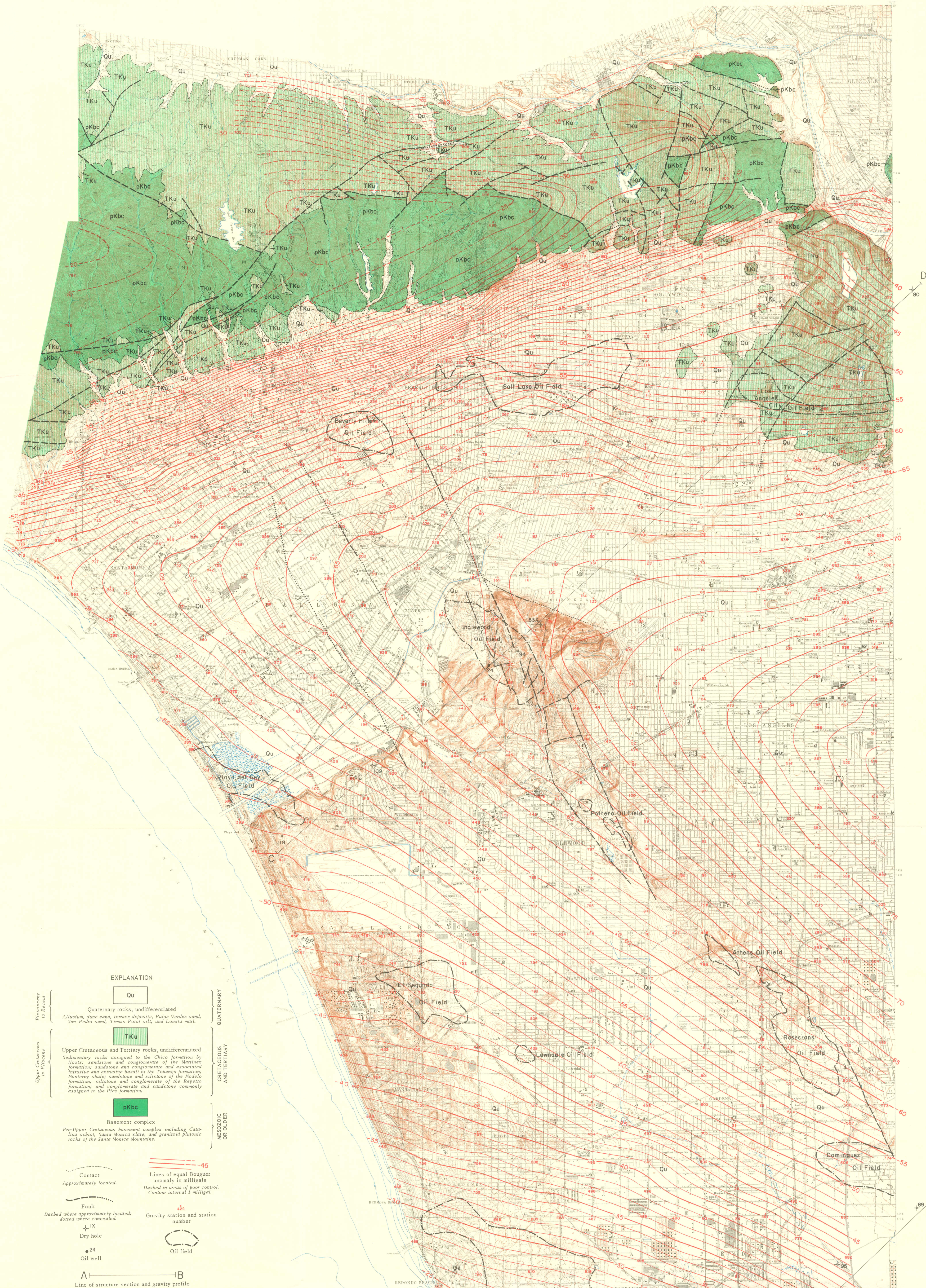


GRAVITY DATA AND COMPUTATIONS FOR STATIONS SHOWN ON SIMPLE BOUGUER ANOMALY MAP

Station	Observed gravity 979.+ gal.	Elevation in feet	Elevation and Bouguer correction in mgal.	Theoretical gravity 979.+ gal.	Bouguer anomaly in mgal.	Station	Observed gravity 979.+ gal.	Elevation in feet	Elevation and Bouguer correction in mgal.	Theoretical gravity 979.+ gal.	Bouguer anomaly in mgal.
1	.57885	174.8	12.2	.6627	-71.65	214	.6047	386.5	27.05	.6679	-36.2
2	.5777	166.6	11.7	.6621	-72.8	215	.6086	402.5	28.2	.6681	-31.4
3	.5822	182.6	12.8	.6638	-68.8	216	.6083	470.7	32.95	.6682	-27.0
4	.58505	230.0	16.1	.6651	-63.95	217	.6061	426.9	29.9	.6680	-32.0
5	.5914	211.7	14.8	.6661	-59.9	218	.6034	397.8	27.85	.6677	-36.45
6	.5918	253.5	17.7	.6666	-57.1	219	.5983	410.3	28.7	.6674	-40.4
7	.5973	297.6	20.8	.6684	-50.3	220	.5933	384.6	26.9	.6670	-46.8
8	.5956	388.8	27.2	.6696	-46.8	221	.5971	146.2	10.2	.6667	-59.3
9	.5936	447.4	31.3	.6702	-45.3	222	.5958	142.3	10.0	.6664	-60.6
10	.5960	539.5	32.4	.6707	-42.3	223	.5943	134.1	9.4	.6660	-62.3
11	.5953	263.8	18.5	.6672	-53.5	224	.5933	132.0	9.2	.6658	-63.2
12	.5762	155.8	10.9	.66145	-74.4	225	.5927	132.3	9.3	.6655	-63.6
13	.5746	144.6	10.1	.6605	-75.7	226	.59045	135.7	9.5	.66495	-65.0
14	.5742	138.8	9.7	.6593	-75.4	227	.5903	126.3	8.8	.6646	-65.5
15	.5745	141.5	9.9	.6580	-73.6	228	.5902	112.2	7.85	.6640	-65.95
16	.5748	196.2	13.7	.65565	-67.1	229	.5897	135.1	9.5	.6644	-65.2
17	.5750	150.5	10.5	.6570	-71.5	230	.5896	143.6	10.05	.6645	-64.85
18	.5752	202.5	14.2	.6553	-65.9	231	.58595	192.7	13.5	.6644	-65.0
19	.57565	203.0	14.2	.6551	-65.2	232	.5913	156.1	10.9	.66555	-63.3
