SECTION 17

DMA-DEVELOPED LOCAL GEODETIC SYSTEM

GEOID HEIGHT CONTOUR CHARTS FOR MAJOR DATUMS

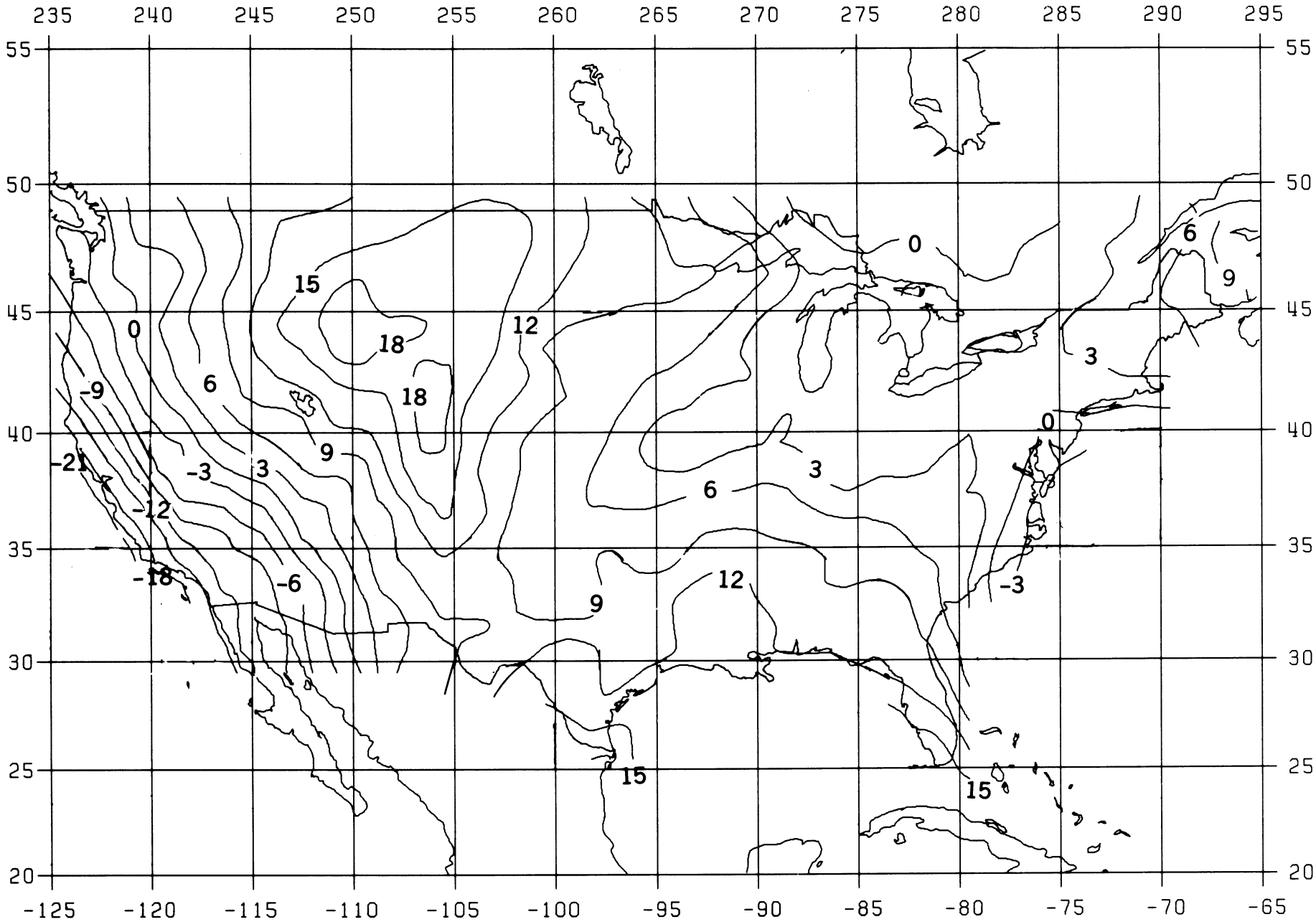

Figure 17.1. DMA-Developed NAD 27 Geoid (CONUS; Referenced to Clarke 1866 Ellipsoid; Units = Meters)

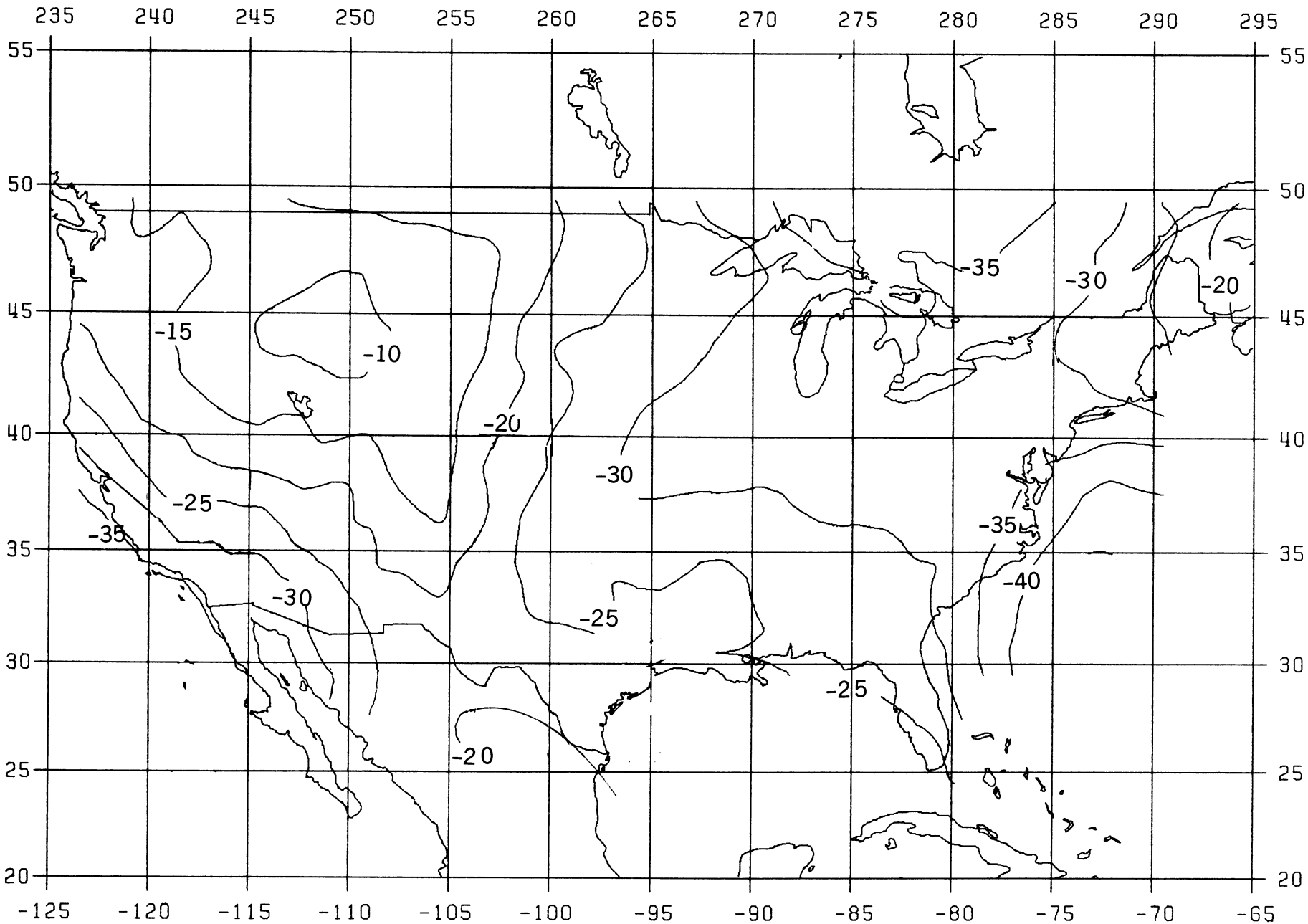

Figure 17.2. DMA-Developed NAD 83 Geoid (CONUS; Referenced to GRS 80 Ellipsoid; Units = Meters)

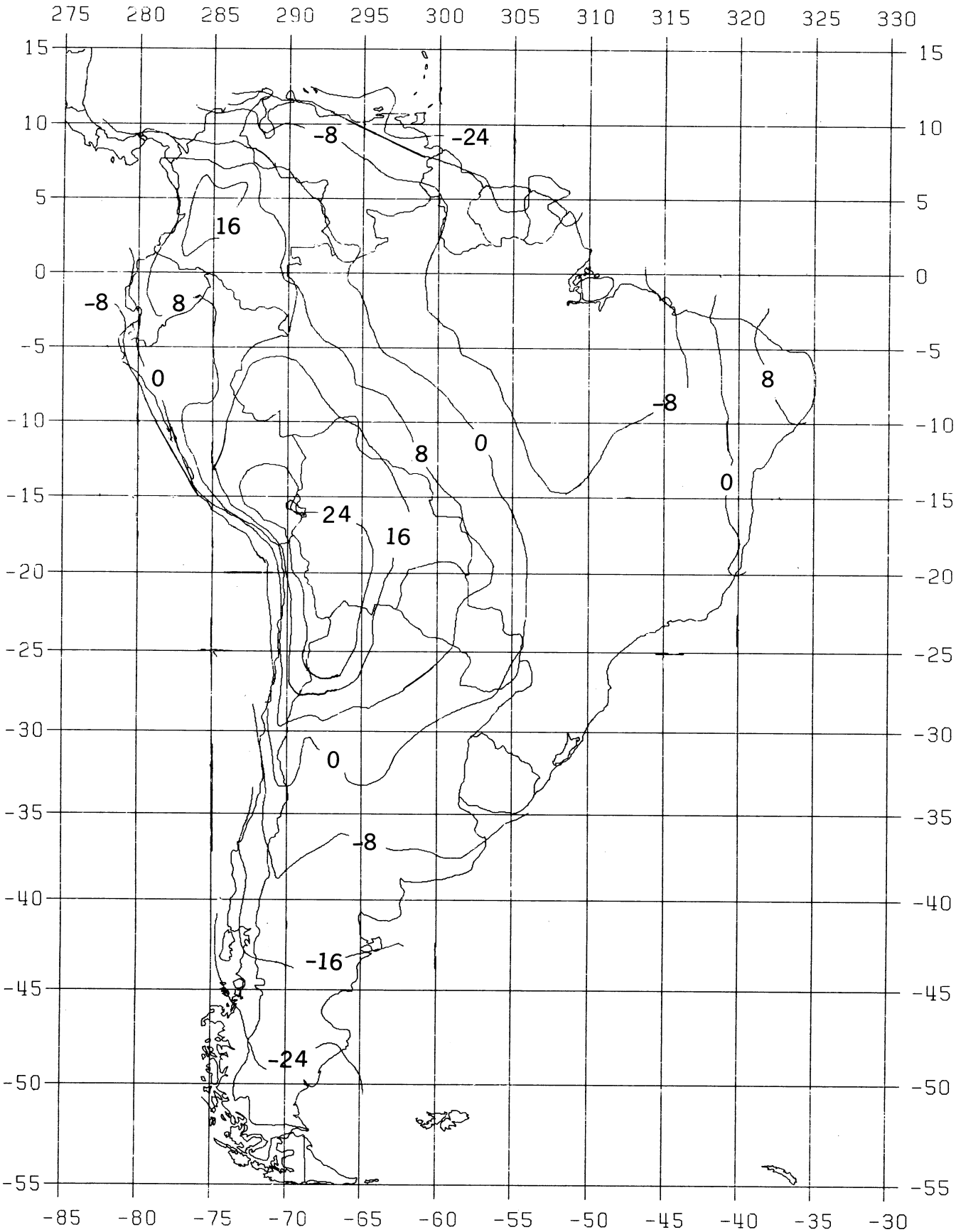

Figure 17.3. DMA-Developed SAD 69 Geoid (Referenced to South American 1969 Ellipsoid; Units = Meters)

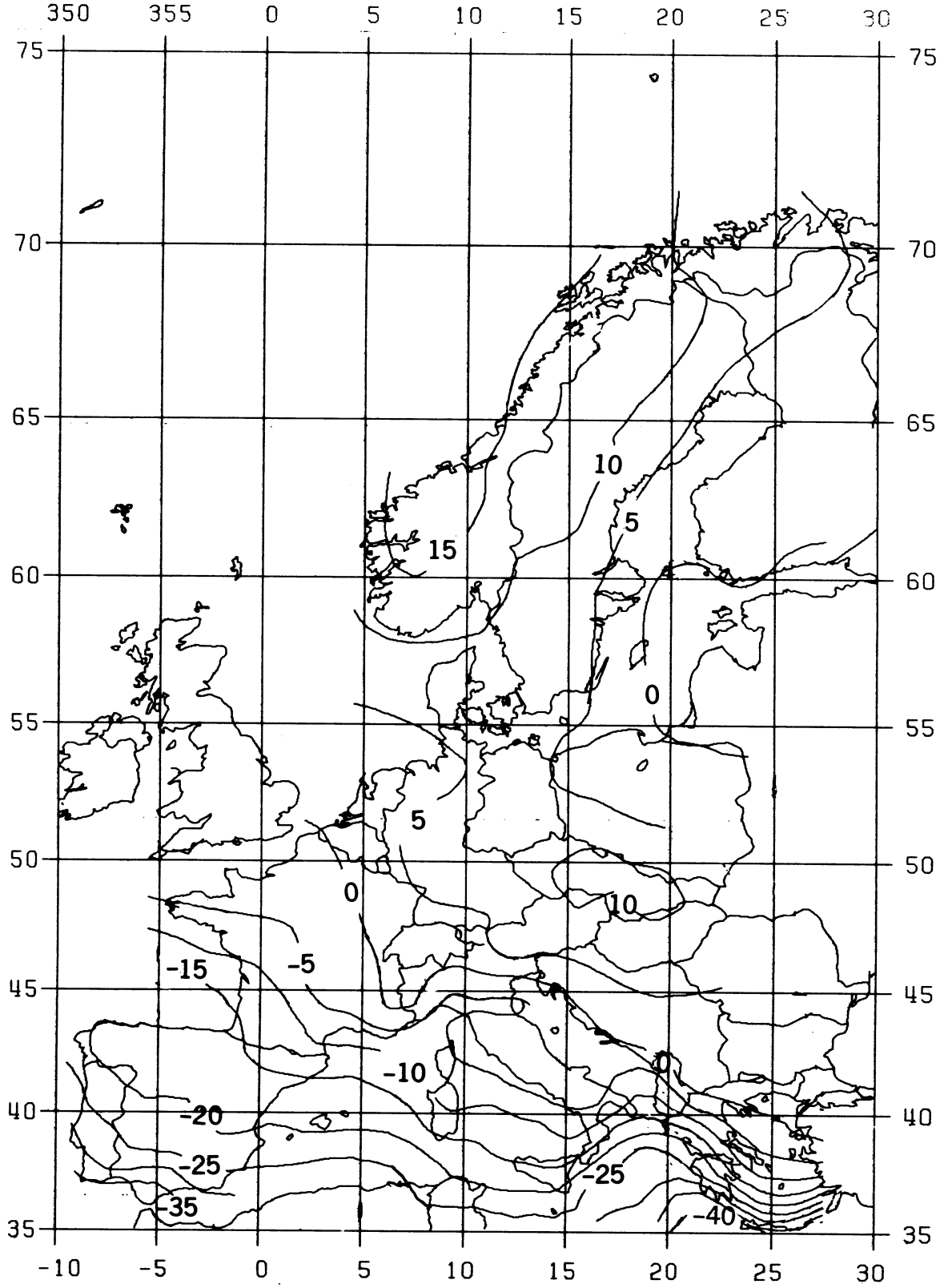

Figure 17.4. **DMA-Developed ED 50 Geoid (Western Europe; Referenced to International Ellipsoid; Units = Meters)**

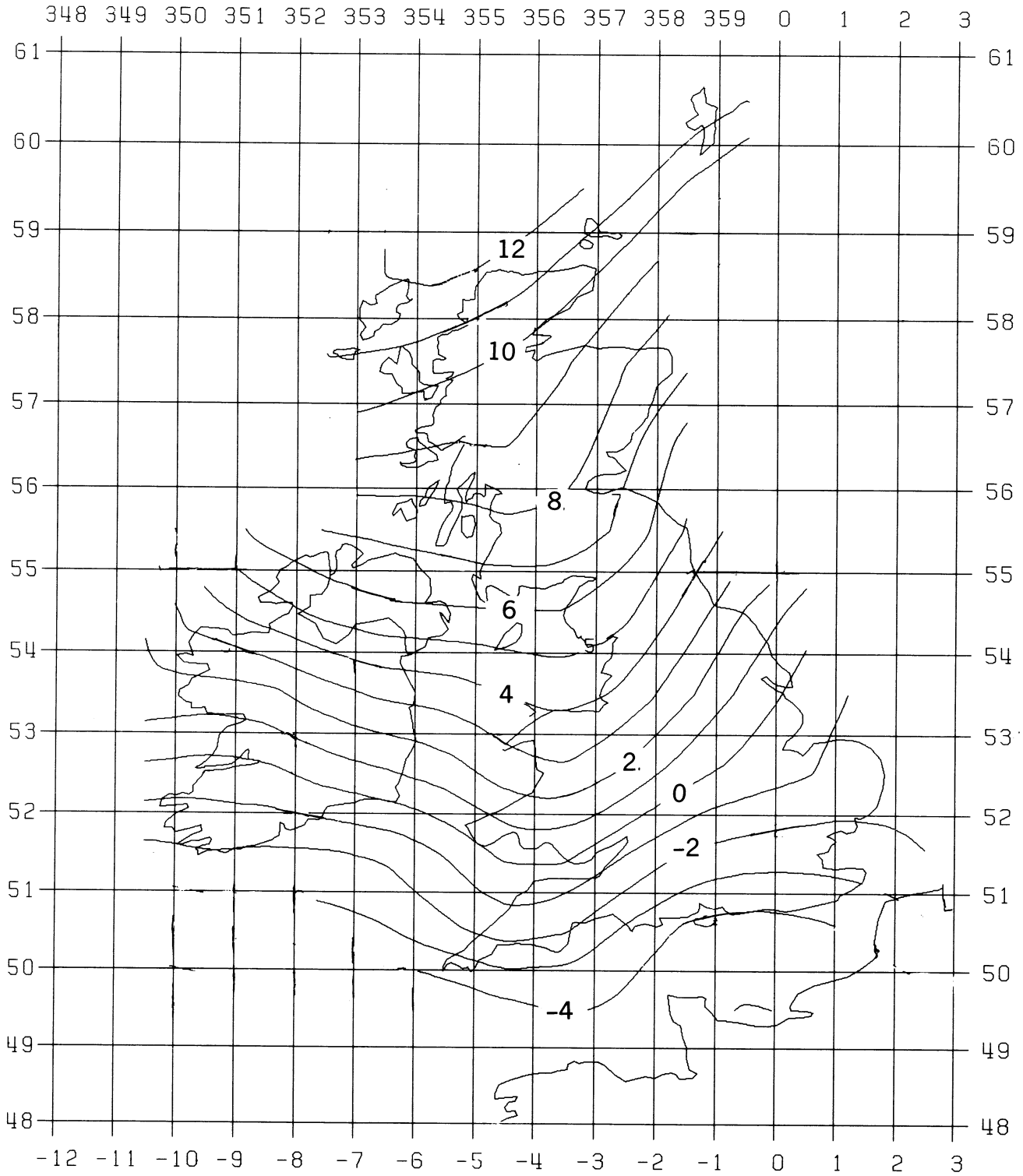

Figure 17.5. DMA-Developed ED 50 Geoid (UK/Ireland; Referenced to International Ellipsoid; Units = Meters)

