

UNITED STATES DEPARTMENT OF THE INTERIOR  
GEOLOGICAL SURVEY

Principal Facts and Complete Bouguer Gravity Map  
Blacktail Mountain Drilling Site,  
Flathead County, Montana

by

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## Introduction

On August 13, 1979, 49 gravity stations were established at Blacktail Mountain, west of the town of Lakeside, in northwest Montana (fig. 1). The survey area is at the site of the U.S. Geological Survey (USGS) Blacktail Mountain drilling project, which is an area of approximately 150 X 270 meters. The gravity data were obtained as part of the U.S. Geological Survey's interdisciplinary program to develop models to help evaluate the mineral-resource potential of green-bed copper and silver occurrences in the Belt Supergroup. This report presents the principal facts for the gravity data and a complete Bouguer anomaly map of the survey area.

## Data Collection

Gravity observations were made using the La Coste-Romberg gravity meter, G-235. The gravity values were referenced to the Department of Defense (DOD) base at Kalispell, Montana, which is part of the International Gravity Standardization Net, IGSN-71, established by the Defense Mapping Agency Aerospace Center (1974). A secondary base, which was tied to the Kalispell DOD base, was established near the study area at the entrance of the Blacktail Mountain Radar Station (Appendix A). Base descriptions are given in detail at the end of this report.

## Elevation Control

Station elevations were surveyed using a Hewlett-Packard distance meter surveying instrument. The elevations were tied to a known elevation of 1980.6 m at station BL-9 (J. Harrison, oral commun., 1978). The elevation differences obtained with this instrument in this terrain were estimated to have a precision of 0.15 m for distances less than 2.1 km. This translates to

uncertainties in Bouguer values of 0.03 mgal. Horizontal distance at this range is also accurate to within 0.15 m.

#### Data Reduction

Computer programs on the USGS Honeywell Multics computer system were used to obtain the terrain-corrected gravity values. A program by D. A. Dansereau and R. R. Wahl (unpub.) was used to calculate earth-tide and linear-meter-drift-corrected observed gravity values. The theoretical gravity value was calculated using the 1967 formula of the Geodetic Reference System (International Association of Geodesy, 1967). Another unpublished program by R. H. Godson was used to compute terrain corrections from each station out to 166.7 km using the method of Plouff (1977). The program uses mean elevation data 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 for the terrain corrections. This program also calculates earth curvature corrections and complete (terrain-corrected) Bouguer anomaly values. Corrections for terrain ranged from 12.95 to 15.66 mgal. These computer-generated corrections were compared with hand generated terrain corrections and were found to be accurate within the 1-mgal contour interval used for the Bouguer anomaly map. Two complete Bouguer anomaly values per station were obtained assuming 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 anomaly map was hand-contoured at a 1-mgal interval (Appendix D).

### References cited

- 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.
- 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 correction based on topography digitized on a geographic grid: U.S. Geological Survey Open-File Report 77-535.