20	.5771	192.8	13.5	.6548	-64.2	233	.5900	184.5	12.9	.6655	-62.6
21	.5779	187.2	13.1	.6547	-63.8	234	.5906	180.2	12.6	.6655	-62.3
22	.5797	164.0	11.5	.6546	-63.5	235	.5932	161.6	11.3	.6660	-61.5
23	.58285	130.3	9.1	.6542	-62.3	236	.5922	180.5	12.6	.6660	-61.2
24	.5848	109.6	7.7	.6541	-61.6	237	.5892	229.35	16.05	.6660	-60.7
25	.5870	85.7	6.0	.6538	-60.8	238	.5885	238.2	16.7	.6658	-60.7
26	.58945	65.4	4.6	.6534	-59.35	239	.5857	248.7	17.4	.6653	-62.2
27	.5921	49.2	3.4	.6528	-57.2	241	.5904	190.55	13.3	.6653	-61.5
28	.5928	51.4	3.6	.6524	-56.0	242	.5898	177.7	12.4	.6649	-62.6
29	.5948	43.6	3.05	.6520	-54.15	243	.5894	218.1	15.3	.6655	-60.8
30	.5966	37.2	2.6	.6516	-52.4	244	.59115	203.0	14.2	.6656	-60.25
31	.5981	38.7	2.7	.6516	-50.8	245	.5923	202.3	14.2	.6658	-59.3
32	.60185	19.5	1.4	.6508	-47.6	246	.5928	215.55	15.1	.6660	-58.1
33	.6028	42.9	3.0	.6502	-44.4	247	.6108	261.9	18.3	.6690	-39.8
34	.6055	46.1	3.2	.6496	-40.9	248	.6153	217.1	15.2	.6688	-38.2
35	.6116	41.0	2.9	.6483	-33.8	249	.6108	224.8	15.7	.6684	-41.9
36	.6145	32.5	2.3	.6478	-31.0	250	.6079	229.4	16.05	.6681	-44.1
37	.6158	45.0	3.15	.6470	-28.1	251	.6050	246.7	17.3	.6679	-45.6
39	.61935	57.0	4.0	.6458	-22.5	252	.6035	249.0	17.4	.6678	-46.9
40	.6188	47.1	3.3	.6463	-24.2	253	.6022	254.85	17.8	.6676	-47.6
41	.6222	36.7	2.6	.6452	-20.4	254	.5989	267.2	18.7	.6673	-49.7
42	.6209	69.5	4.9	.6445	-18.7	255	.5980	266.6	18.7	.6672	-50.6
43	.6234	48.3	3.4	.6439	-17.1	256	.5965	271.2	19.0	.6670	-51.5
44	.6234	64.0	4.5	.6432	-15.3	257	.5950	270.3	18.9	.6668	-52.9
45	.6271	22.8	1.6	.64265	-13.9	258	.5917	286.9	20.1	.6665	-54.7
46	.6285	28.4	2.0	.64215	-11.7	259	.5915	283.3	19.8	.6664	-55.1
47	.6402	9.4	0.7	.6409	-0.1	260	.5935	245.7	17.2	.6662	-55.6