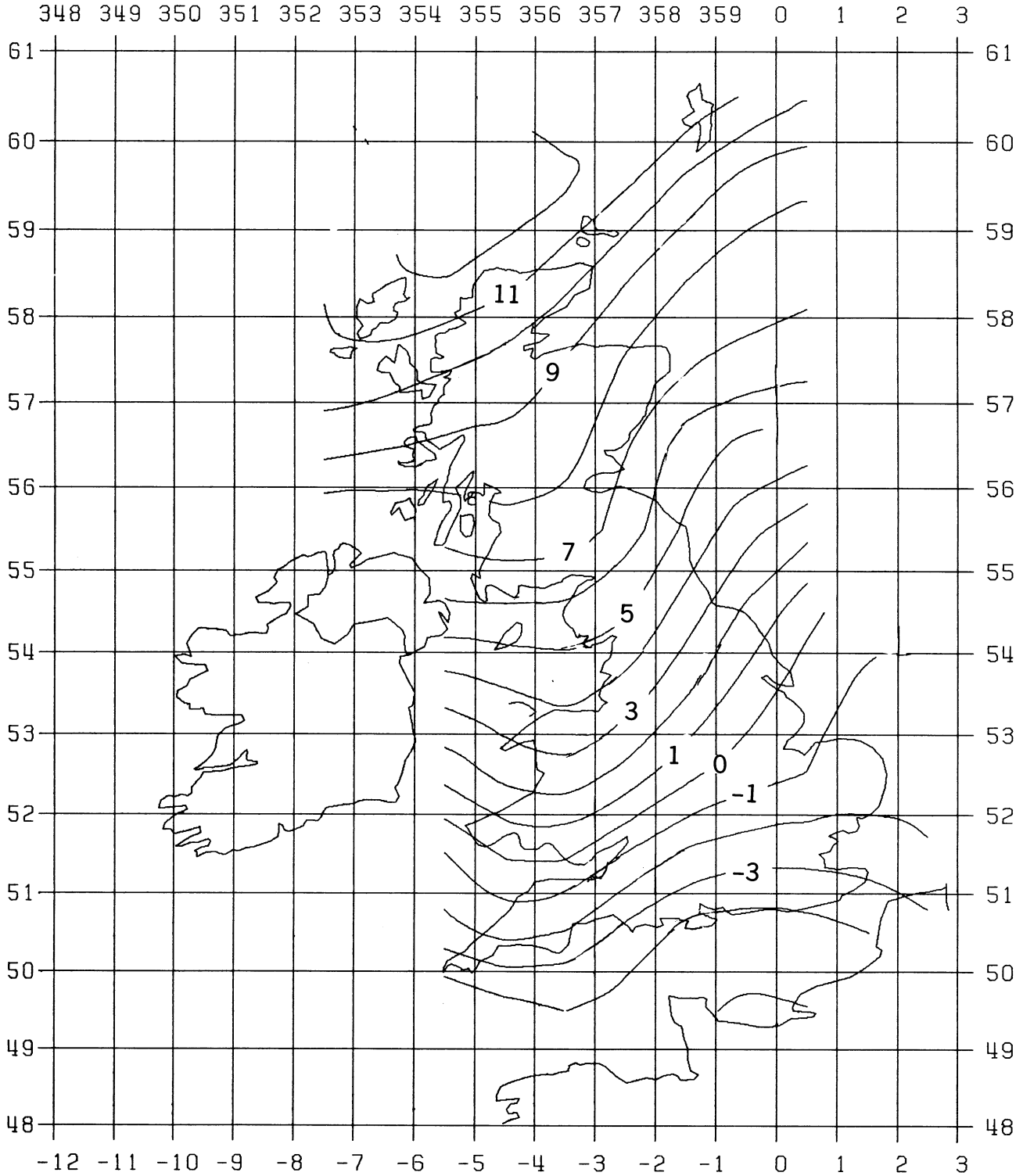

Figure 17.6. DMA-Developed ED 50 Geoid (UK Only; Referenced to International Ellipsoid; Units = Meters)

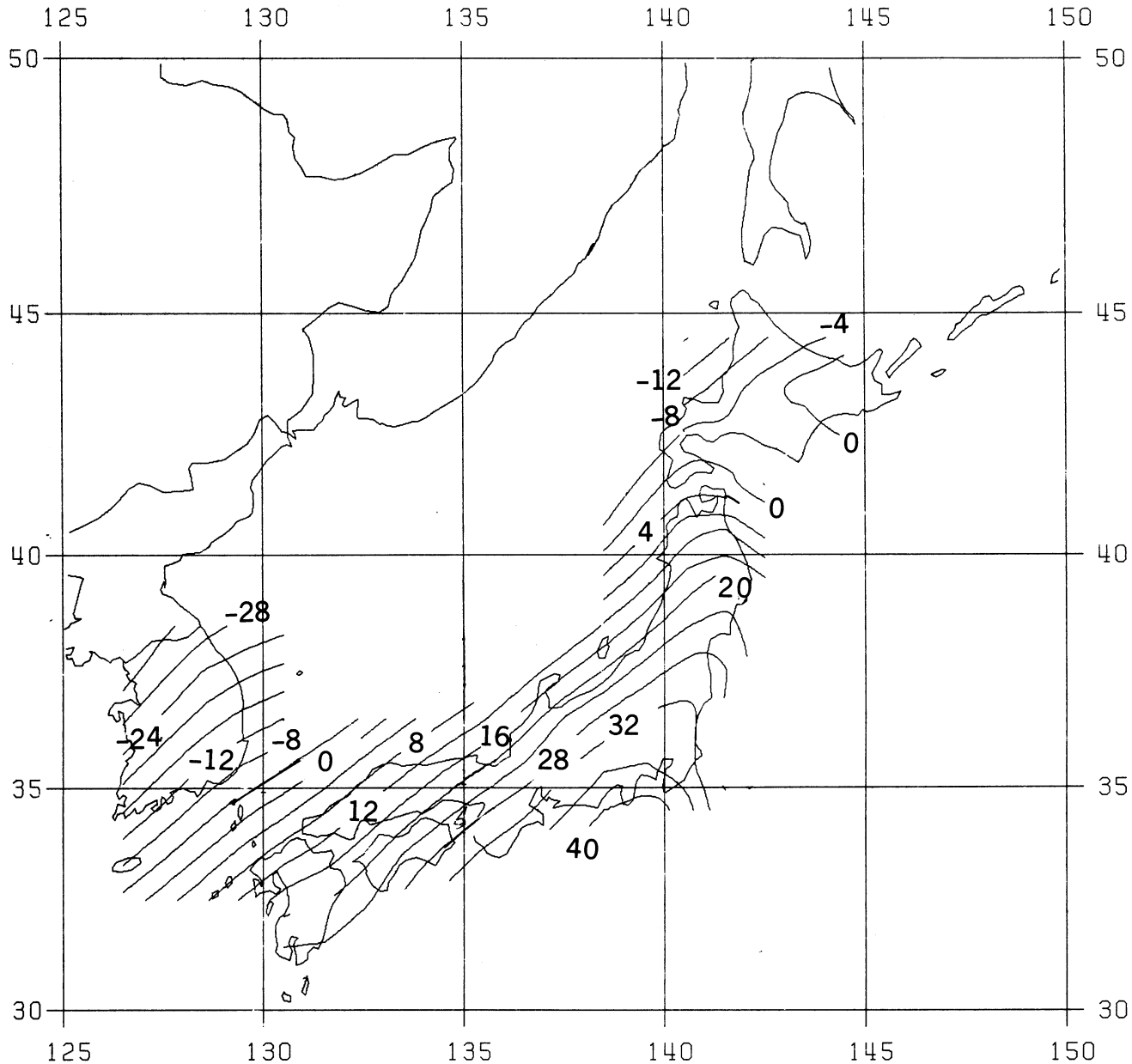

Figure 17.7. DMA-Developed TD Geoid (Referenced to Bessel 1841 Ellipsoid; Units = Meters)

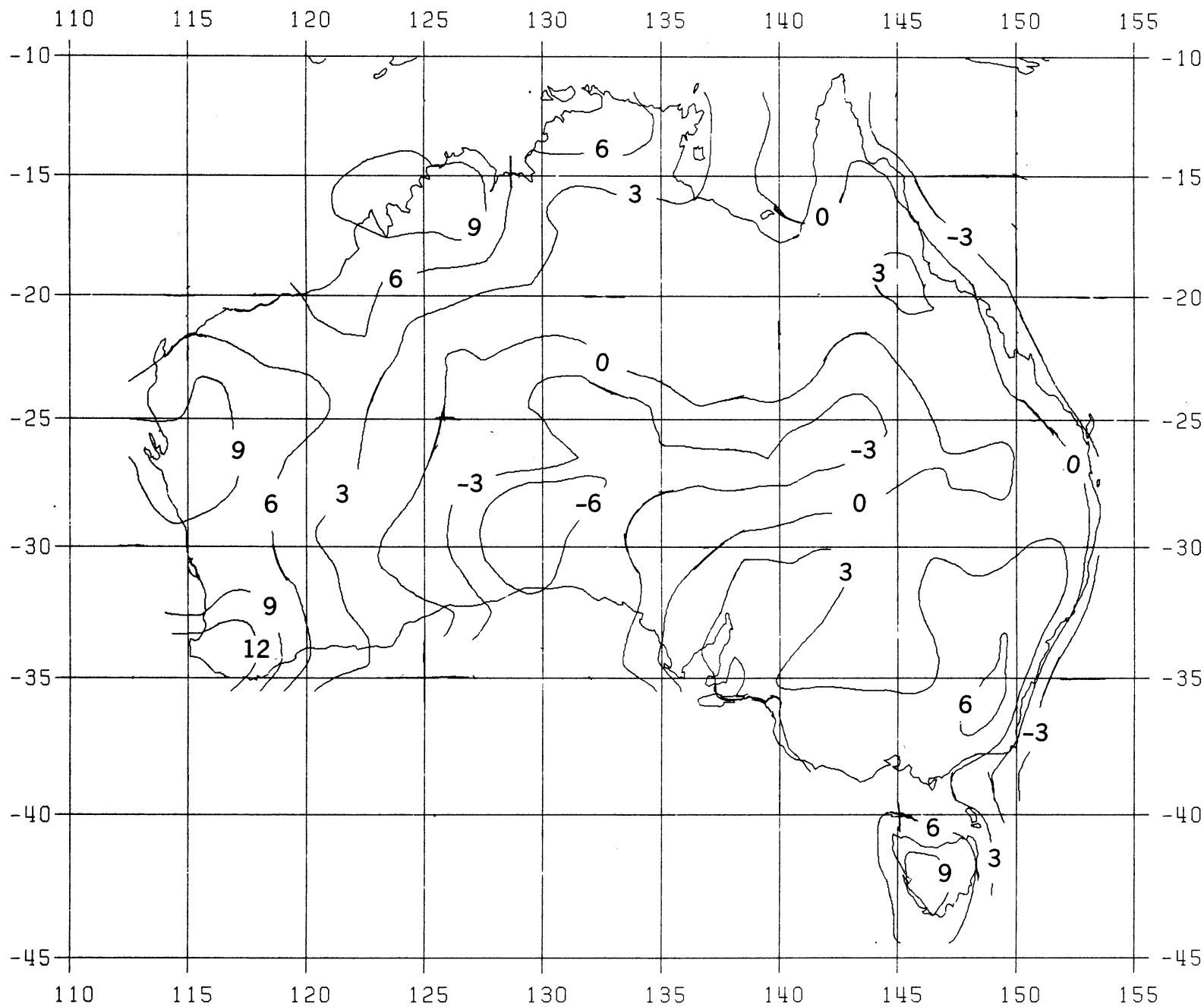

Figure 17.8. DMA-Developed AGD 66 Geoid (Referenced to Australian National Ellipsoid; Units = Meters)

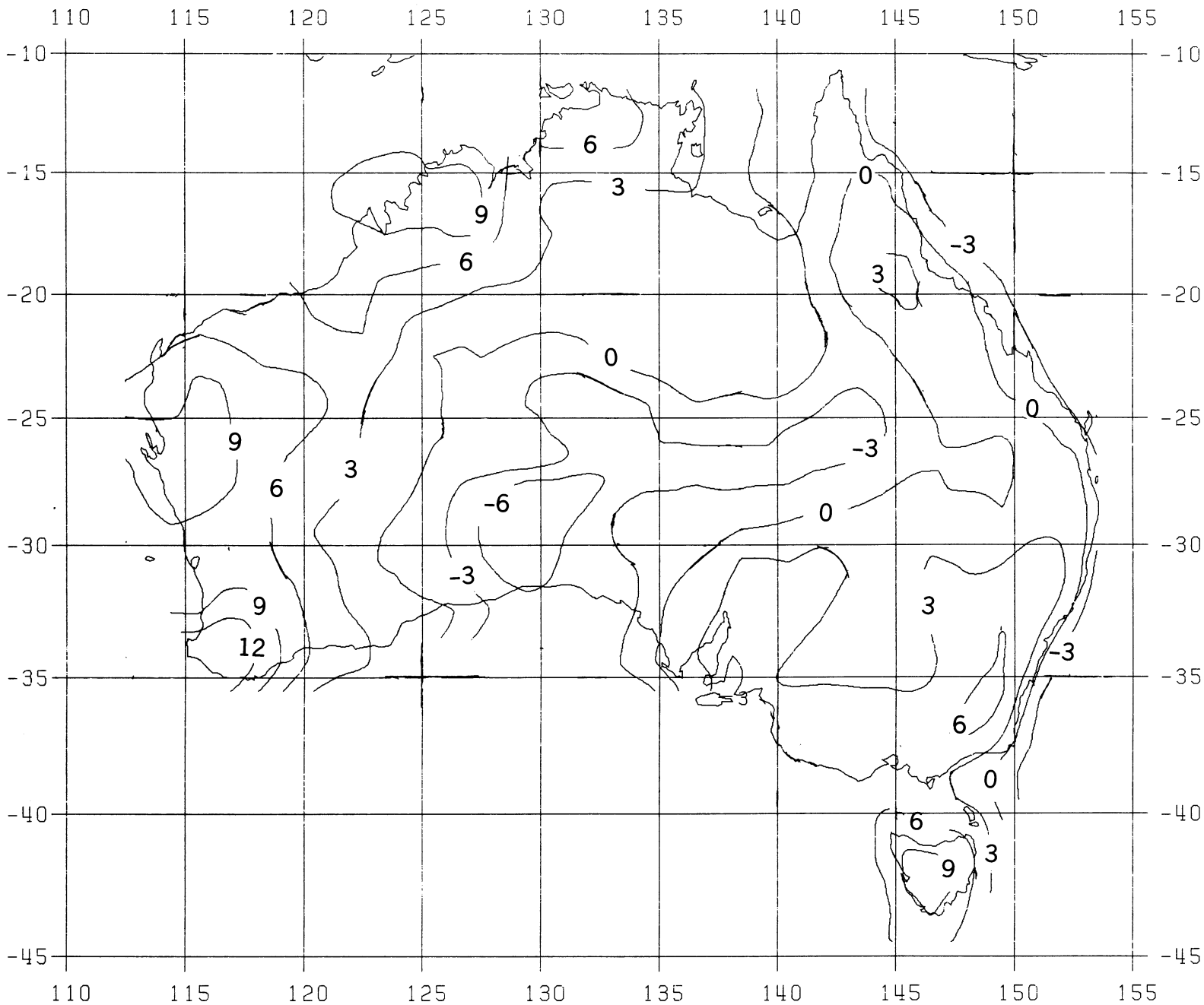

Figure 17.9. DMA-Developed AGD 84 Geoid (Referenced to Australian National Ellipsoid; Units = Meters)

SECTION 18

[Revised: 30 September 1988]

DMA-DEVELOPED LOCAL GEODETIC SYSTEM GEOID HEIGHT CONTOUR CHARTS FOR AN ADDITIONAL 30 OF THE 83 LOCAL GEODETIC SYSTEMS* -

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* CONTOUR CHARTS NOT INCLUDED FOR EUROPEAN DATUM 1979 (SINCE IT DOES NOT REPLACE ED 50), OR FOR THOSE LOCAL GEODETIC SYSTEMS WHERE THE USE OF GEOID HEIGHT CONTOUR CHARTS WOULD HAVE LITTLE OR NO PRACTICAL VALUE (MOST ISLAND DATUMS AND/OR DATUMS REPRESENTING SMALL GEOGRAPHICAL AREAS). FOR DMA-DEVELOPED GEOID HEIGHTS FOR SUCH LOCAL GEODETIC SYSTEMS, SEE SECTION 23 (IN PARTICULAR, TABLE 23.43).

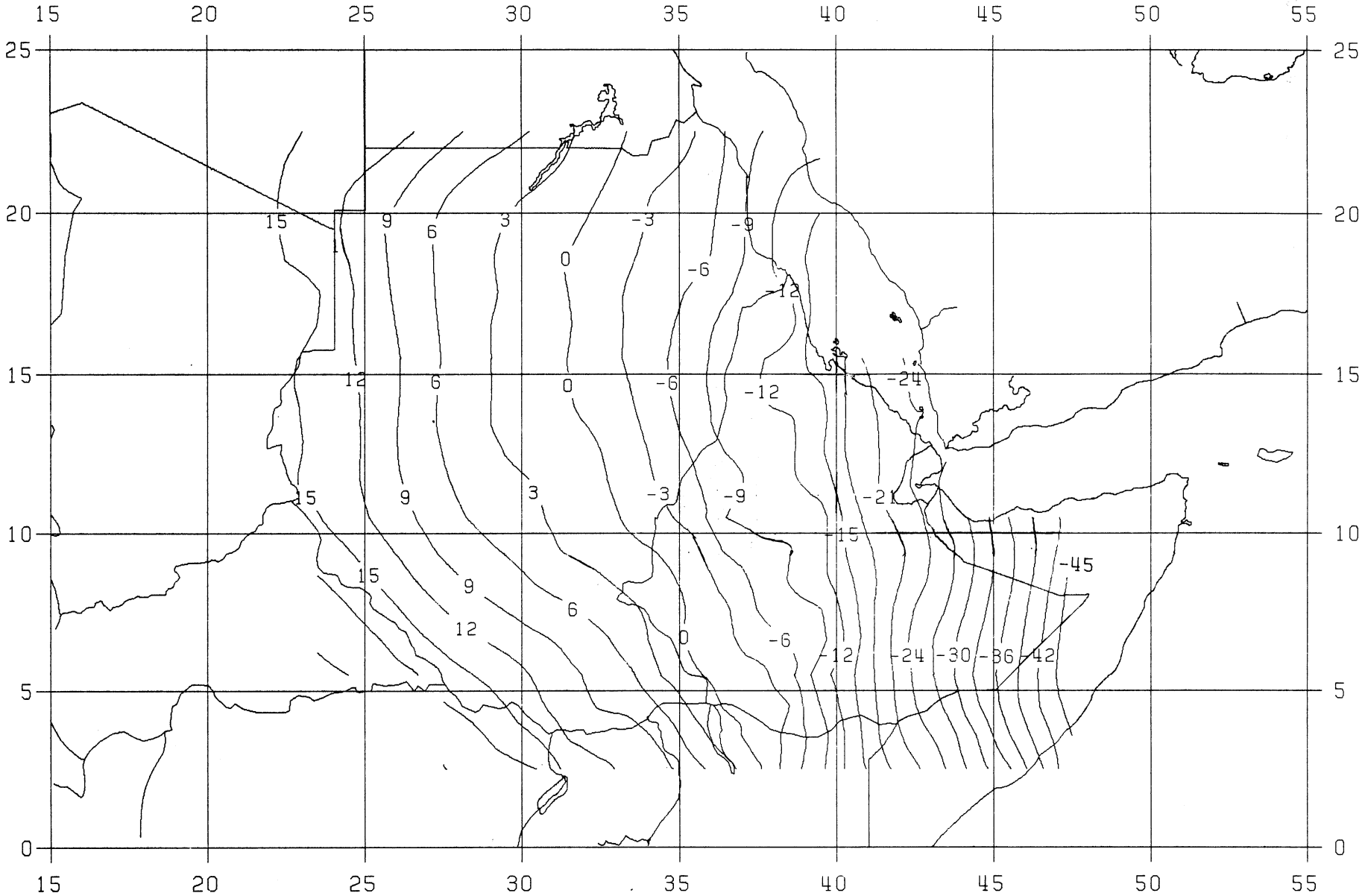

Figure 18.1. DMA-Developed Adindan Datum Geoid (Referenced to Clarke 1880 Ellipsoid; Units = Meters)

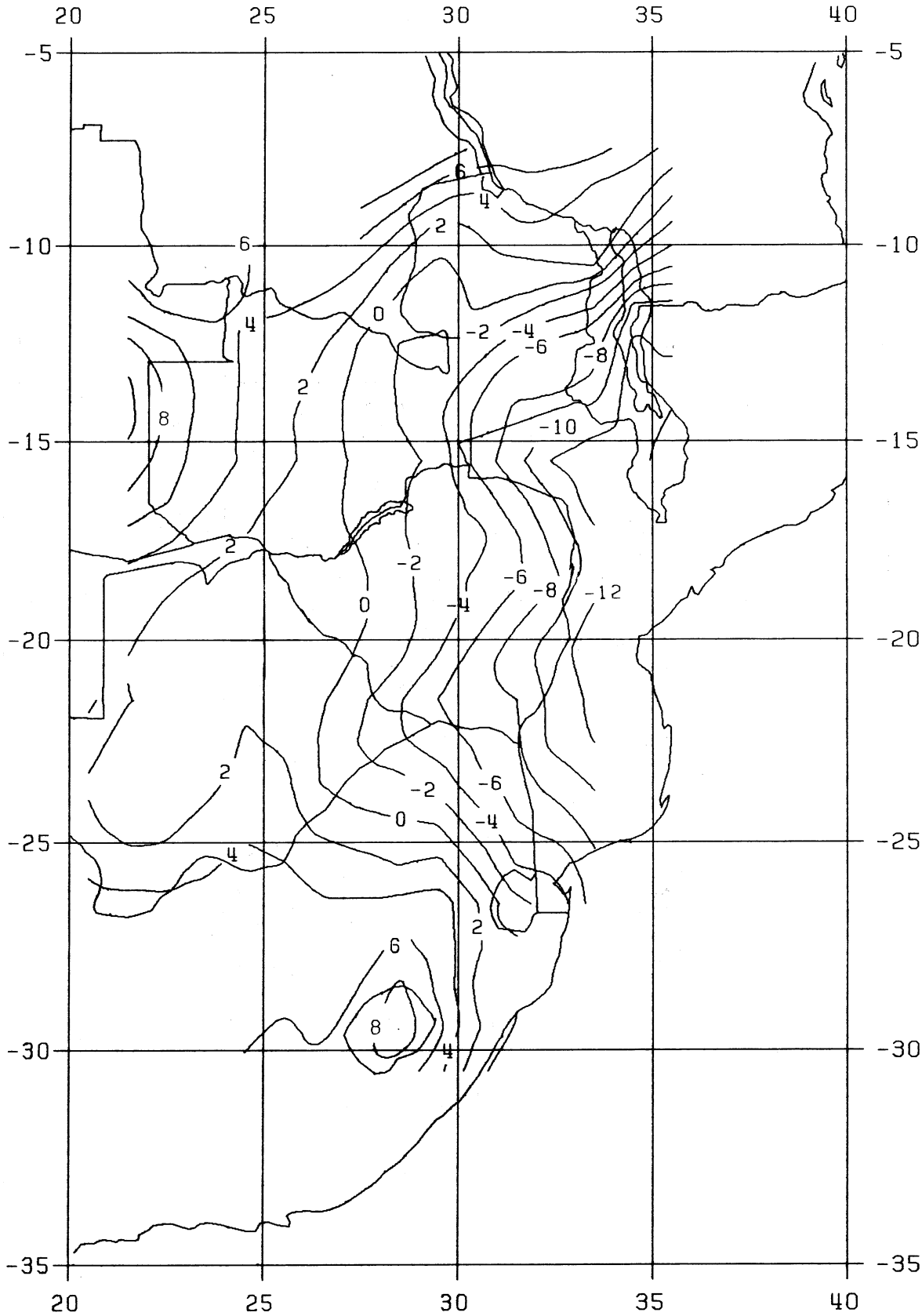

Figure 18.2. DMA-Developed Arc Datum 1950 Geoid (Referenced to Clarke 1880 Ellipsoid; Units = Meters)