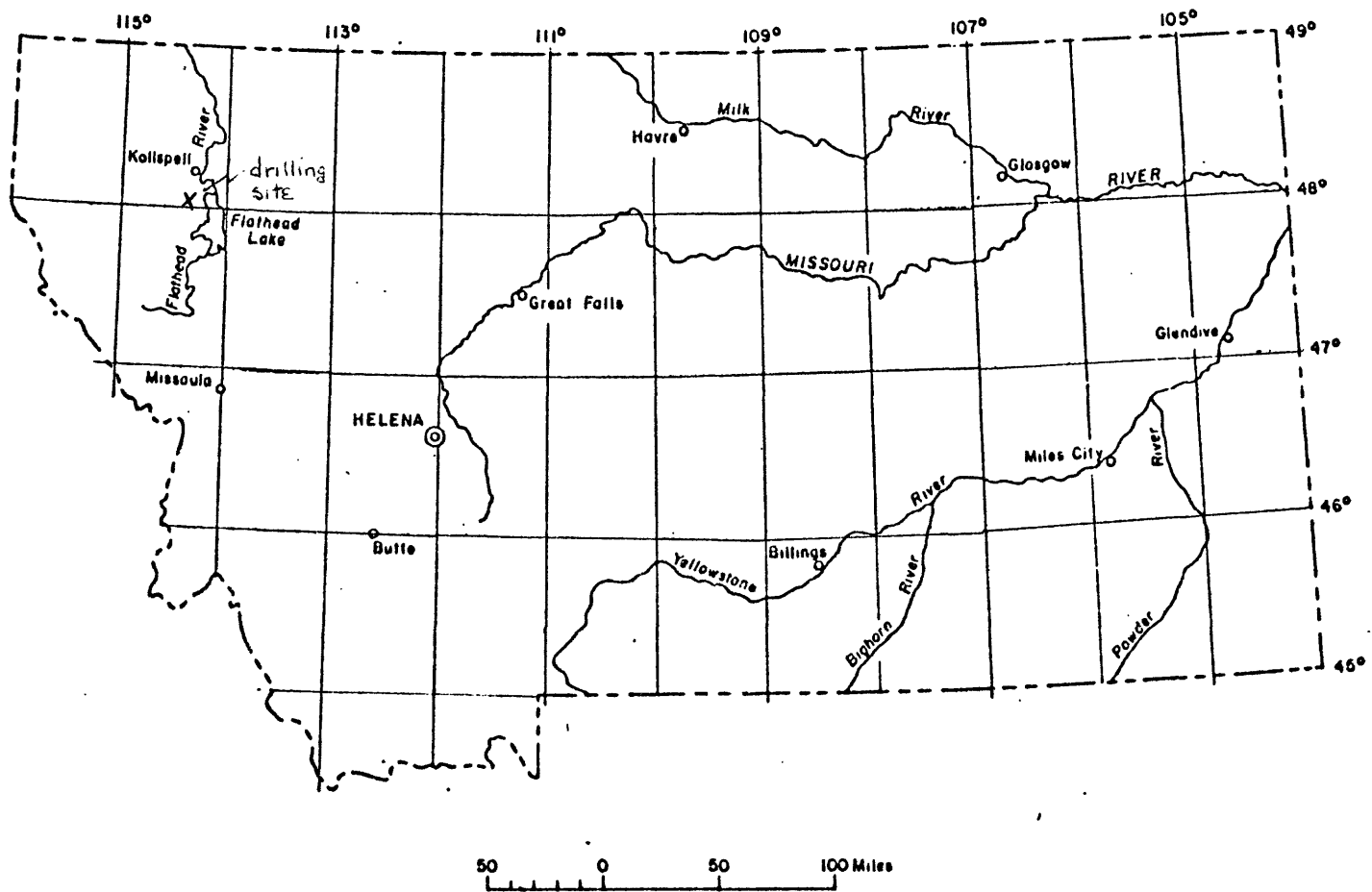


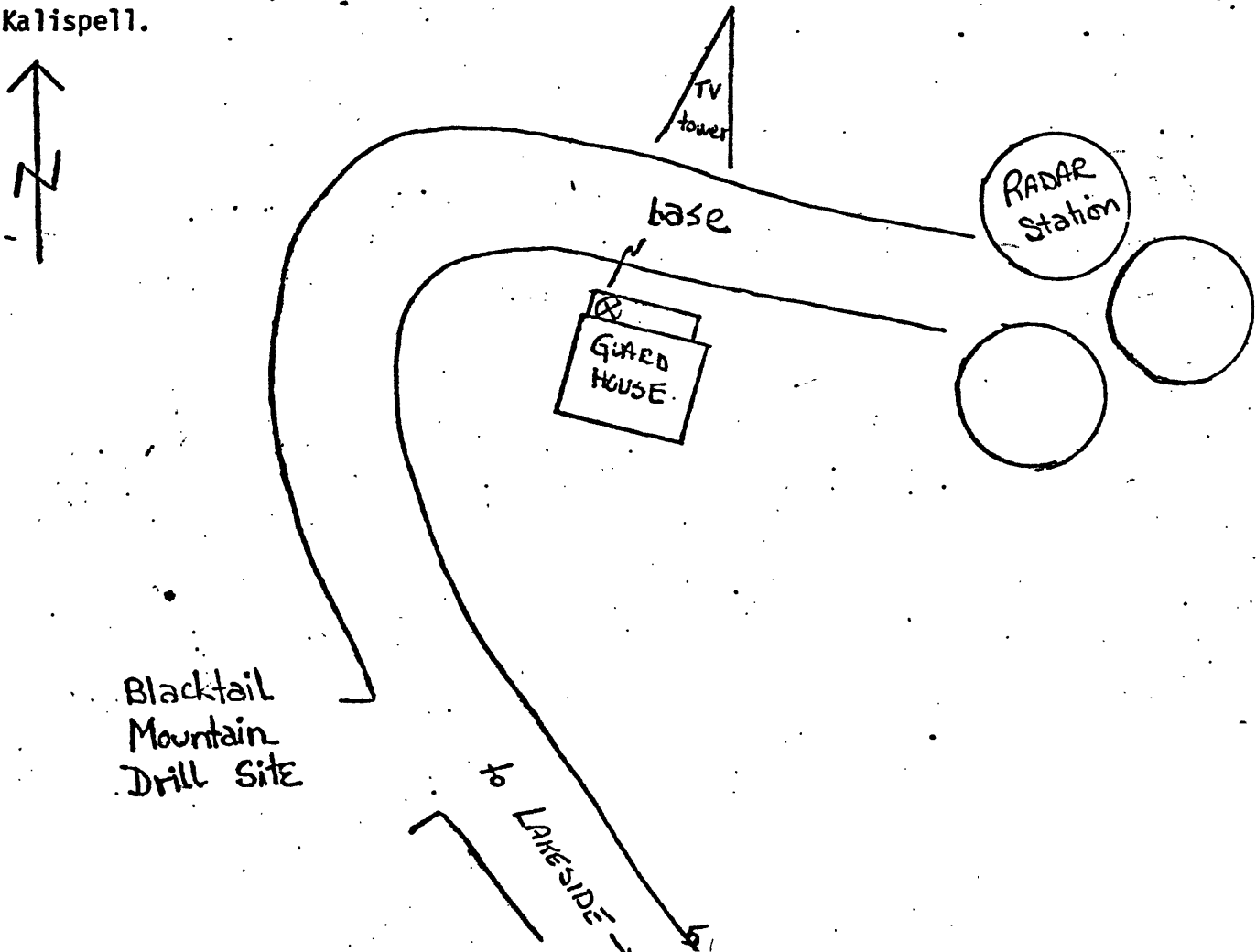
Figure 1. Index map showing the Blacktail Mountain drilling site, Montana.

Appendix A  
 U.S. GEOLOGICAL SURVEY  
 GRAVITY BASE STATION

STATE/COUNTRY		STATION DESIGNATION		OBSERVED GRAVITY
Montana		Blacktail Mountain		980343.71 mgals
NEAREST TOWN		LONGITUDE		LATITUDE
Lakeside		114° 21.96'		48° 00.78'
ELEVATION		TOPOGRAPHIC MAP(S)		
2027.2 m (6650' est)		Lion Mountain 1/24,000		
DATE	OBSERVER	METER	REFERENCE STATION	REFERENCE VALUE
7/11/78	Kleinkopf/Brickey	G-235	Kalispell Airport (DOD)	980567.39 mgals

DESCRIPTION/SKETCH

Read at northwest corner of guard house on cement slab, located at entrance to Blacktail Mountain Radar Station, opposite TV tower station, KCFW, Channel 9, Kalispell.