48	.6377	12.0	0.8	.6412	-2.7	261	.59375	297.3	20.8	.6666	-52.1
49	.6377	130.5	9.1	.6402	+6.6	262	.5937	323.5	22.6	.6668	-50.4
50	.6458	106.7	7.5	.63975	+13.55	263	.5910	238.2	16.7	.6657	-58.0
51	.6497	110.8	7.8	.6392	+18.3	264	.5904	198.3	13.9	.6653	-61.0
190	.5872	160.4	11.2	.6586	-60.2	403	.60015	9.6	0.7	.6593	
191	.5880	158.8	11.1	.65835	-59.3	404	.6010	14.8	1.0	.6606	
192	.5913	136.0	9.5	.6590	-58.1	405	.60135	13.5	0.95	.6600	
193	.5939	126.6	8.9	.6580	-55.2	406	.6013	10.0	0.7	.6594	
194	.5940	129.4	9.1	.6580	-55.0	407	.6022	7.0	0.5	.6588	
195	.5981	14.5	1.0	.6596	-60.5	408	.5934	133.3	9.3	.6583	
196	.5971	17.1	1.2	.6601	-61.9	409	.5961	41.5	2.9	.6611	
197	.5931	53.0	3.7	.6621	-65.3	410	.5966	31.1	2.2	.6607	
198	.5926	66.0	4.6	.6627	-65.5	411	.5971	22.5	1.6	.6605	
199	.5914	90.2	6.3	.6633	-65.6	412	.5953	19.5	1.4	.6603	
200	.5905	112.0	7.8	.6637	-65.4	413	.5906	134.0	9.4	.6580	
201	.5872	179.8	12.6	.6642	-64.4	414	.5927	160.5	11.2	.6580	
202	.5851	221.7	15.5	.6646	-64.0	415	.5968	109.3	7.7	.6579	
203	.58325	254.2	17.8	.6648	-63.7	417	.5996	81.7	5.7	.6572	
204	.5842	253.35	17.7	.6651	-63.1	418	.5986	91.8	6.4	.6568	
205	.5864	259.0	18.1	.6656	-61.0	419	.5985	104.5	7.3	.6563	
206	.6118	392.55	23.55	.6694	-34.0	420	.5990	109.7	7.7	.6556	
207	.6119	409.25	24.55	.6693	-32.9	421	.5969	127.7	8.9	.6556	
208	.6154	343.2	20.6	.6690	-33.0	422	.5968	113.7	7.9	.6556	
209	.6137	411.3	24.7	.6690	-30.6	423	.5957	95.5	6.7	.6556	
210	.61445	399.4	24.0	.6689	-30.5	424	.5931	71.0	5.0	.6556	
211	.6131	374.6	24.35	.6686	-31.2	425	.5918	68.3	4.8	.6556	
212	.6102	381.25	26.7	.6684	-31.5	426	.5905	68.0	4.8	.6556	
213	.60835	356.4	24.95	.6681	-34.8	427	.5846	119.1	8.3	.6556	