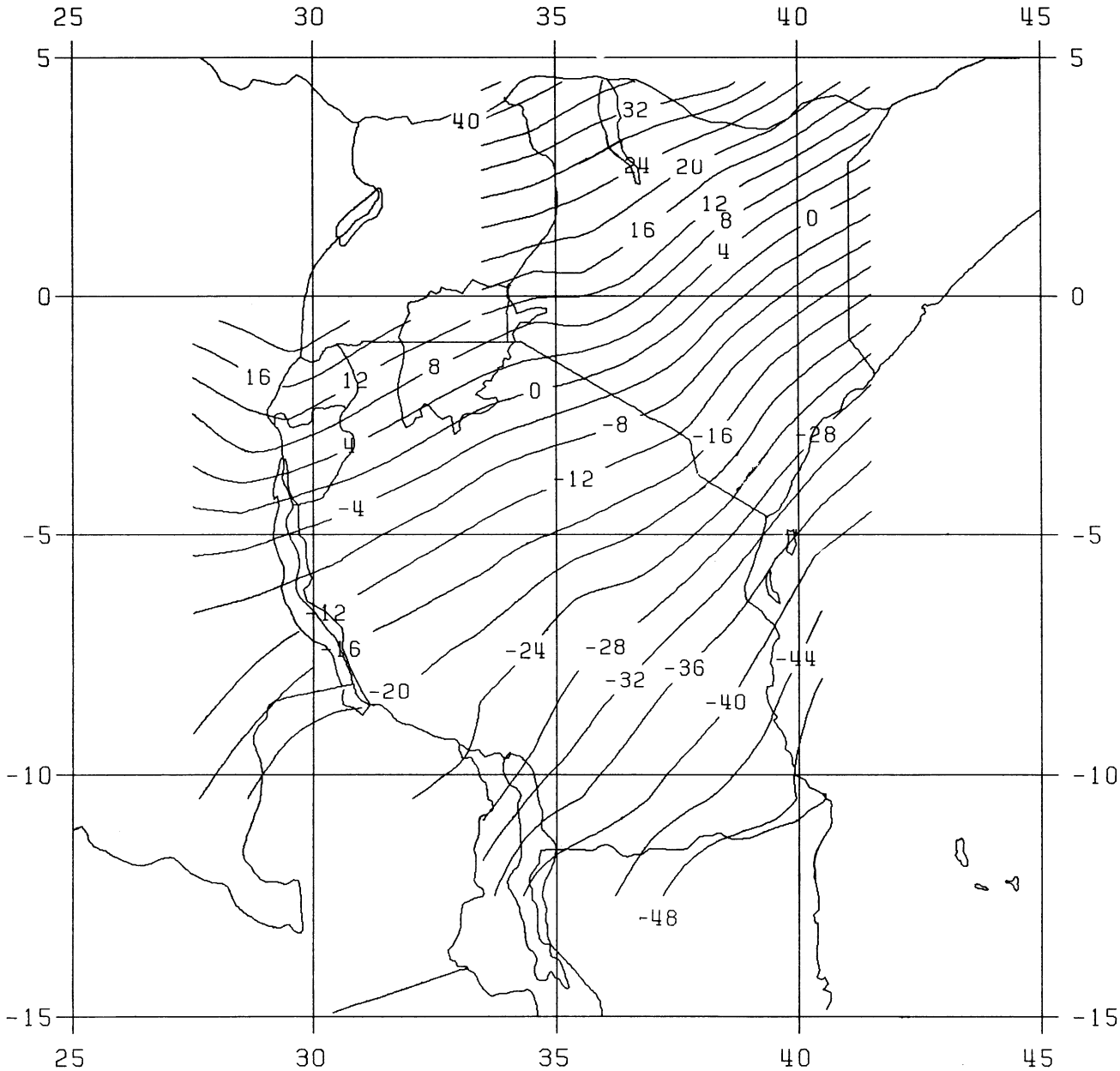

Figure 18.3. DMA- Developed Arc Datum 1960 Geoid (Referenced to Clarke 1880 Ellipsoid; Units = Meters)

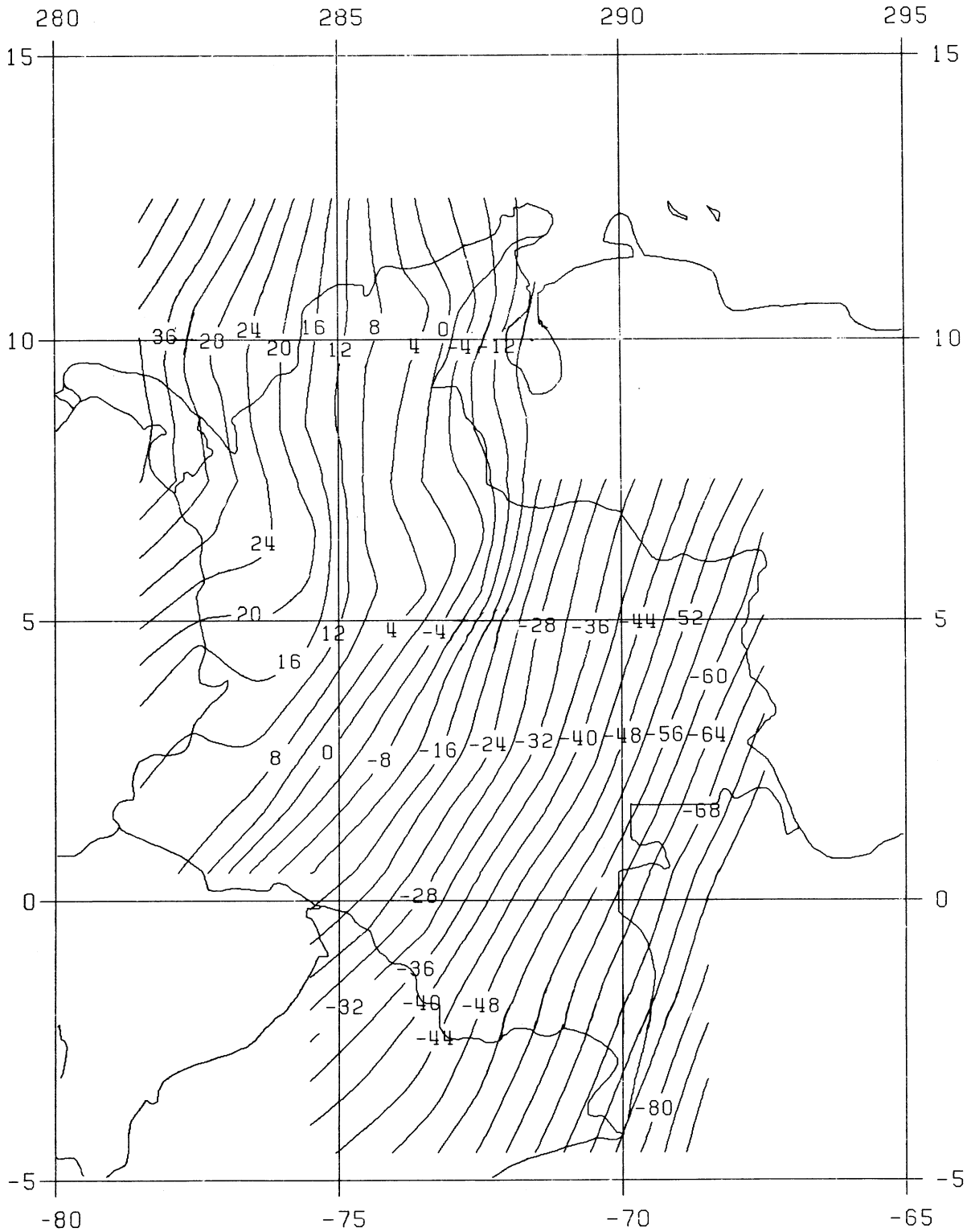

Figure 18.4. DMA-Developed Bogota Observatory Datum Geoid (Referenced to International Ellipsoid; Units = Meters)

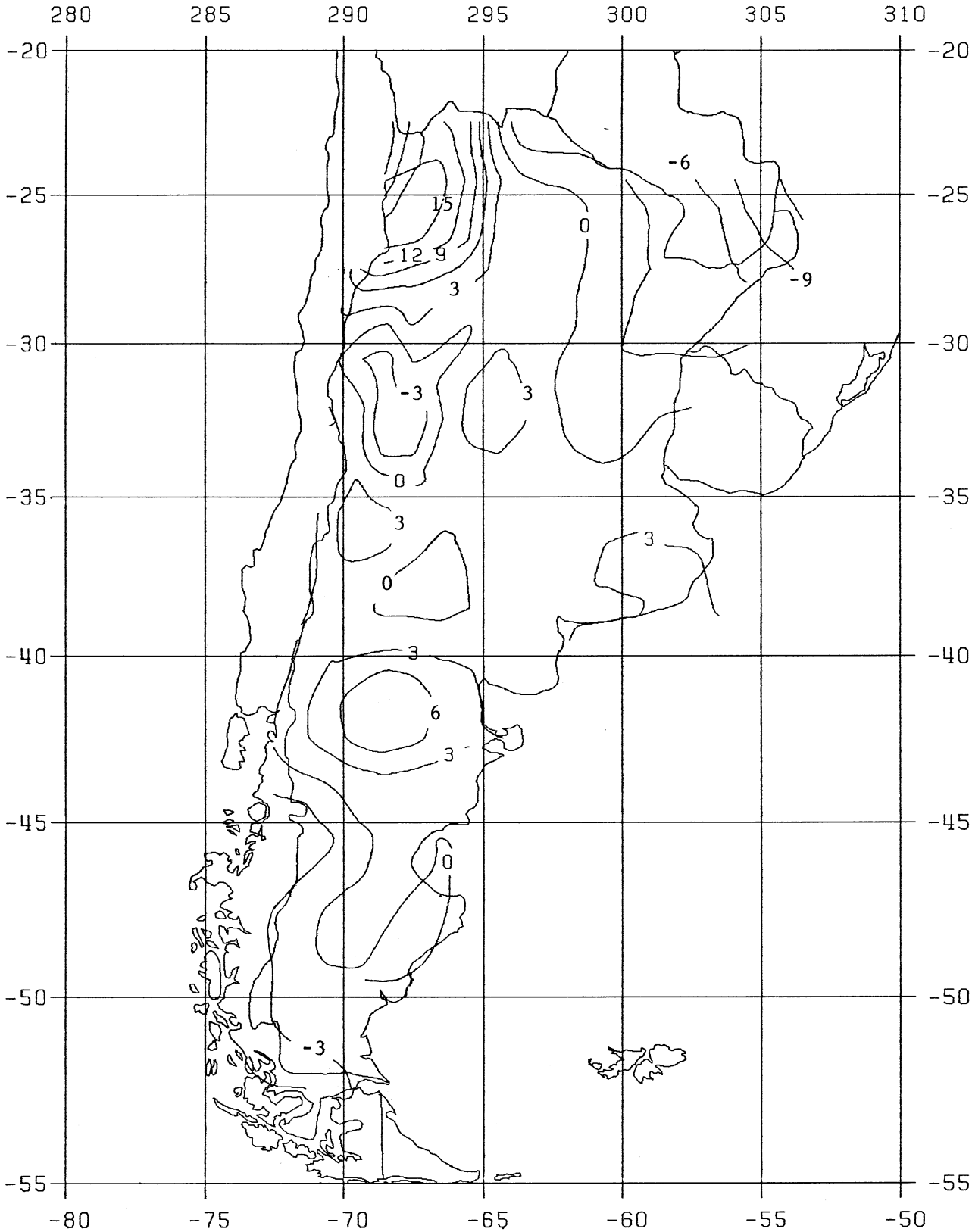

Figure 18.5. DMA-Developed Campo Inchauspe Datum Geoid (Referenced to International Ellipsoid; Units = Meters)

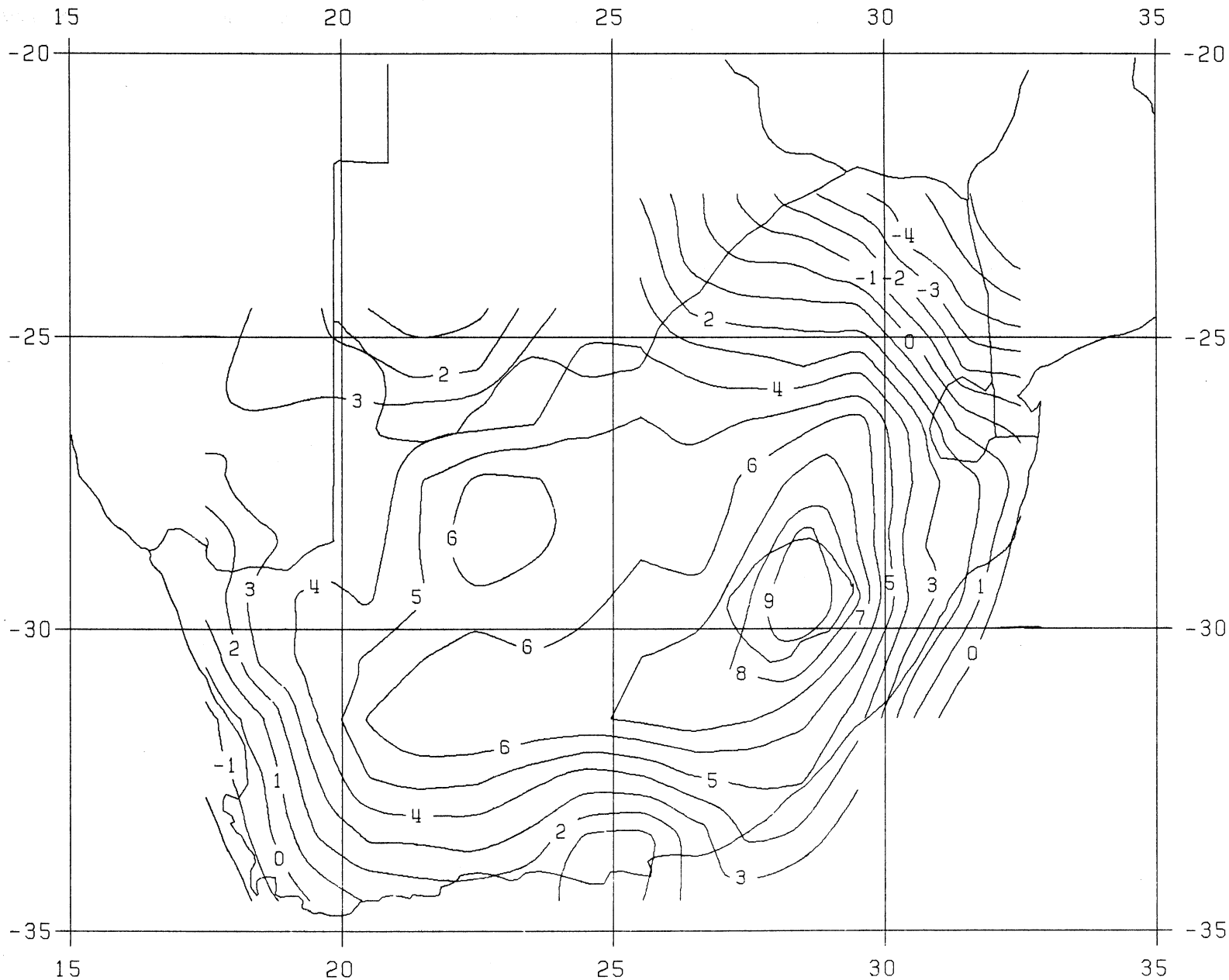

Figure 18.6. DMA-Developed Cape Datum Geoid (Referenced to Clarke 1880 Ellipsoid; Units = Meters)

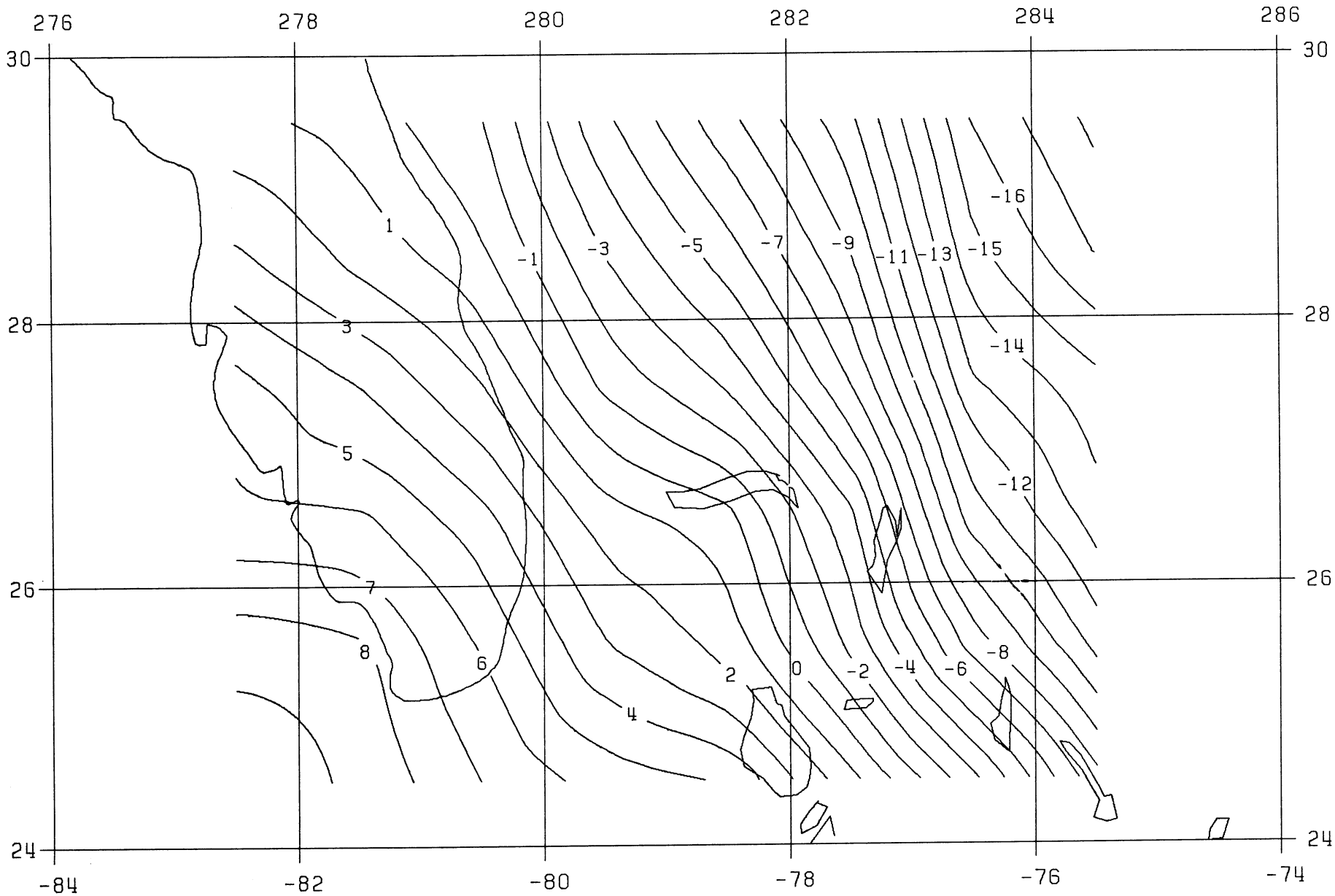

Figure 18.7. DMA-Developed Cape Canaveral Datum Geoid (Referenced to Clarke 1866 Ellipsoid; Units = Meters)