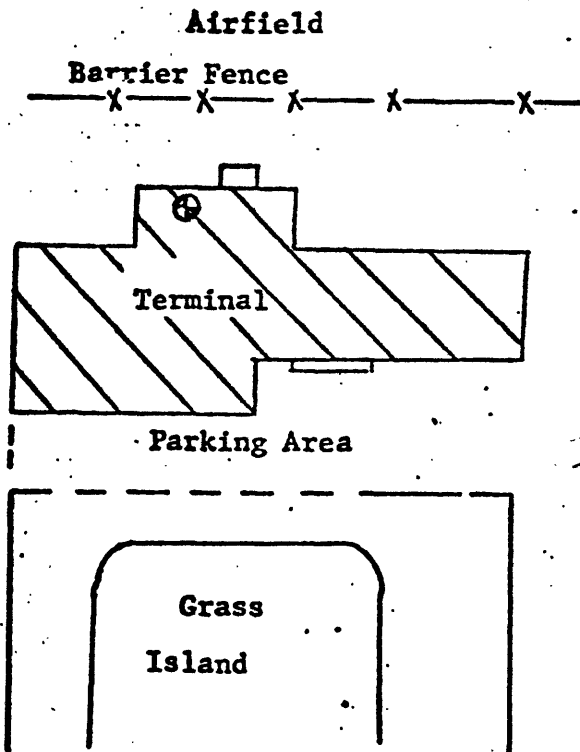


GRAVITY BASE STATION

LATITUDE 48° 18.50' N (1)		STATION DESIGNATION	
LONGITUDE 114° 15.00' W (1)		KALISPELL	
ELEVATION 905.6 METERS (1)		COUNTRY/STATE USA/Montana	
REFERENCE CODE NUMBERS		ADOPTED GRAVITY VALUE	
ACIC 0441-0		g = 980 567.39	mgals
IGC 15684 J			
WA 32			
		ESTIMATED ACCURACY	DATE
		± 0.1 mgals	MONTH/YEAR Aug/1971

DESCRIPTION AND/OR SKETCH

Station is located at the Flathead Airport, six miles north of Kalispell, Mont., on the west side of St. Hwy. #206, inside the airport lobby, on the floor, at the west side of the entrance to the apron and loading area. (1)



(2)

REFERENCE SOURCE

(1) 01355 (2) 05100



## Appendix C: Principal Facts of Gravity Data

### Explanation of headings

#### identification

proj	Project name.
sta-id	Gravity station identification number.

#### location

latitude	North latitude in degrees, minutes, and hundredths of minutes.
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longitude	West longitude in degrees, minutes, and hundredths of minutes.
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elev, f	Station elevation, in feet.
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st	State where survey area is located.
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observed gravity	Observed gravity, in milligals.
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theoretical gravity	Theoretical gravity.
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#### corrections

terrain	Terrain correction out to 166.7 km. in milligals.
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Bouguer	Elevation correction, in milligals.
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curv	Earth curvature correction, in milligals.
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special	Not used.
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#### anomalies

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

Appendix C

Blacktail Mountain Gravity Survey  
 Kleinkopf, Rankey, and Patton 1979  
 Meter ID: 9-235 Date: 11/26/79

STATION IDENTIFICATION	proj	sta-id	LATITUDE deg	LONGITUDE deg	L O C A T I O N S E C	E L C	S T	OBSERVED GRAVITY	TERRAIN BOUGUER CURV	C O R R E C T I O N S	SPECIAL	FREE AIR	A N O M A L I E S	SPEC FIELDS	
			min	min			(in ft)	THEORETICAL	BOUGUER	BOUGUER		2.67	2.45		
North	:	b143	48 0.27	-114 21.81	6427.6	MT	980359.36	980890.55	13.20	-219.23	-1.51	0.00	72.98	-134.56	-117.46
North	:	b144	48 0.29	-114 21.81	6438.4	MT	980358.84	980890.58	13.42	-219.59	-1.51	0.00	73.45	-134.24	-117.13
North	:	b145	48 0.32	-114 21.81	6444.1	MT	980358.19	980890.63	13.59	-219.96	-1.51	0.00	73.76	-134.13	-117.00
North	:	b146	48 0.34	-114 21.82	6461.1	MT	980357.41	980890.66	13.80	-220.37	-1.51	0.00	74.07	-134.01	-116.86
North	:	b147	48 0.37	-114 21.84	6478.1	MT	980356.37	980890.70	14.06	-220.95	-1.51	0.00	74.58	-133.82	-116.65
North	:	b148	48 0.34	-114 21.85	6480.3	MT	980356.43	980890.66	14.22	-221.02	-1.51	0.00	74.89	-133.42	-116.26
North	:	b149	48 0.30	-114 21.83	6467.8	MT	980357.53	980890.59	14.09	-220.60	-1.51	0.00	74.88	-133.14	-116.00
North	:	b152	48 0.30	-114 21.87	6500.8	MT	980355.12	980890.59	14.92	-221.73	-1.51	0.00	75.57	-132.75	-115.58
North	:	b152	48 0.37	-114 21.88	6496.8	MT	980356.53	980890.70	14.45	-221.59	-1.51	0.00	76.51	-132.15	-114.95