INTRODUCTION

The Los Angeles Basin is one of California's most prolific oil-producing areas. The oil-producing formations are exposed around the margins of this basin and have been intensively studied by many geologists, but in most of the oil fields these formations are covered by sedimentary rocks of Pleistocene and Recent age. Geologic interpretations of the structure of the older rocks are therefore largely based upon data obtained from the many deep wells drilled in search of oil.

Where the oil-producing strata have not been penetrated because of excessive depth or unfavorable structure, geologic interpretations cannot be made without recourse to geophysical methods. Various geophysical methods have been used in this area, but the results of such work are not published. The gravity survey herein reported was undertaken to provide a geophysical basis for extending geologic interpretations from the explored parts into the deeper parts of the Los Angeles Basin.

This report presents a simple Bouguer gravity map of the northwestern part of the basin, outlines the major stratigraphic and structural features of the area, and points out the correlations between the gravity map and known geologic structures. Several gravity anomalies unrelated to known structures seem to be deserving of more careful study because of their possible economic value.

The area described in this report is bounded on the east by 118°15' west longitude, on the north by the Los Angeles River, and on the west and south by the Pacific Ocean (see index map). It approximates the northwestern one-third of the Tertiary Los Angeles Basin, as described by Woodford, et al. (1954, p. 65).

The author is indebted for elevation data to the staff of the Bureau of Engineering of the City of Los Angeles; to W. J. Fox, Los Angeles County Engineer and Surveyor; and to officers of the engineering departments of the communities of Beverly Hills, Santa Monica, El Segundo, Manhattan Beach, and Redondo Beach.

L. B. Slichter and Leon Knopoff of the Institute of Geophysics of the University of California at Los Angeles made possible and facilitated the use of a gravimeter.

L. C. Pakiser, G. D. Bath, and D. R. Mabey of the U. S. Geological Survey have provided technical advice and guidance.

W. R. Jones and E. F. McCulloh assisted in computing the geophysical data, and R. D. Von Huene and Philip Blacet assisted in parts of the field work.

GRAVITY SURVEY

A total of 1,267 gravity observations made at 857 stations between February 1955 and November 1956 constitute the basic data. 840 stations are shown on the map; the remainder are outside the limits of the map or were occupied for drift control purposes only. Worden gravimeter number 88 (geodetic model), having a scale value of 0.08916 milligal per scale division, was used for all but seven of the observations; for these seven, Worden gravimeter number 236, having a scale value of 0.47209 milligal per scale division, was used.

All gravity measurements were tied together through a network of 27 base stations. Each base station was tied to two or more of the base stations through three or more independent loops, and all of the stations were tied ultimately to U. S. Coast and Geodetic Survey Pendulum Station 314 at Pasadena, Calif., and to the approximate location of the destroyed U. S. Coast and Geodetic Survey Pendulum Station 66 at Compton, Calif.

Twenty-five of the 840 stations were arbitrarily selected for repeat observations based upon different base stations. The mean of the differences between the original and repeat observations for these stations is 0.045 milligal. The maximum and minimum differences are 0.109 and 0.003 milligal, respectively.