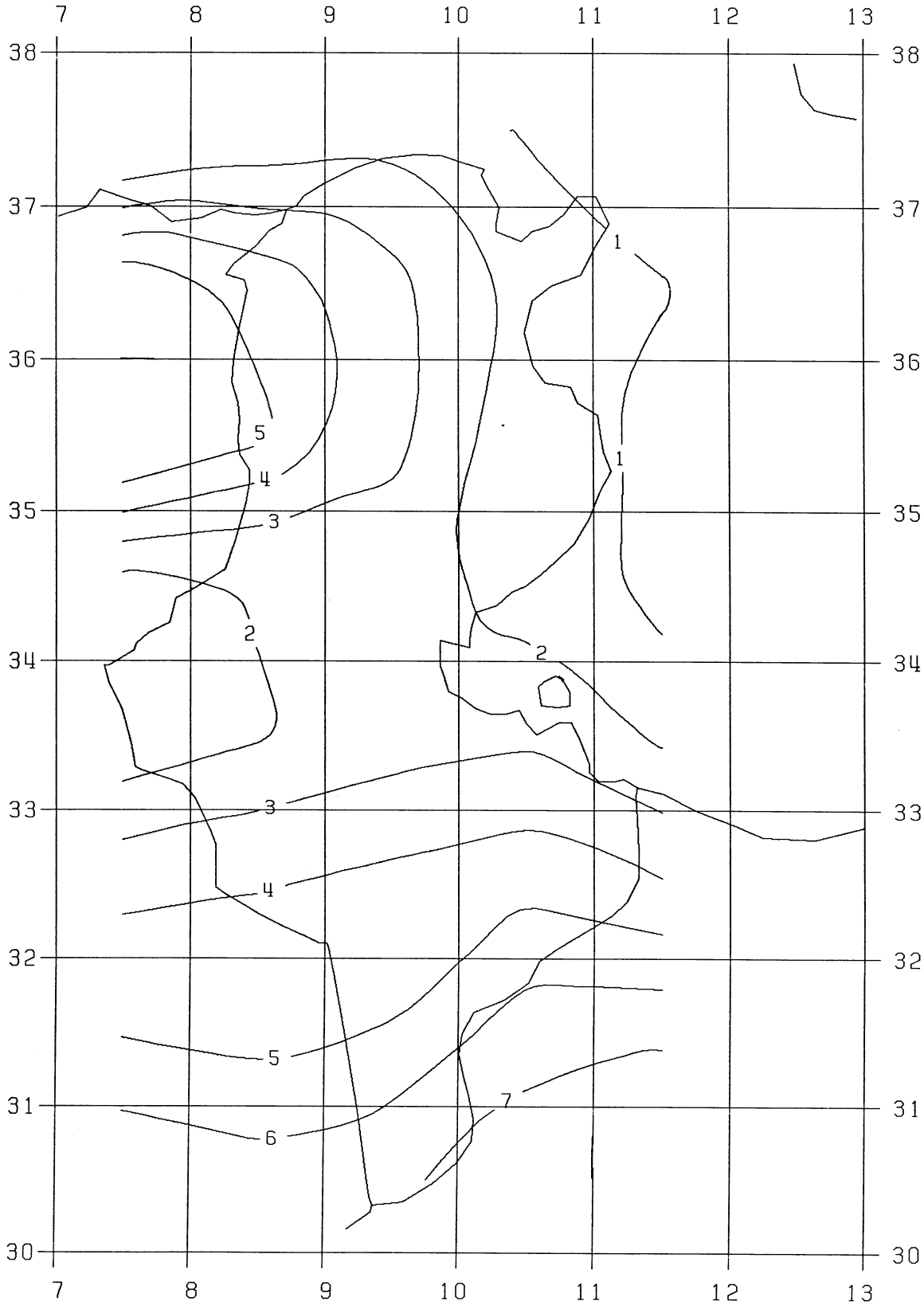

Figure 18.8. DMA-Developed Carthage Datum Geoid (Referenced to Clarke 1880 Ellipsoid; Units = Meters)

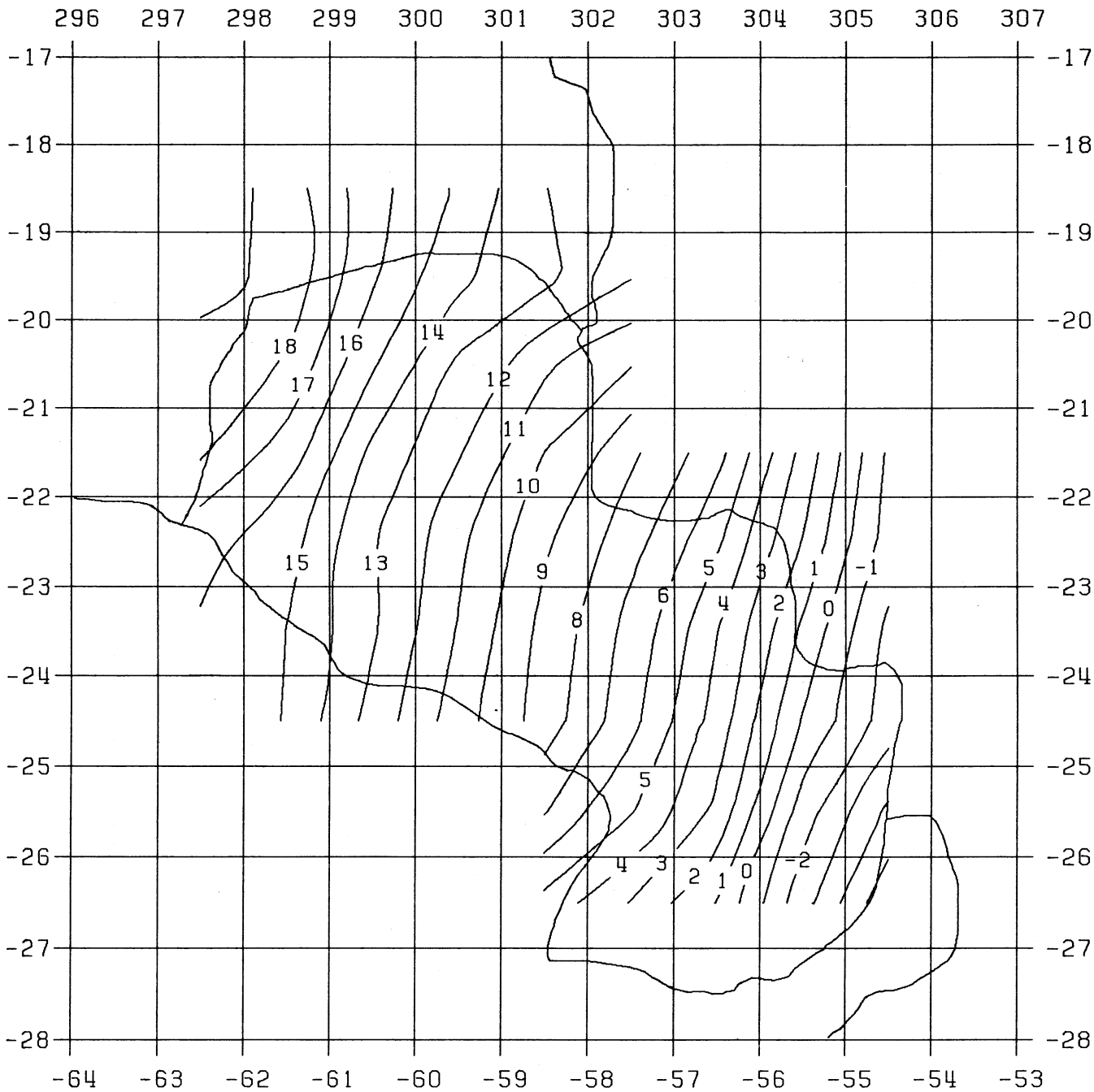

Figure 18.9. DMA-Developed Chua Astro Datum Geoid (Referenced to International Ellipsoid; Units = Meters)

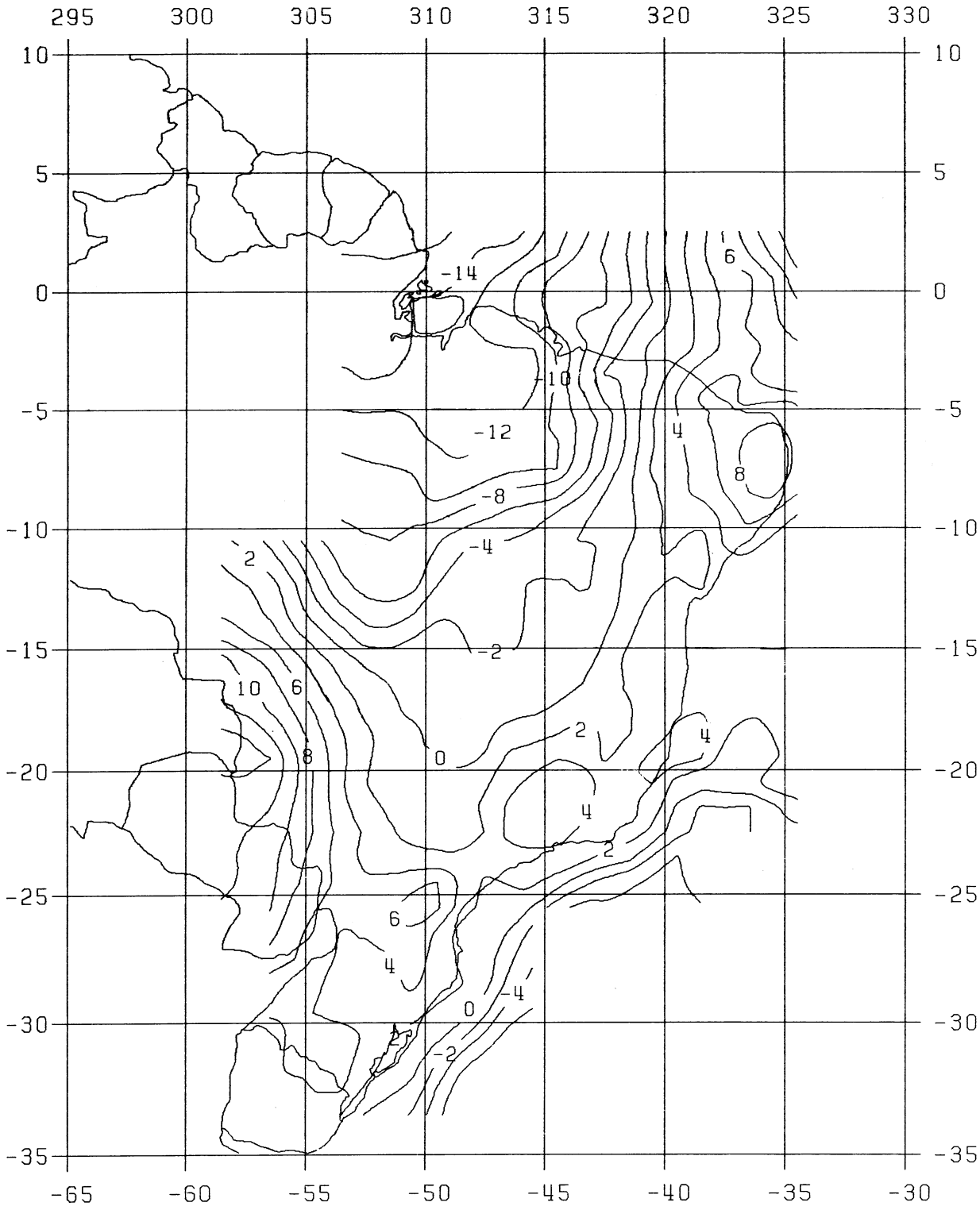

Figure 18.10. DMA-Developed Corrego Alegre Datum Geoid (Referenced to International Ellipsoid; Units = Meters)

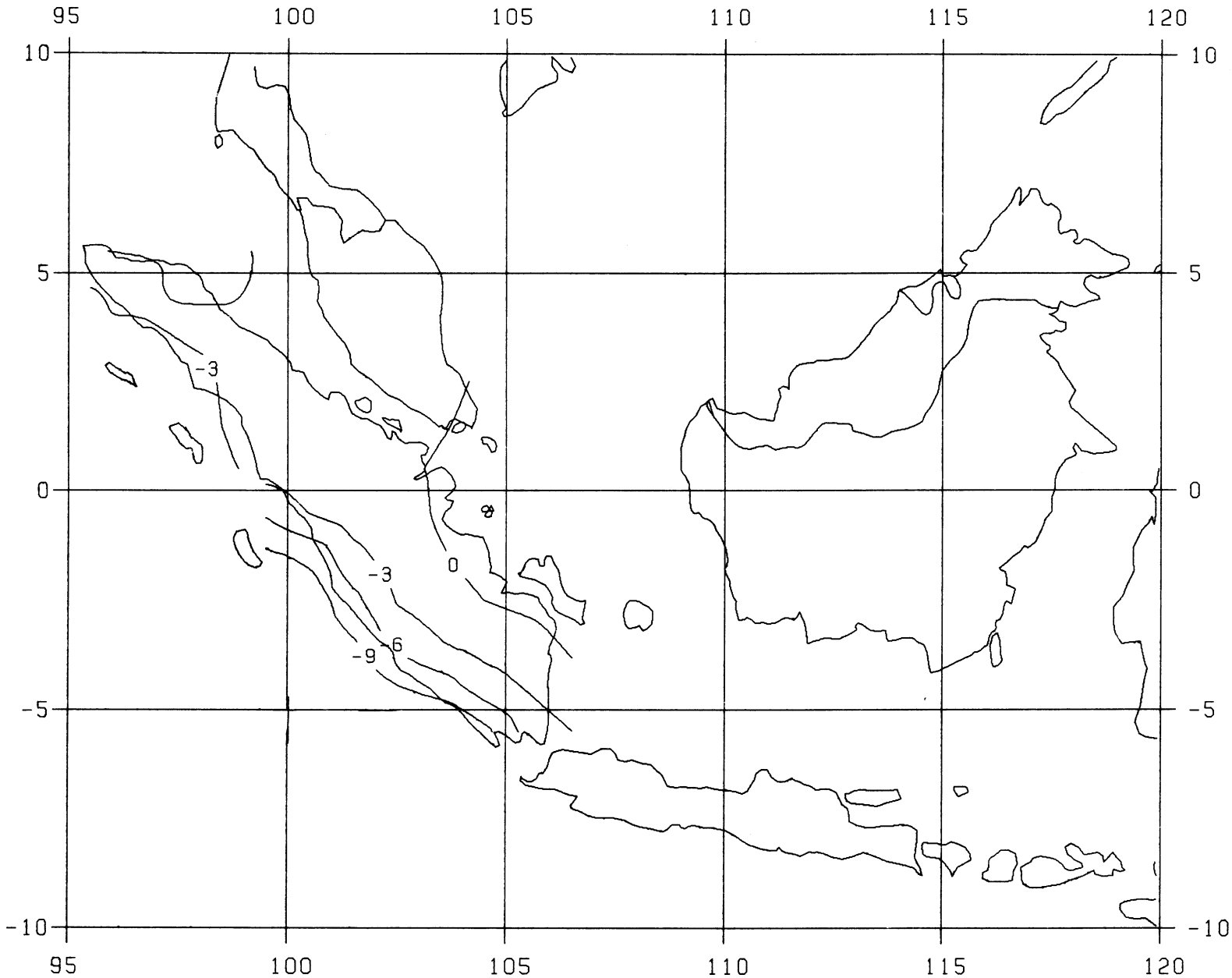

Figure 18.11. DMA-Developed Djakarta Datum Geoid (Referenced to Bessel 1841 Ellipsoid; Units = Meters)

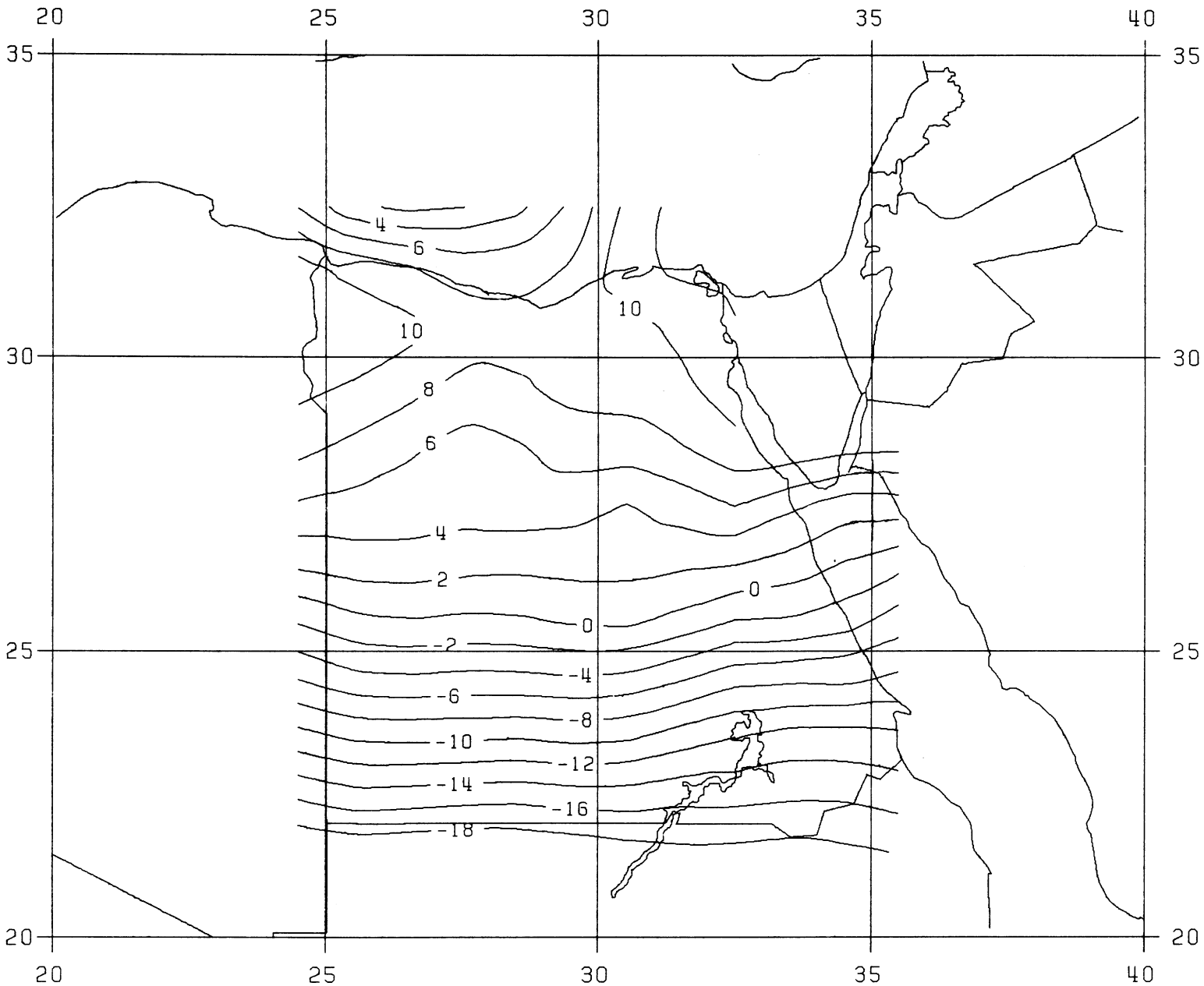

Figure 18.12. DMA-Developed ED 50 (Egypt) Geoid (Referenced to International Ellipsoid; Units = Meters)

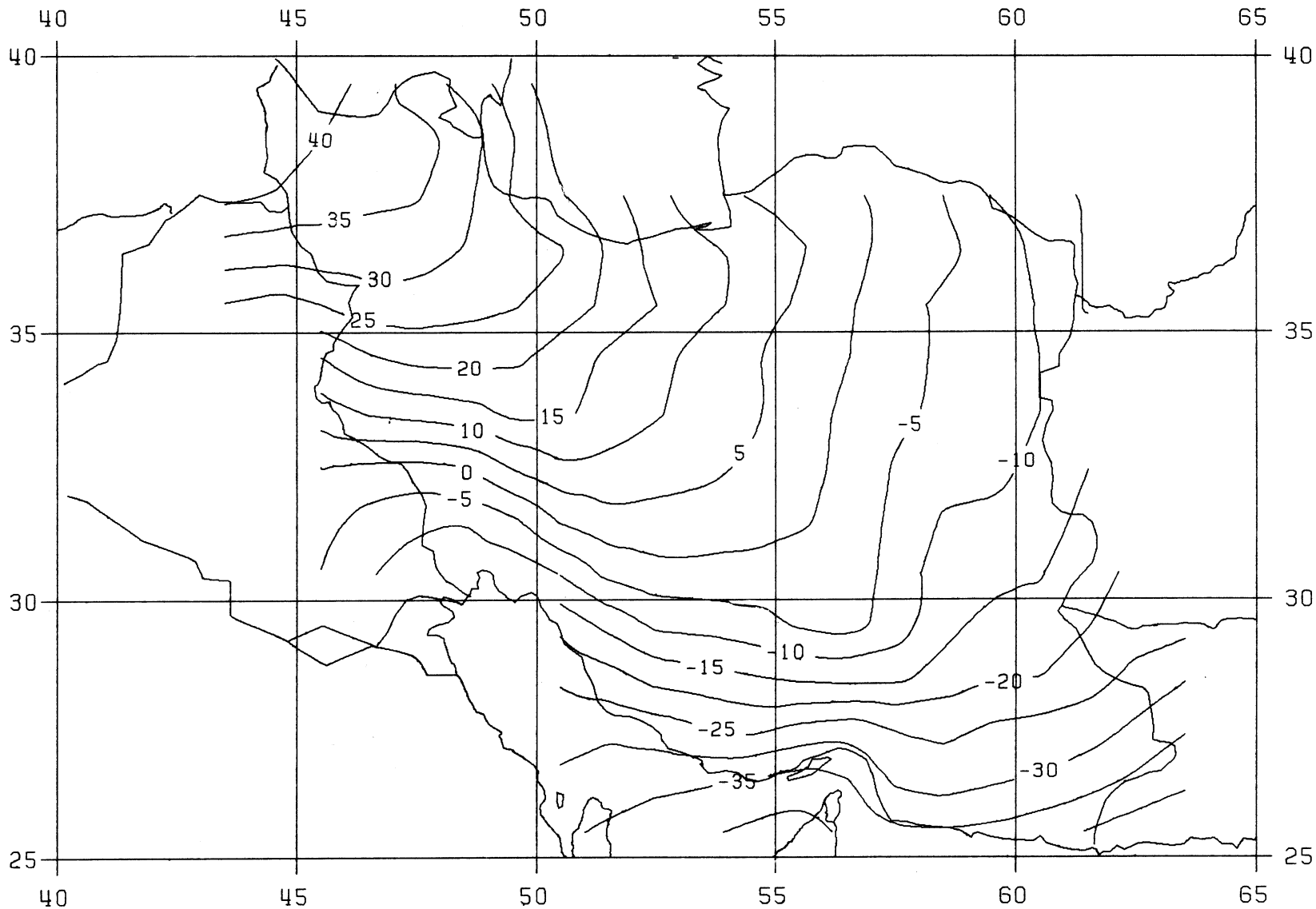

Figure 18.13. DMA-Developed ED 50 (Iran) Geoid (Referenced to International Ellipsoid; Units = Meters)

