.57
:	a134	31	3.68	-111 15.28	3267.8	mx	979094.02	979407.91	0.61 -111.46 -1.11	0.00	-6.52	-118.48	-109.25
:	a135	31	3.68	-111 15.34	3324.3	mx	979090.55	979407.91	0.66 -113.38 -1.12	0.00	-4.68	-118.53	-109.15
:	a136	31	3.68	-111 15.41	3277.0	mx	979093.55	979407.91	0.59 -111.77 -1.11	0.00	-6.14	-118.43	-109.18
:	a137	31	3.68	-111 15.47	3240.4	mx	979095.53	979407.91	0.65 -110.52 -1.10	0.00	-7.59	-118.56	-109.42

# ROUGHUP GRAVITY DATA

page C-6

alcanarrosa-sonora gravity survey  
consejo de recursos minerales 1979  
Meter ID: a-486 Date: 02/11/80

STATION IDENTIFICATION proj, sta-id	L O C A T I O N S		ELE ST (in ft)	G R A V I T Y UNSRVED THEORETICAL	C O R R E C T I O N S		A N O M A L I E S						
	LATITUDE deg min	LONGITUDE deg min			TERRAIN BOUGUER CURV	SPECIAL	FREE AIR	COMPLETE-BOUGUER d1=2.67 d2=2.45	SPEC FIELDS				
: a138	31	3.68	-111 15.53	3306.5 mx	979091.34	979407.91	0.61	-112.78	-1.12	0.00	-5.56	-118.85	-109.51
: a139	31	3.68	-111 15.59	3233.3 mx	979095.54	979407.91	0.68	-110.28	-1.10	0.00	-8.26	-118.95	-109.83
: a140	31	3.68	-111 15.66	3218.6 mx	979096.36	979407.91	0.75	-109.78	-1.10	0.00	-8.82	-118.94	-109.87
: a141	31	3.68	-111 15.72	3273.6 mx	979093.37	979407.91	0.57	-111.65	-1.11	0.00	-6.63	-118.83	-109.58