Station locations were chosen where elevations were available. Most were chosen at or near bench marks of the U. S. Coast and Geodetic Survey, the U. S. Geological Survey, the Los Angeles County Surveyor, or the City of Los Angeles Engineering Department. Bench marks established by the engineering departments of smaller municipalities, such as Beverly Hills, Santa Monica, El Segundo, Manhattan Beach, and Redondo Beach, were used for some stations. Datum for all station elevations is mean sea level.

The elevation of each station is known within 0.5 foot. An error in elevation of 0.5 foot would produce an error in Bouguer anomaly of approximately 0.035 milligal. Appreciable changes in the elevation of bench marks at several localities in the area studied have been recorded (Grant and Sheppard, 1939; Grant and Gilluly, 1949). Data were available from leveling done in these areas only a few months to two years prior to the field work, and elevation errors due to ground movements are therefore negligible.

The horizontal position of each station is known within a maximum latitudinal error of ±50 feet. An error in location of 100 feet along a meridian would produce an error in Bouguer anomaly of approximately 0.02 milligal.

Availability of bench marks, the character of the topography, and the quality of geological information available are the factors that controlled the choice of station spacing and density. The average station density is 2.3 per square mile; however, within the low-lying plain between the Santa Monica Mountains and the Palos Verdes Hills, the density averages approximately 4 stations per square mile. An effort was made to locate stations at one-half mile intervals wherever possible in areas of little geological information. Where elevation data are scarce, such as in the Santa Monica Mountains and the Palos Verdes Hills, geologic information is generally plentiful and gravity information is therefore relatively less essential to this study.

Observed gravity values were corrected for meter drift by interpolation between base station measurements made at the beginning and end of traverses that varied in duration from one-half hour to 2 hours.