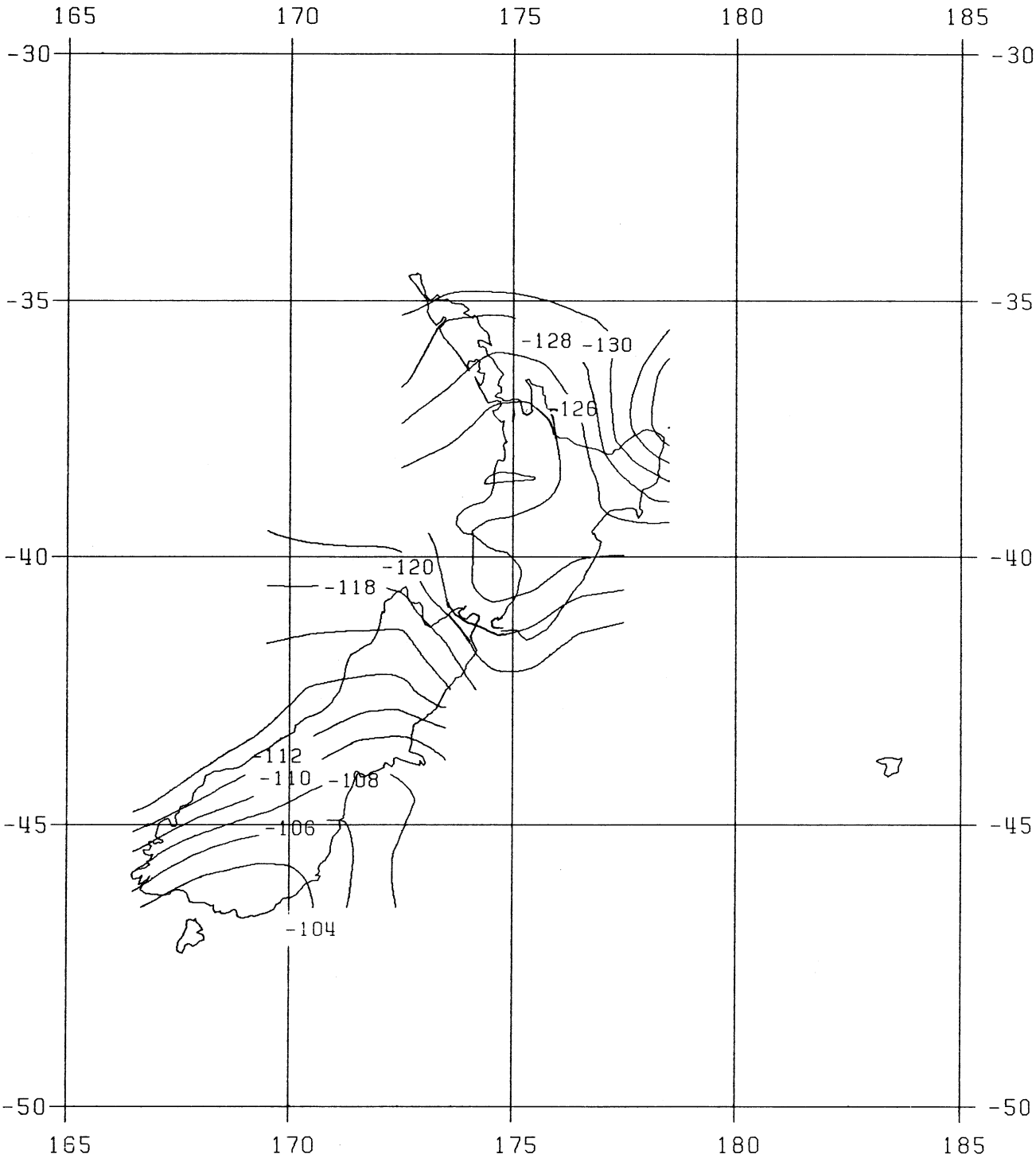

Figure 18.14. DMA-Developed Geodetic Datum 1949 Geoid (Referenced to International Ellipsoid; Units = Meters)

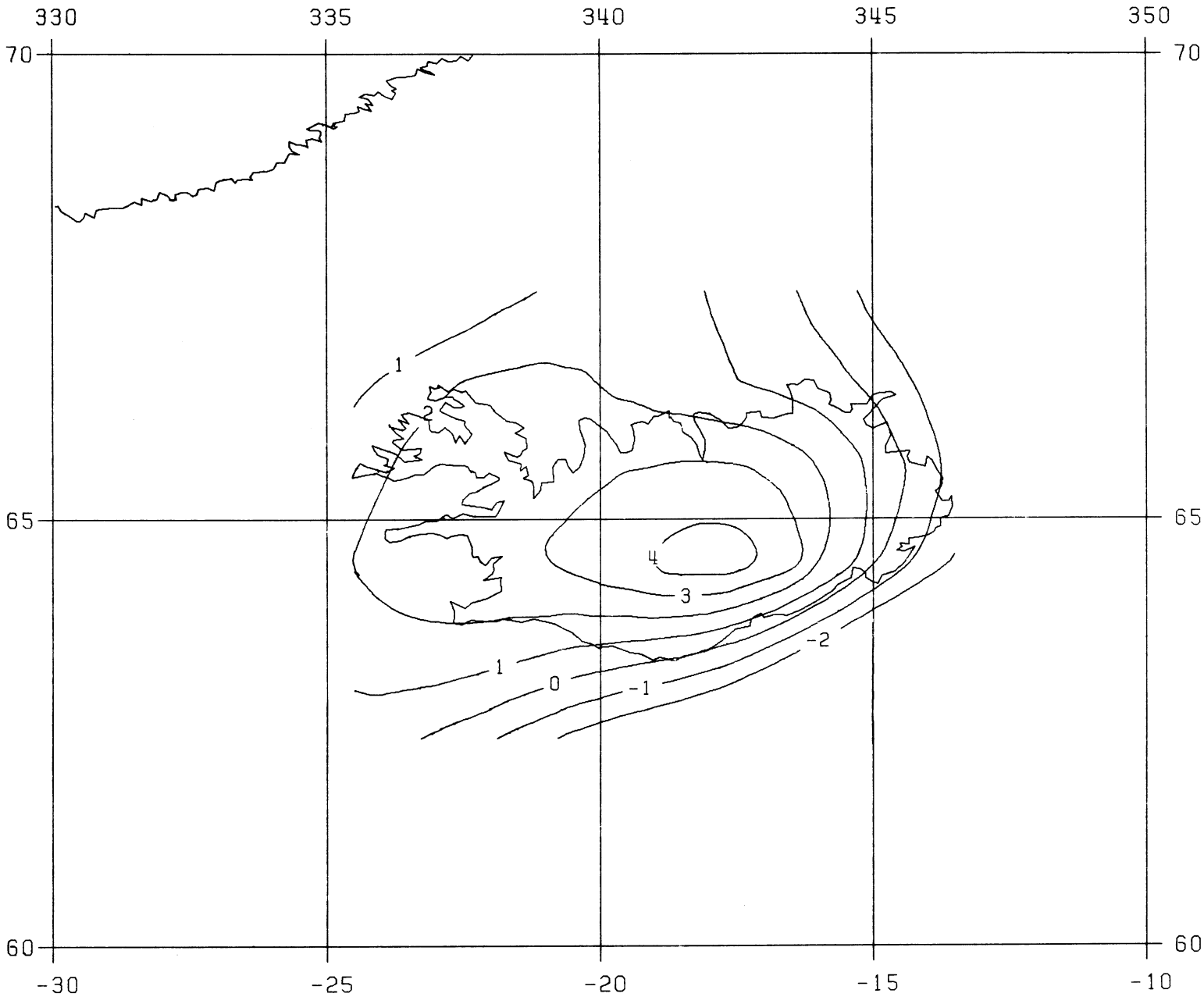

Figure 18.15. DMA-Developed Hjorsey Datum 1955 Geoid (Referenced to International Ellipsoid; Units = Meters)

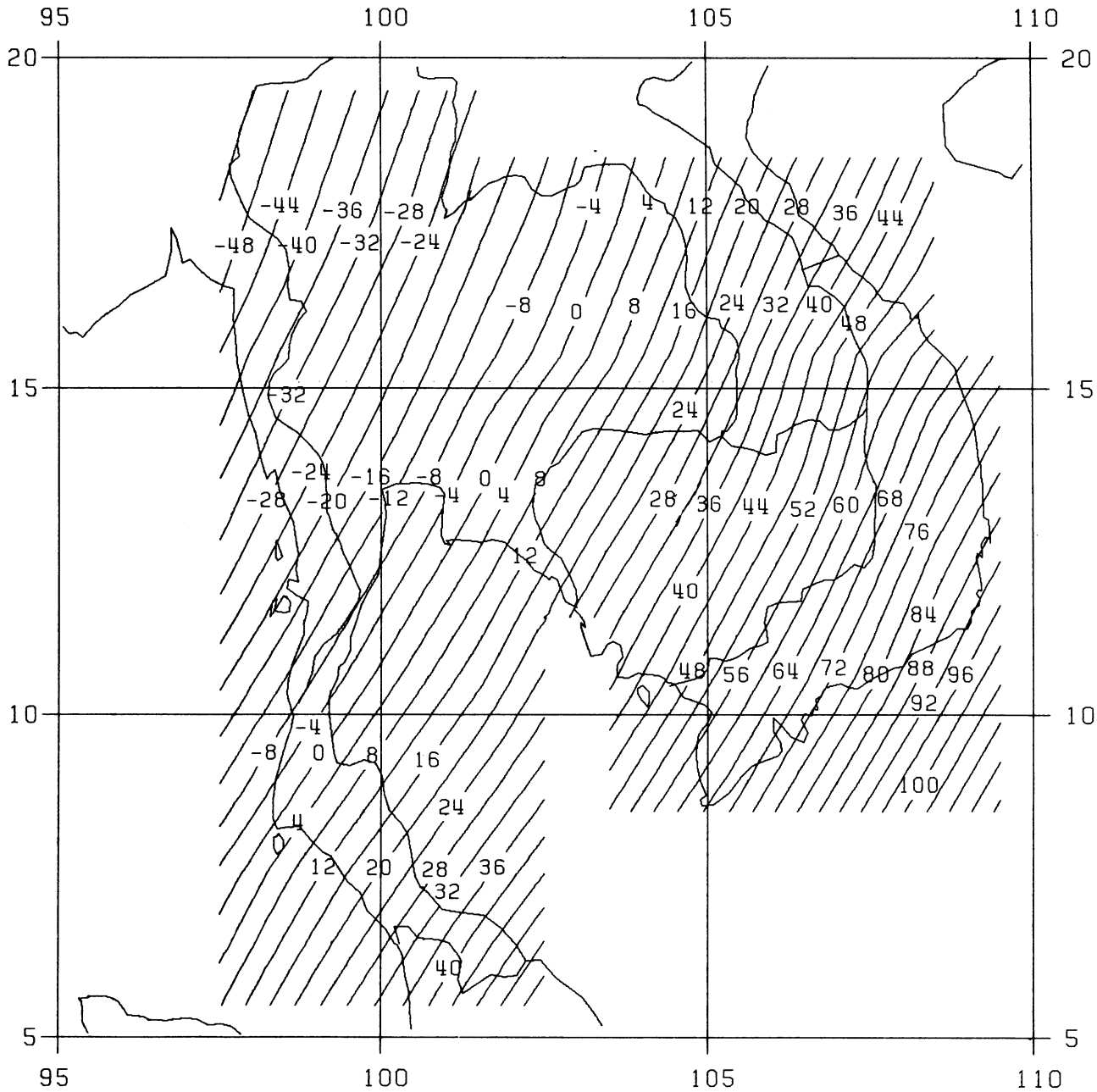

Figure 18.16. DMA-Developed Indian Datum Geoid (Referenced to Everest Ellipsoid; Units = Meters)

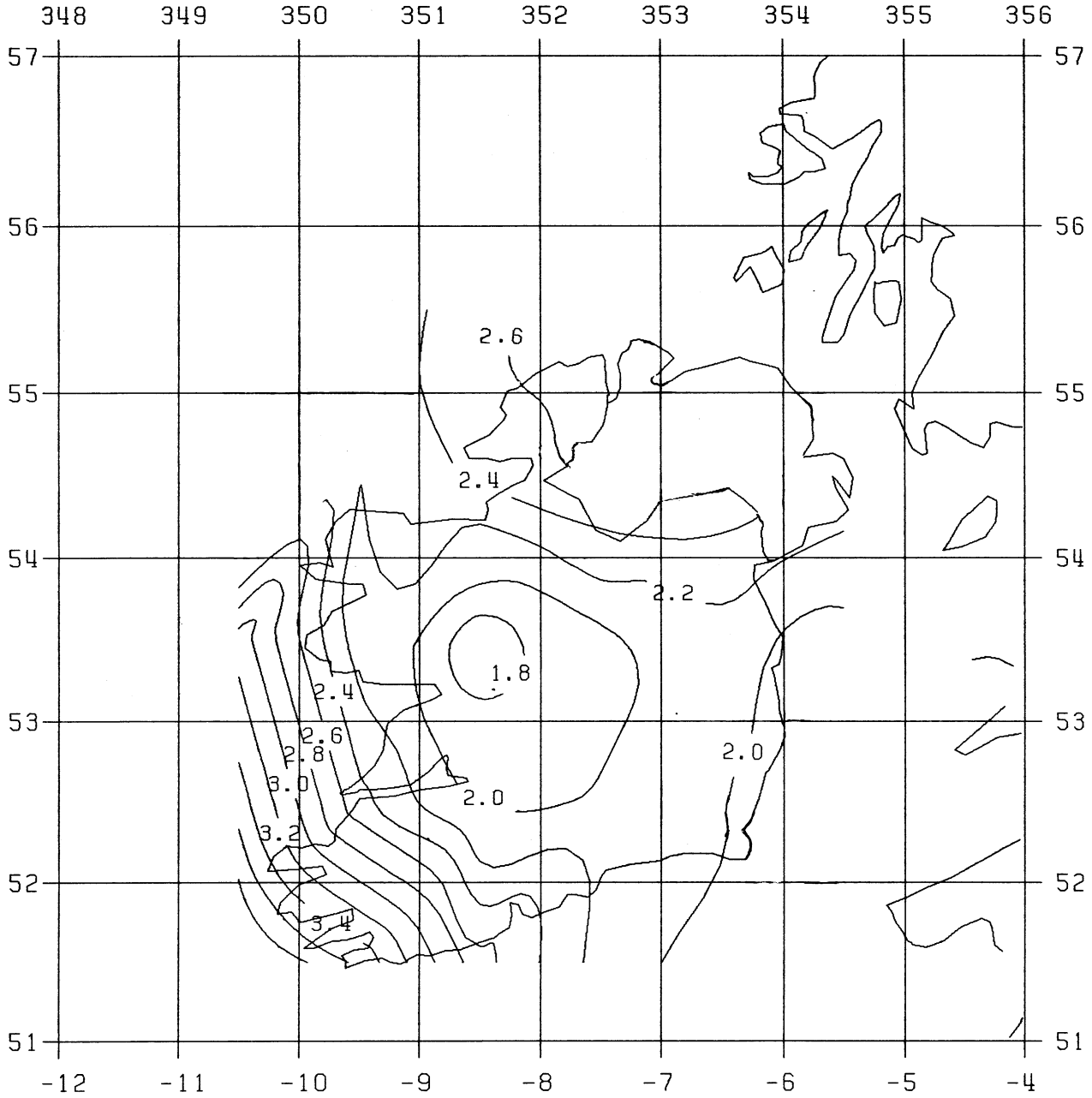

Figure 18.17. DMA-Developed Ireland Datum 1965 Geoid (Referenced to Modified Airy Ellipsoid; Units = Meters)

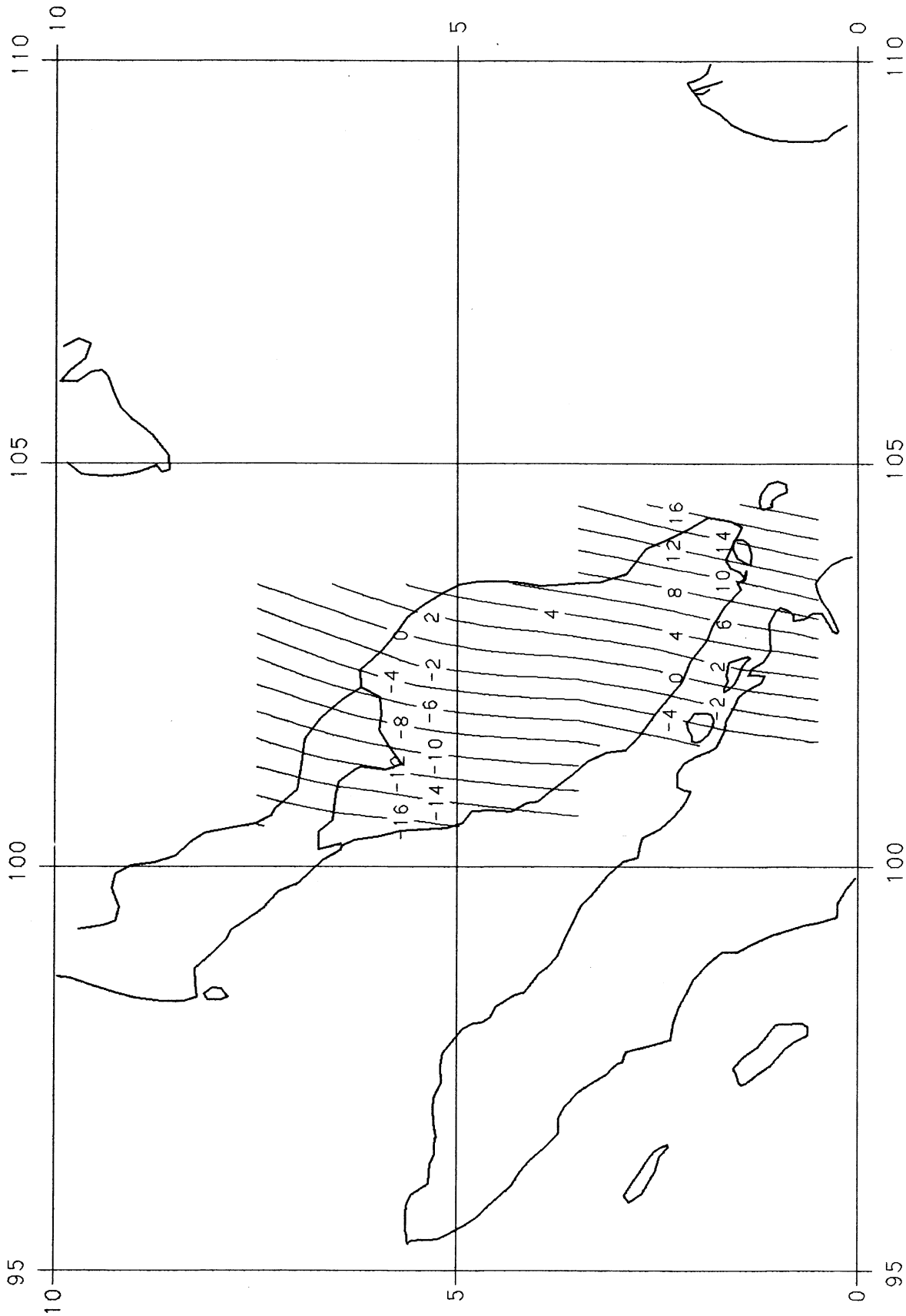

Figure 18.18. DMA-Developed Kertau Datum 1948 Geoid (Referenced to Modified Everest Ellipsoid; Units = Meters)

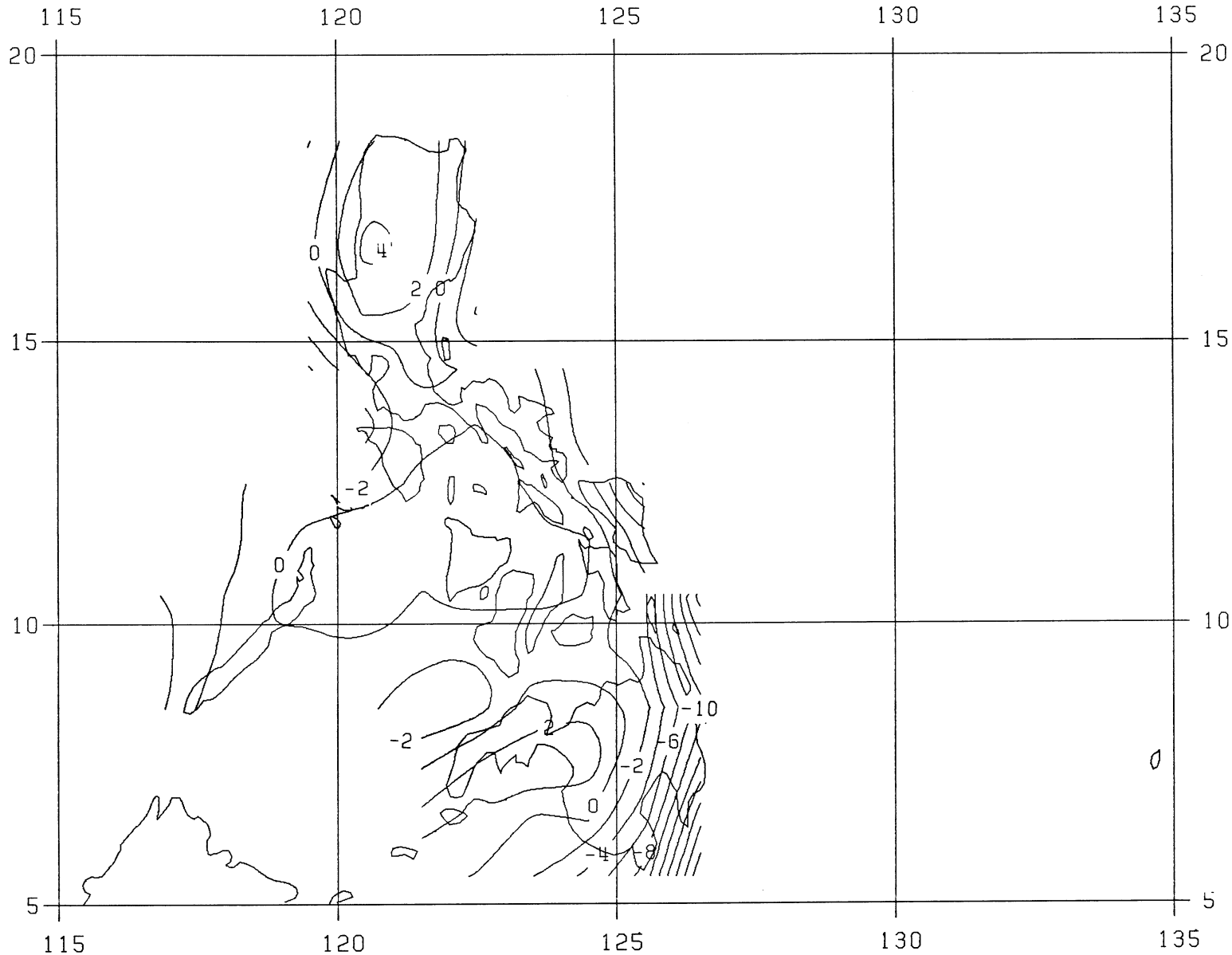

Figure 18.19. DMA-Developed Luzon Datum Geoid (Referenced to Clarke 1866 Ellipsoid; Units = Meters)

Figure 18.20. DMA-Developed Merchich Datum Geoid (Referenced to Clarke 1880 Ellipsoid; Units = Meters)

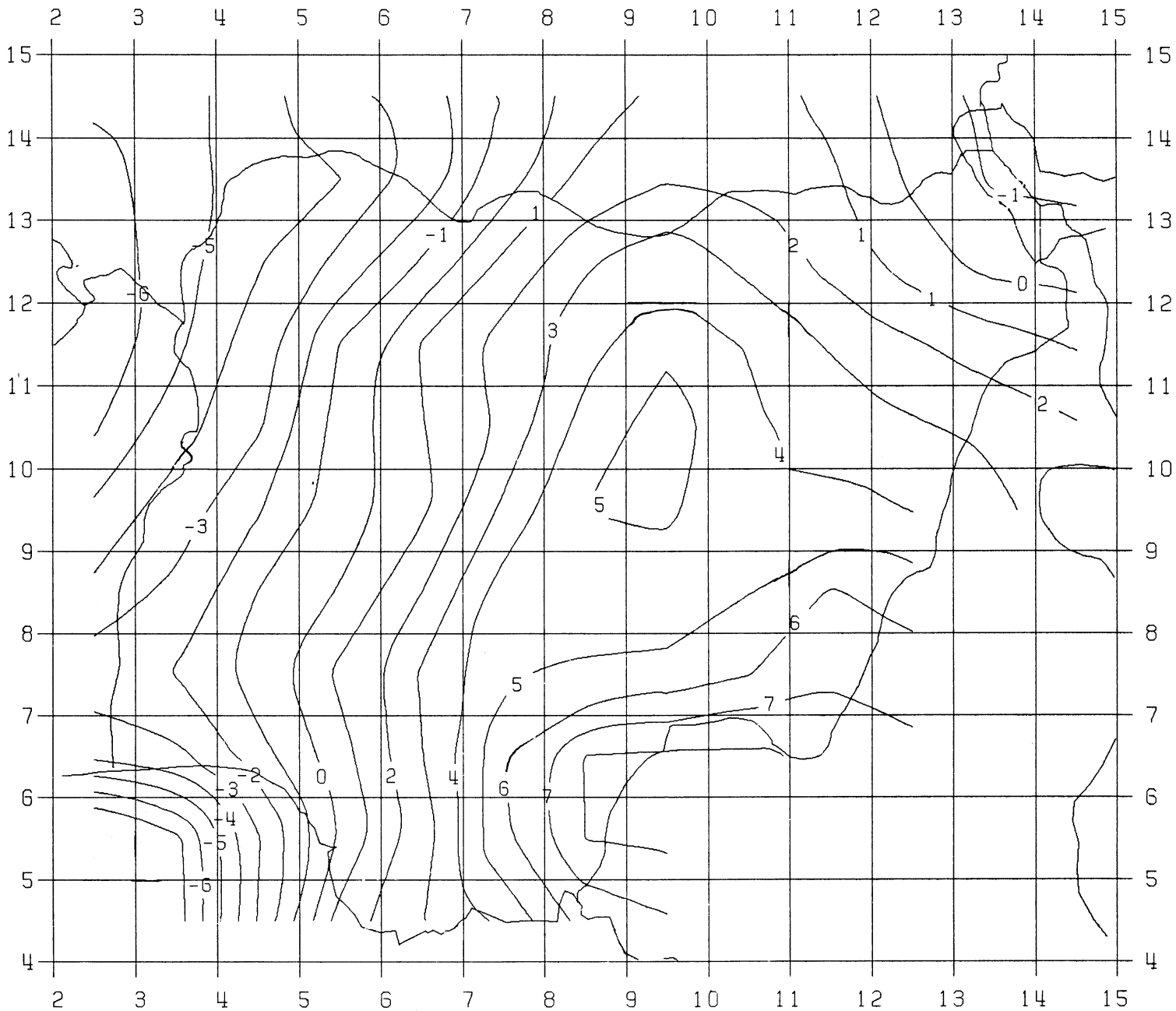

Figure 18.21. DMA-Developed Minna Datum Geoid (Referenced to Clarke 1880 Ellipsoid; Units = Meters)

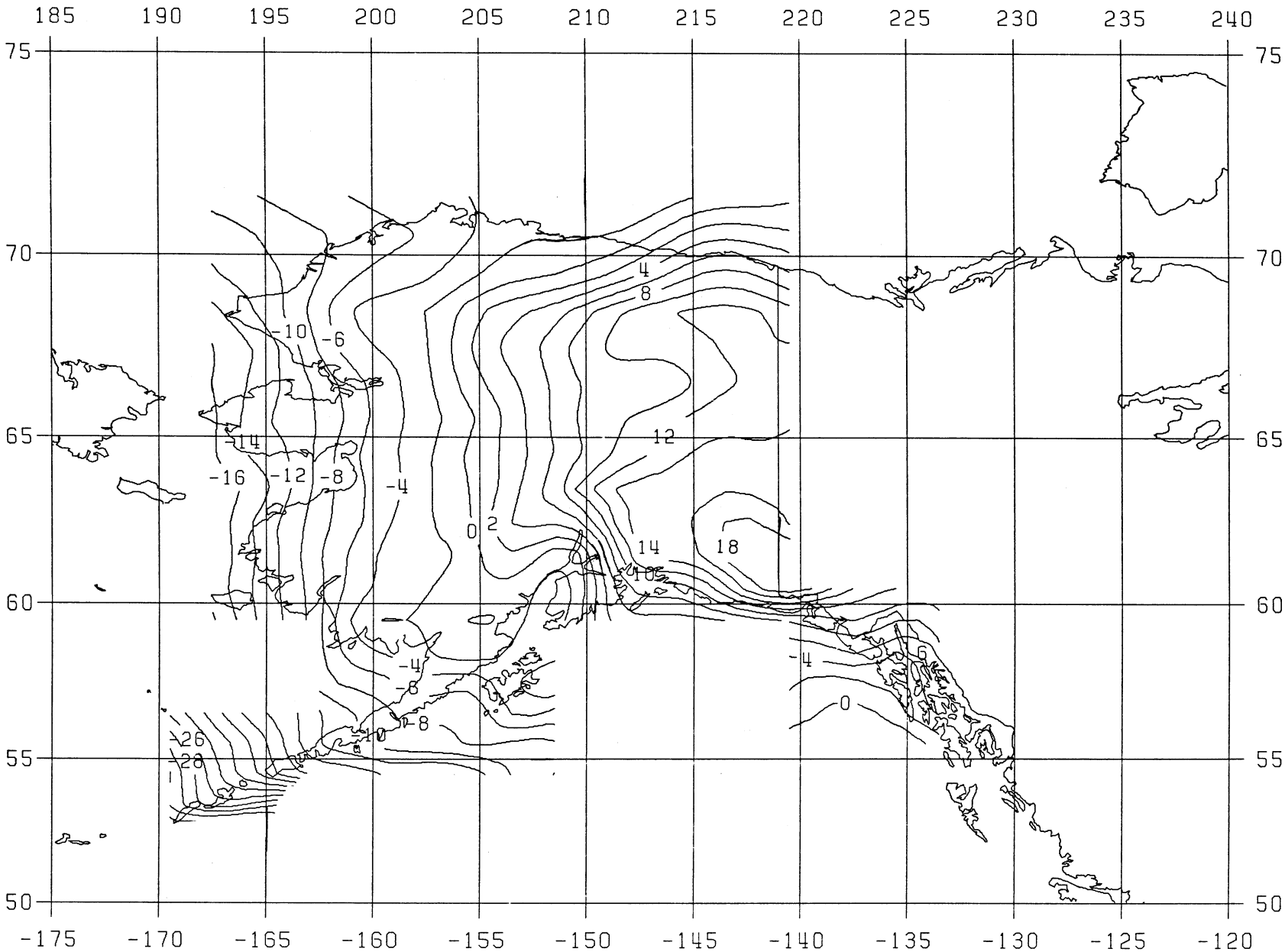

Figure 18.22. DMA-Developed NAD 27 (Alaska) Geoid (Referenced to Clarke 1866 Ellipsoid; Units = Meters)

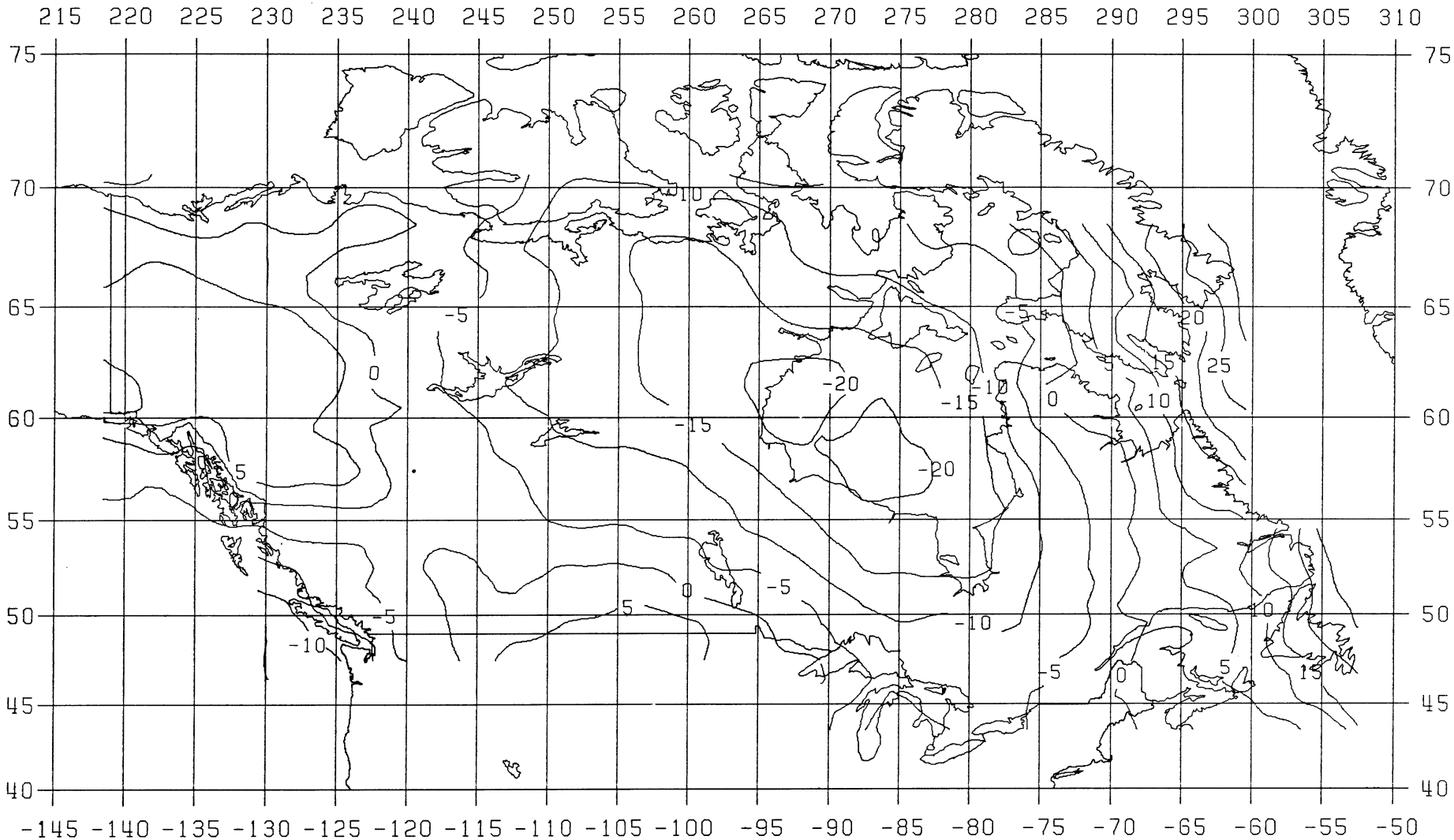

Figure 18.23. DMA-Developed NAD 27 (Canada) Geoid (Referenced to Clarke 1866 Ellipsoid; Units = Meters)

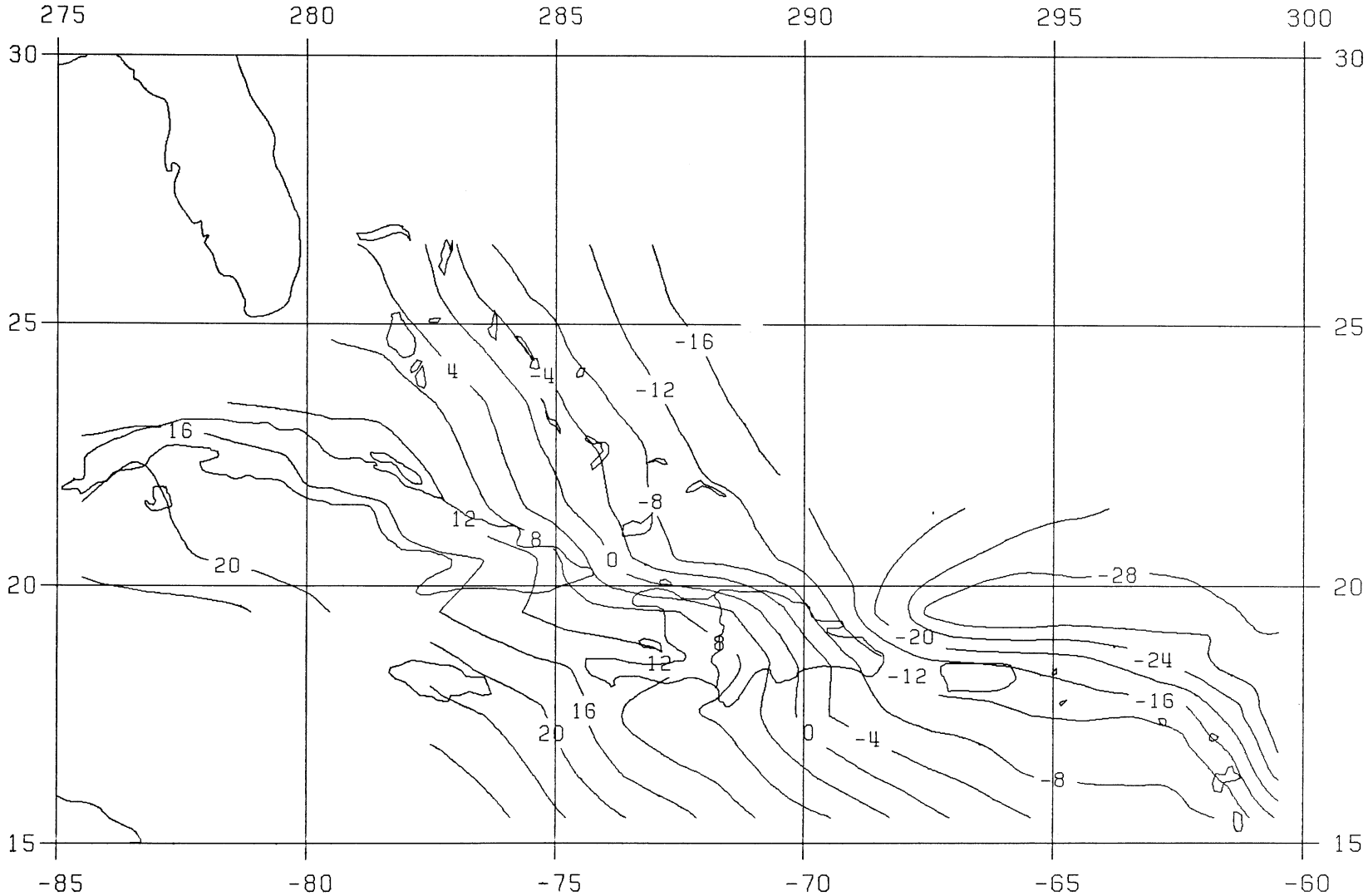

Figure 18.24. DMA-Developed NAD 27 (Caribbean) Geoid (Referenced to Clarke 1866 Ellipsoid; Units = Meters)

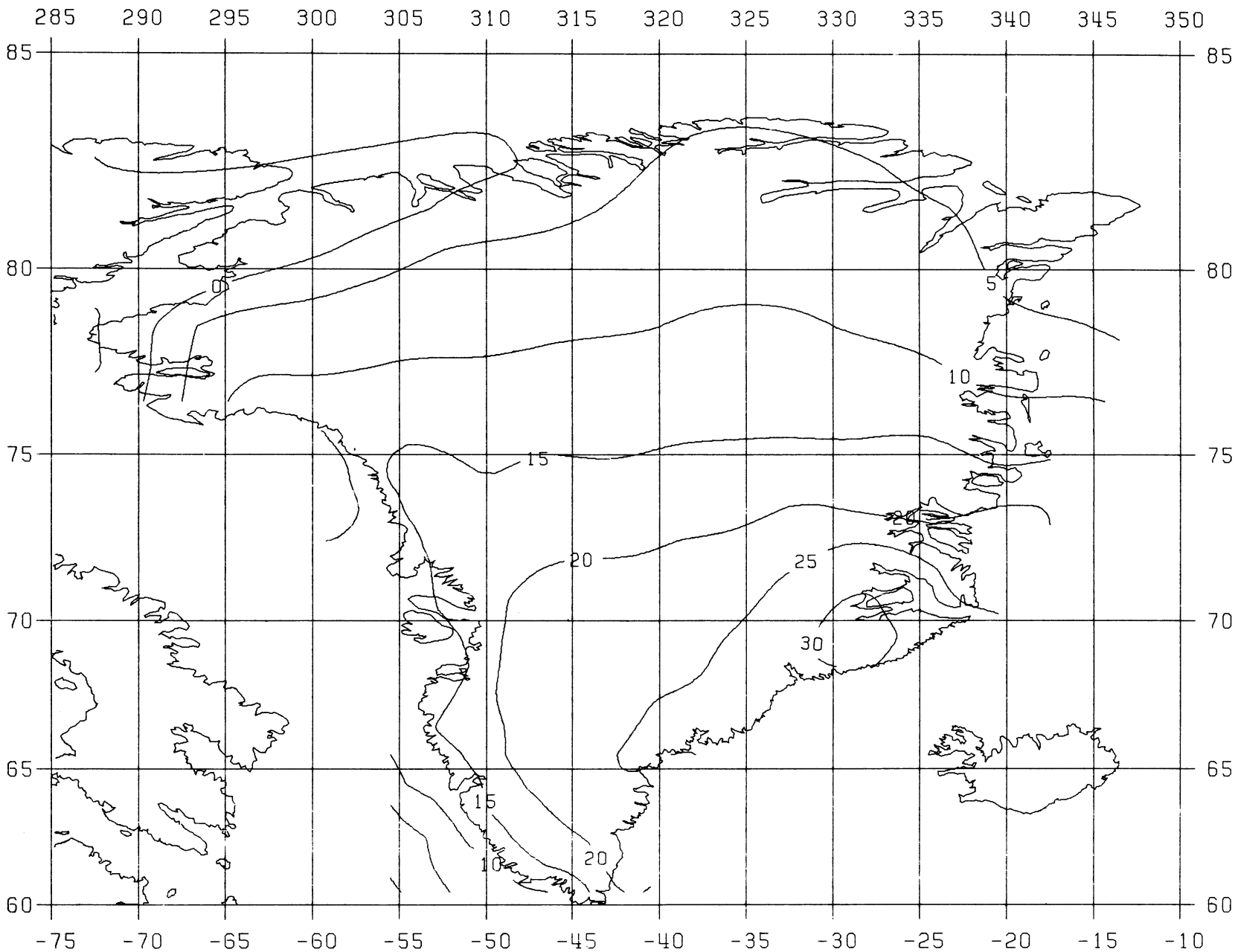

Figure 18.25. DMA-Developed NAD 27 (Greenland/Hayes Peninsula) Geoid (Referenced to Clarke 1866 Ellipsoid; Units = Meters)