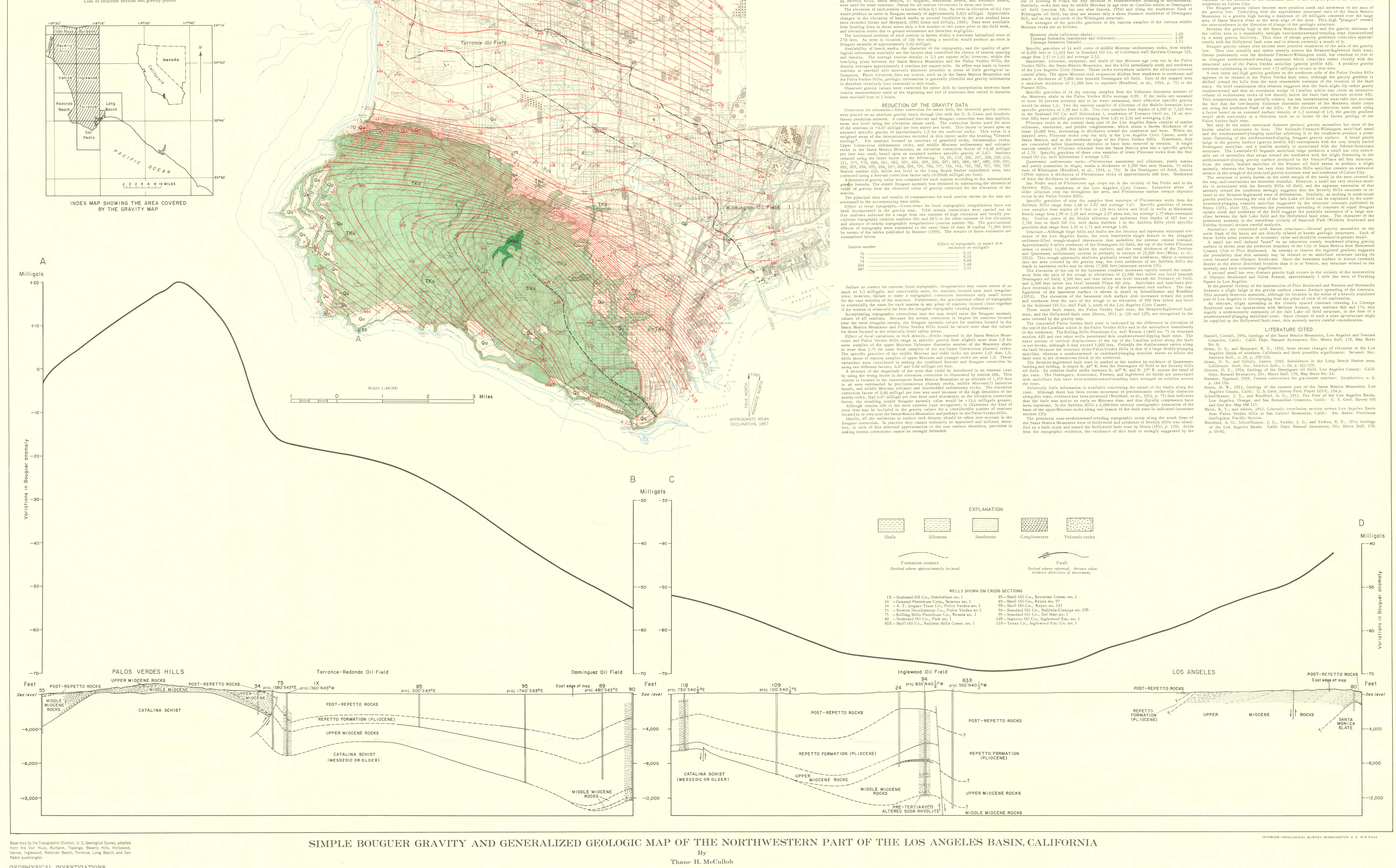
REDUCTION OF THE GRAVITY DATA

Correction for elevation.—After correction for meter drift, the observed gravity values were placed on an absolute gravity basis through ties with the U. S. Coast and Geodetic Survey pendulum network. A combined free-air and Bouguer correction was then applied, mean sea level being the elevation datum used. The correction factor used for most of the stations is +0.07 milligal per foot above sea level. This factor is based upon an assumed specific gravity of approximately 1.9 for the surficial rocks. This value is a weighted mean of the determinations recorded in this report under the heading "General Geology". For stations located on outcrops of granitoid rocks, metamorphic rocks, Upper Cretaceous sedimentary rocks, and middle Miocene sedimentary and volcanic rocks in the Santa Monica Mountains, an elevation correction factor of +0.06 milligal per foot was used, based upon an assumed surface specific gravity of 2.67. Stations reduced using the latter factor are the following: 10, 65, 119, 206, 207, 208, 209, 210, 211, 575, 576, 600, 601, 602, 603, 604, 605, 606, 607, 685, 686, 687, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 705, 706, 707, 734, 764, 765, 766, 767, 768, 769. Station number 626, below sea level in the Long Beach Harbor subsidence area, was corrected using a free-air correction factor only (0.09406 milligal per foot).

A theoretical gravity value was computed for each station according to the international gravity formula. The simple Bouguer anomaly was obtained by subtracting the theoretical value of gravity from the observed value of gravity corrected for the elevation of the station.

The principal data and results of computations for each station shown on the map are presented in the accompanying data table.

Effect of local topography.—Corrections for local topographic irregularities have not been incorporated in the gravity map. Trial terrain corrections were carried out on five stations selected for a range from one extreme of high elevation and locally precipitous topography (station numbers 604 and 687) to the other extreme of low elevation and absence of nearby topographic irregularities (station number 78). The gravitational effects of topography were estimated to the outer limit of zone M (radius 71,996 feet) [illegible]



SIMPLE BOUGUER GRAVITY AND GENERALIZED GEOLOGIC MAP OF THE NORTHWESTERN PART OF THE LOS ANGELES BASIN, CALIFORNIA

By
Thane H. McCulloh

1957