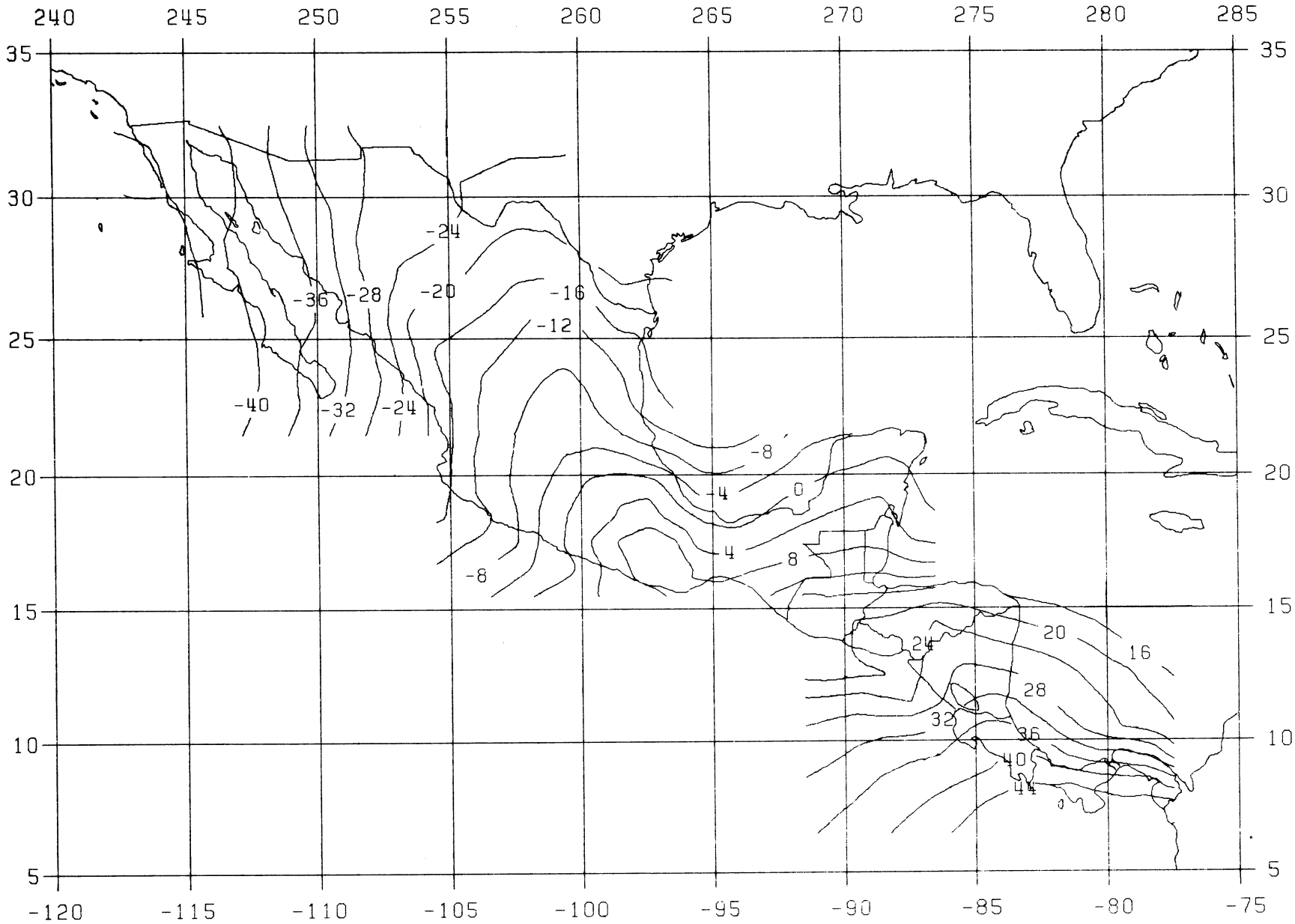

Figure 18.26. DMA-Developed NAD 27 (Mexico, Central America) Geoid (Referenced to Clarke 1866 Ellipsoid; Units = Meters)

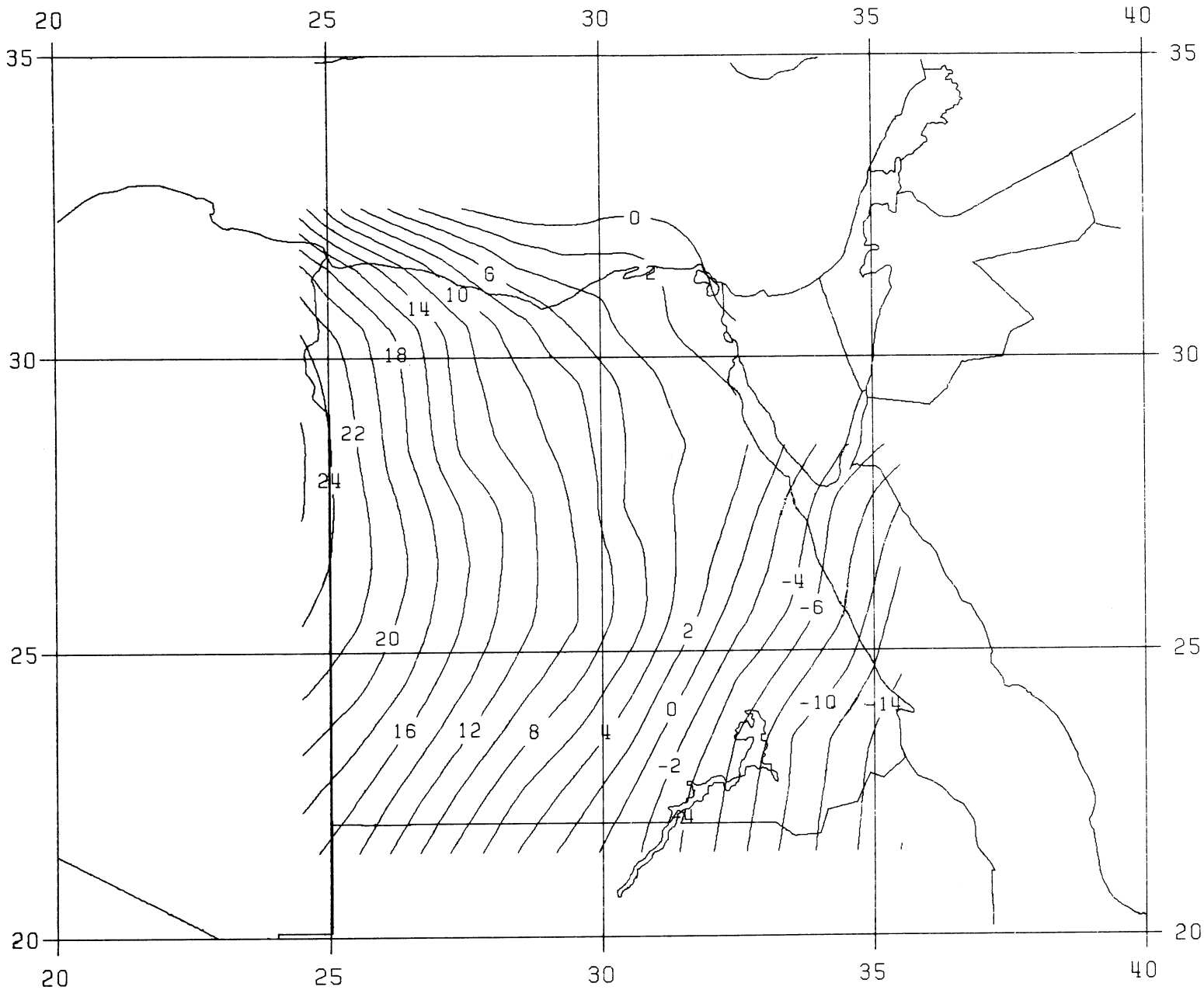

Figure 18.27. DMA-Developed Old Egyptian Datum Geoid (Referenced to Helmert 1906 Ellipsoid; Units = Meters)

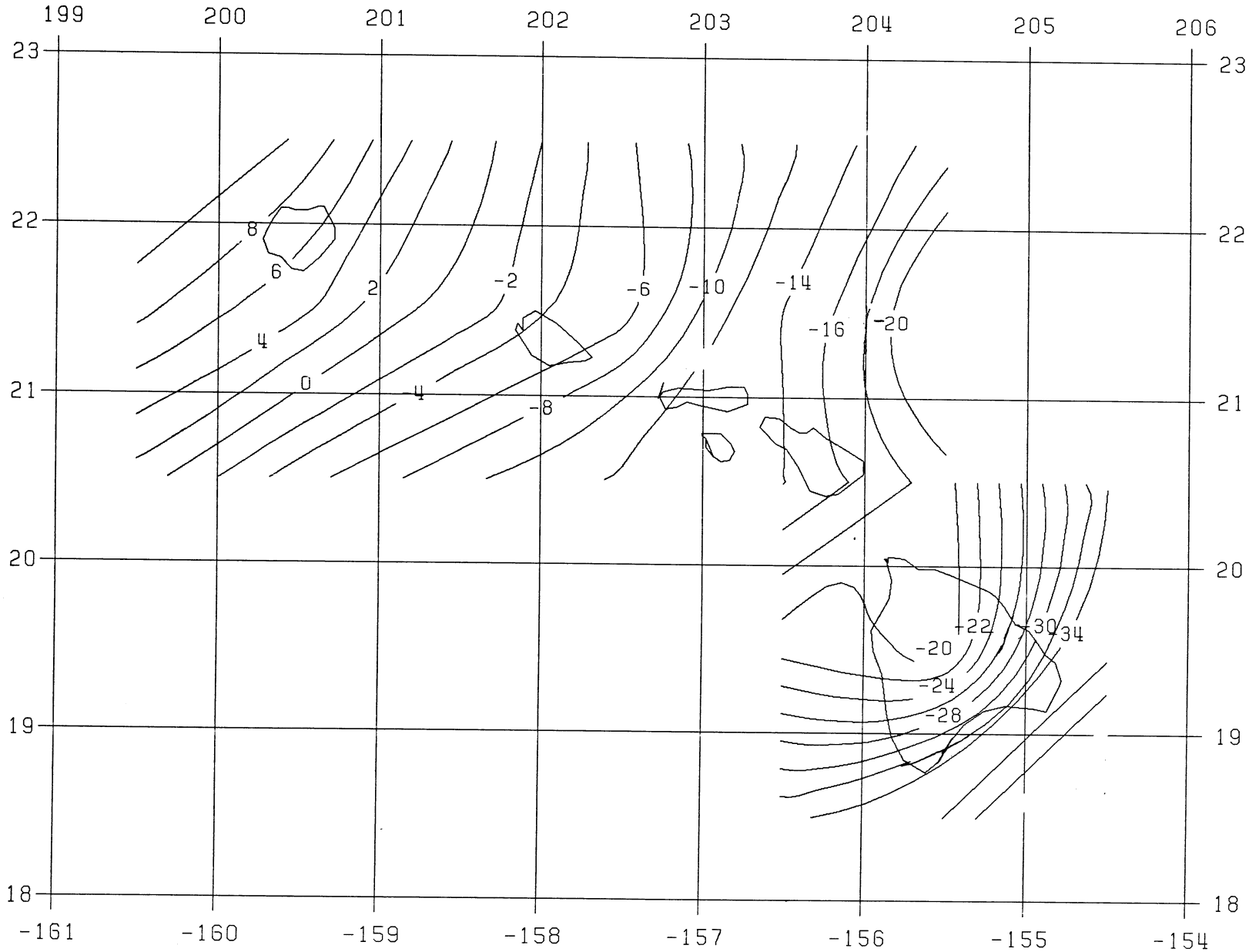

Figure 18.28. DMA-Developed Old Hawaiian Datum Geoid (Referenced to Clarke 1866 Ellipsoid; Units = Meters)

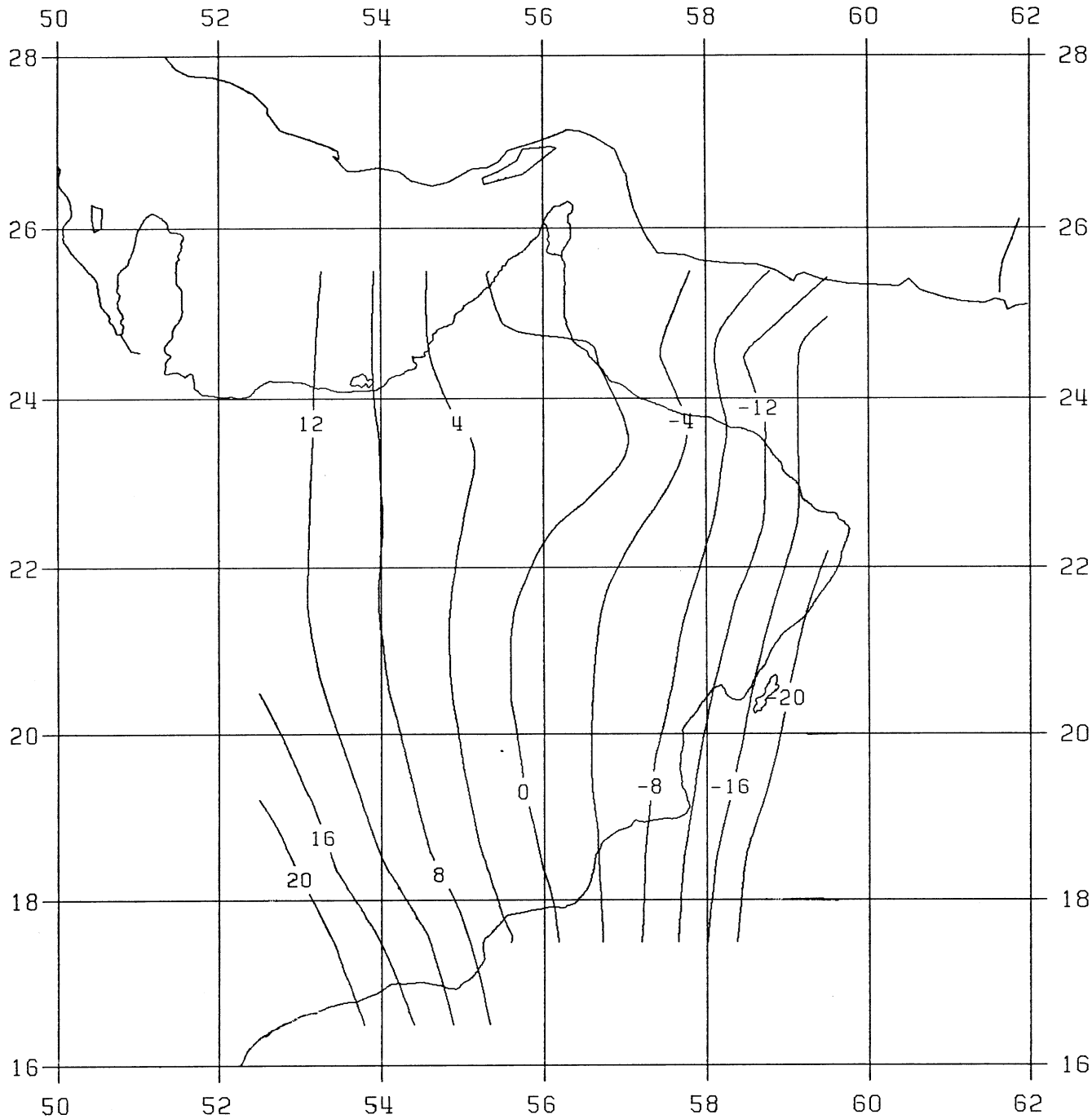

Figure 18.29. DMA-Developed Oman Datum Geoid (Referenced to Clarke 1880 Ellipsoid; Units = Meters)

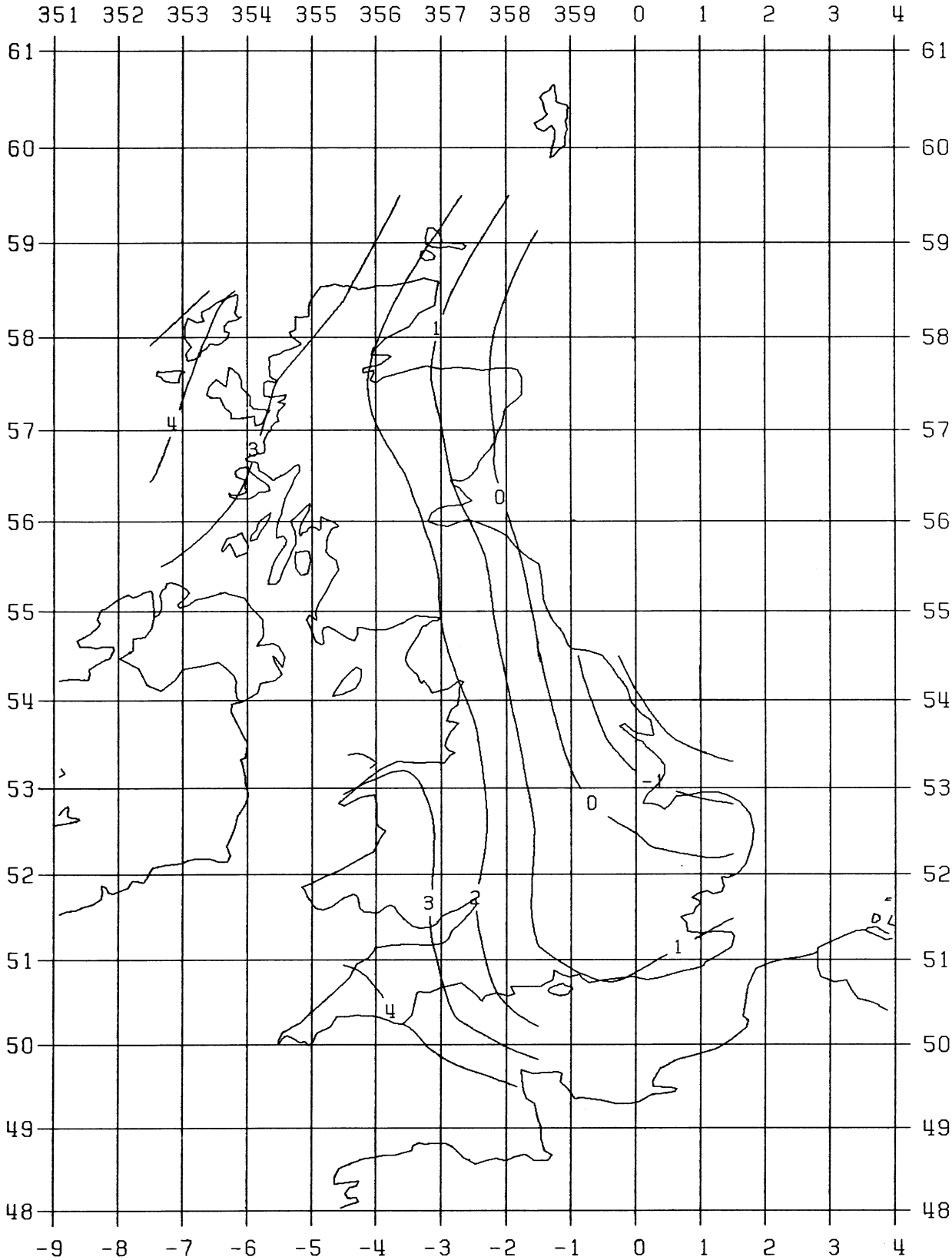

Figure 18.30. DMA-Developed Ordnance Survey of Great Britain 1936 Datum Geoid (Referenced to Airy Ellipsoid; Units = Meters)

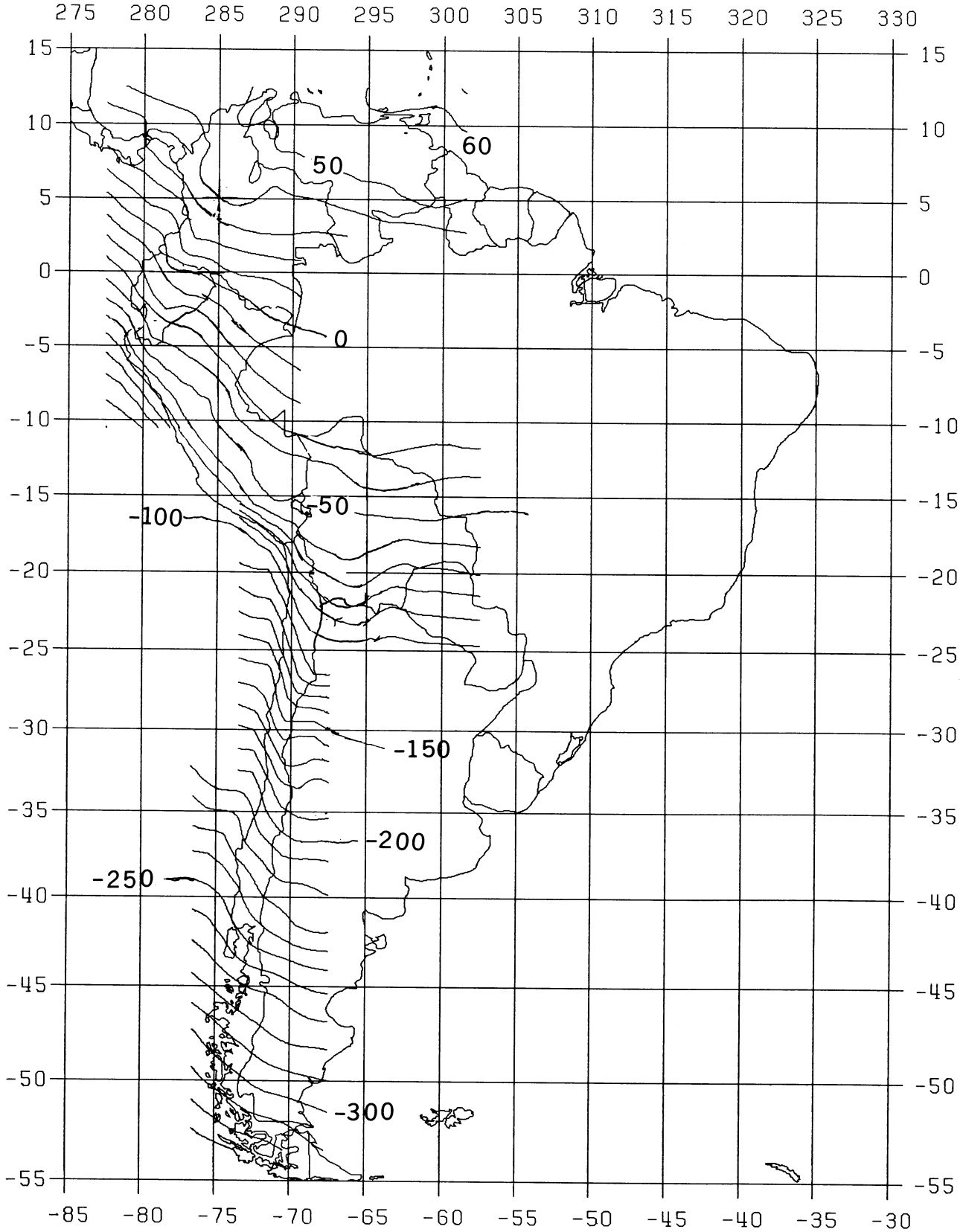

Figure 18.31. DMA-Developed Provisional South American Datum 1956 Geoid (Referenced to International Ellipsoid; Units = Meters)

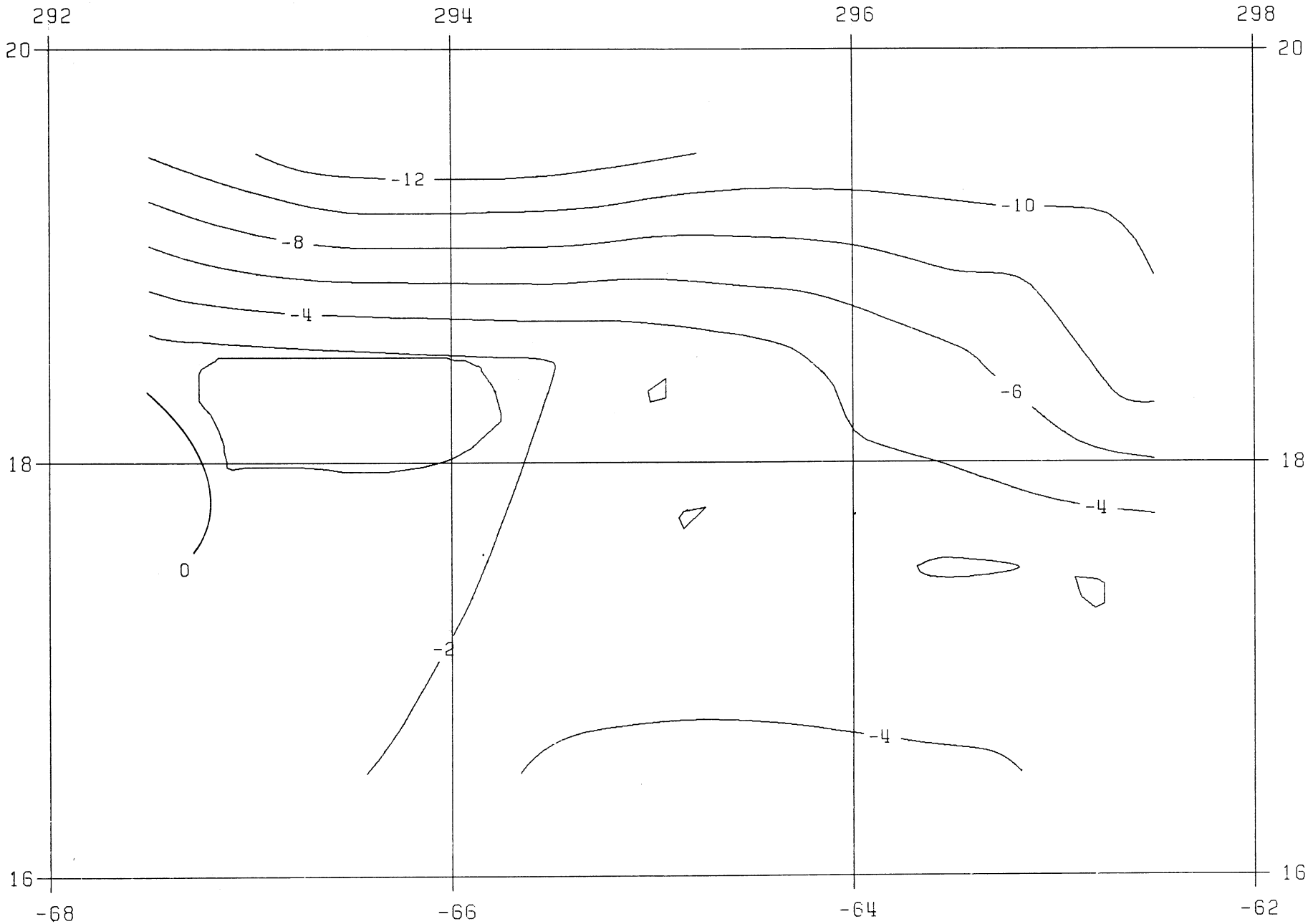

Figure 18.32. DMA-Developed Puerto Rico Datum Geoid (Referenced to Clarke 1866 Ellipsoid; Units = Meters)

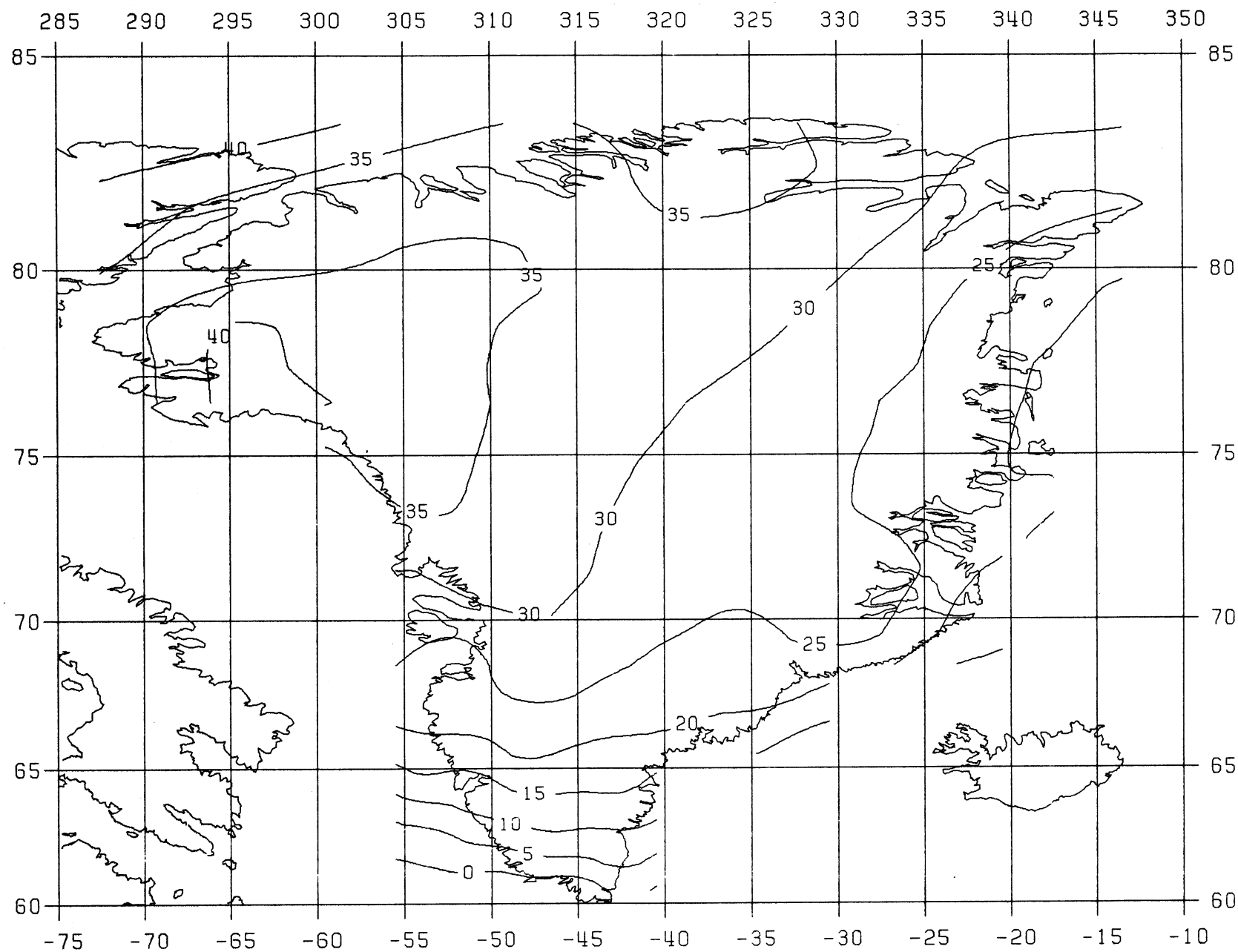

Figure 18.33. DMA-Developed Qornoq Datum Geoid (Referenced to International Ellipsoid; Units = Meters)

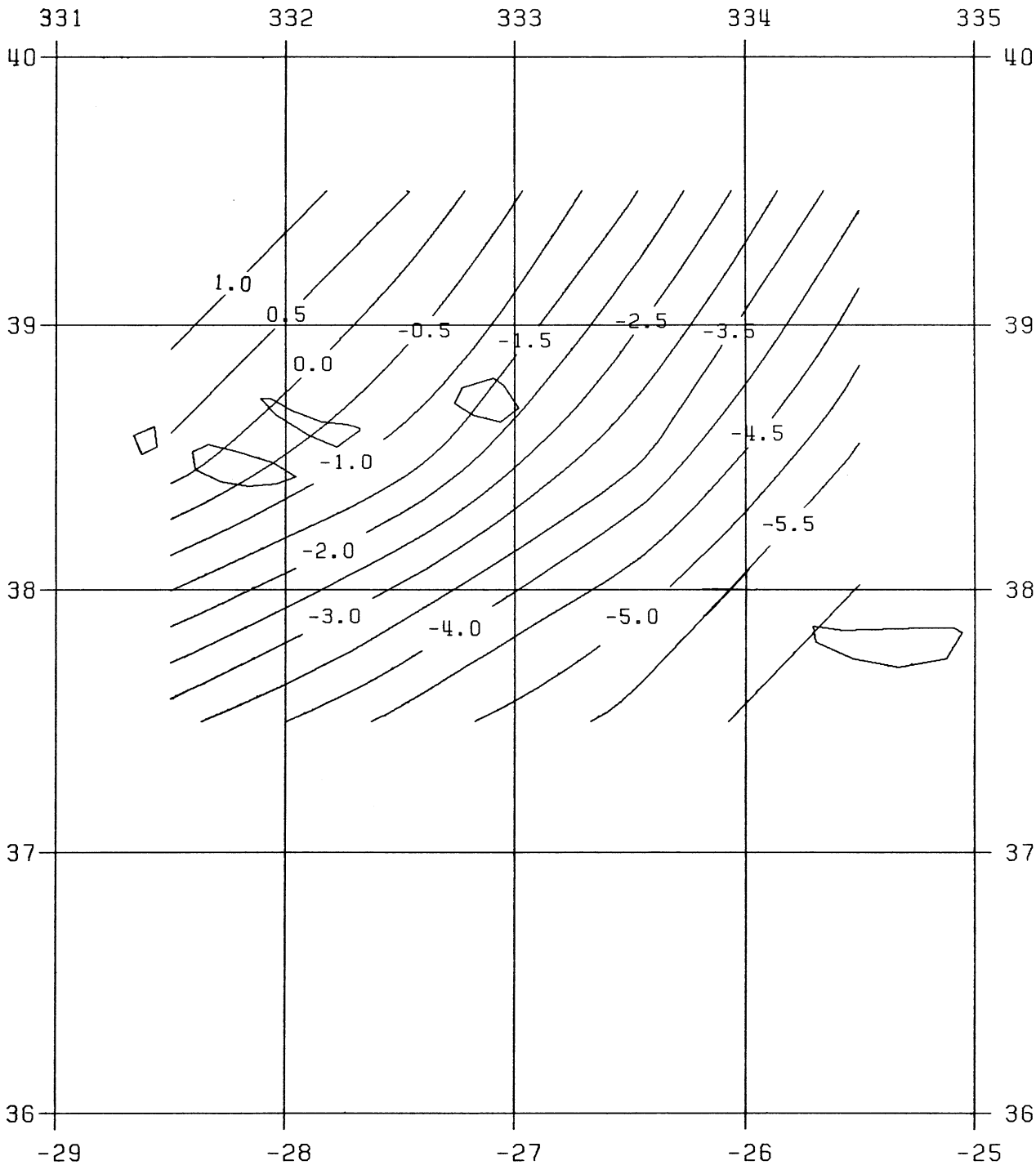

Figure 18.34. DMA-Developed Southwest Base Datum Geoid (Referenced to International Ellipsoid; Units = Meters)

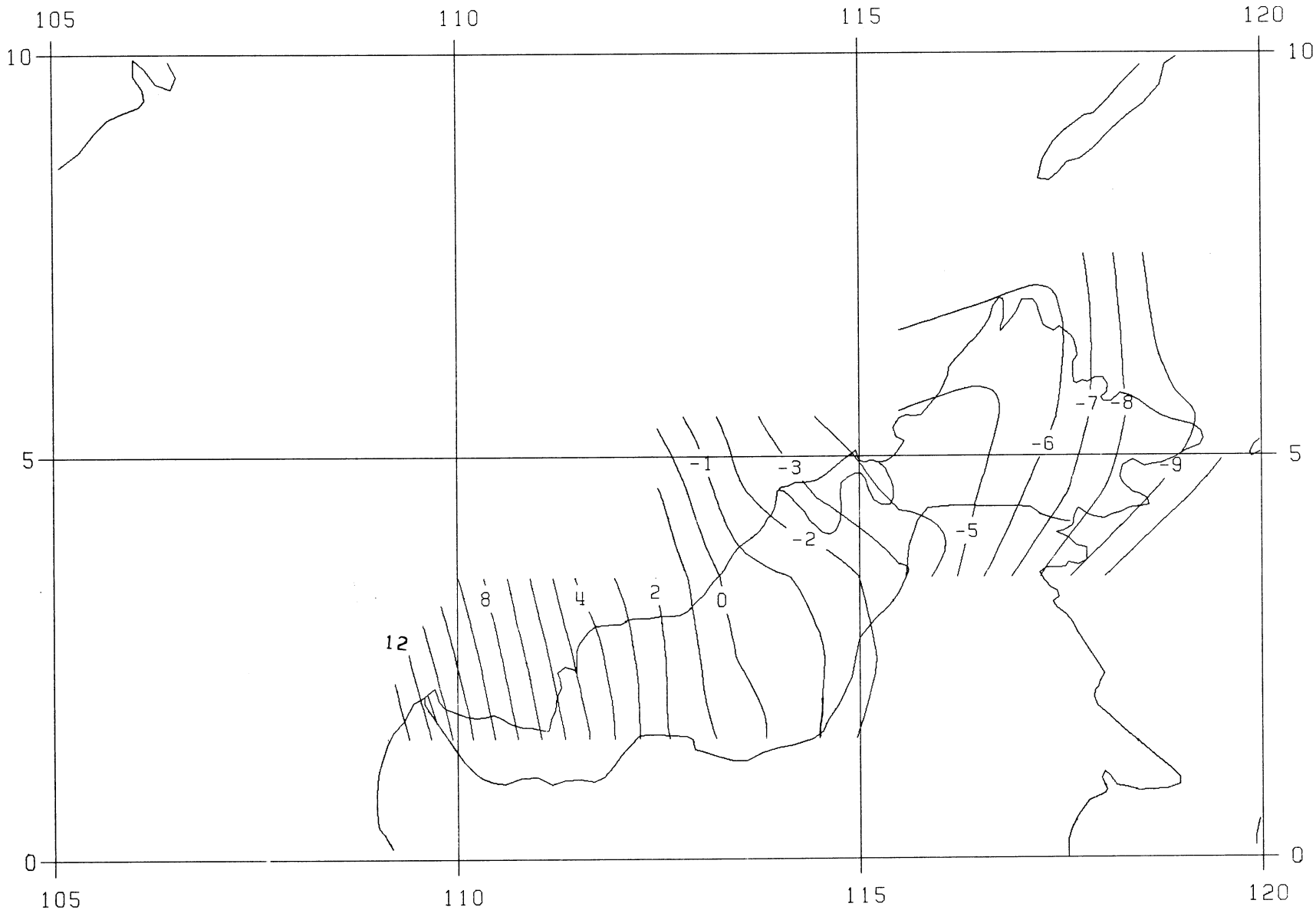

Figure 18.35. DMA-Developed Timbalai Datum 1948 Geoid (Referenced to Everest Ellipsoid; Units = Meters)

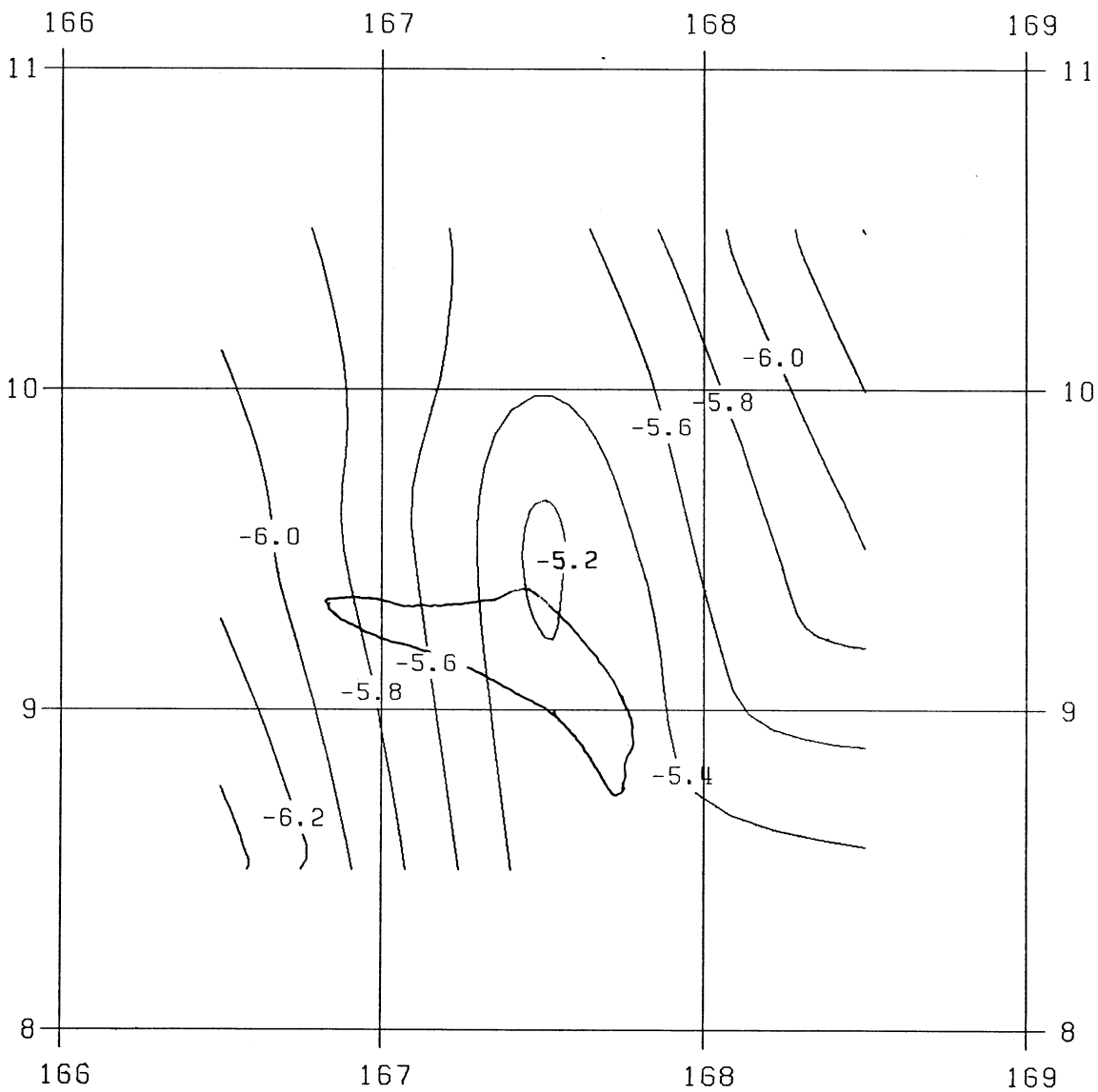

Figure 18.36. DMA-Developed Wake-Eniwetok Datum 1960 Geoid (Referenced to Hough Ellipsoid; Units = Meters)

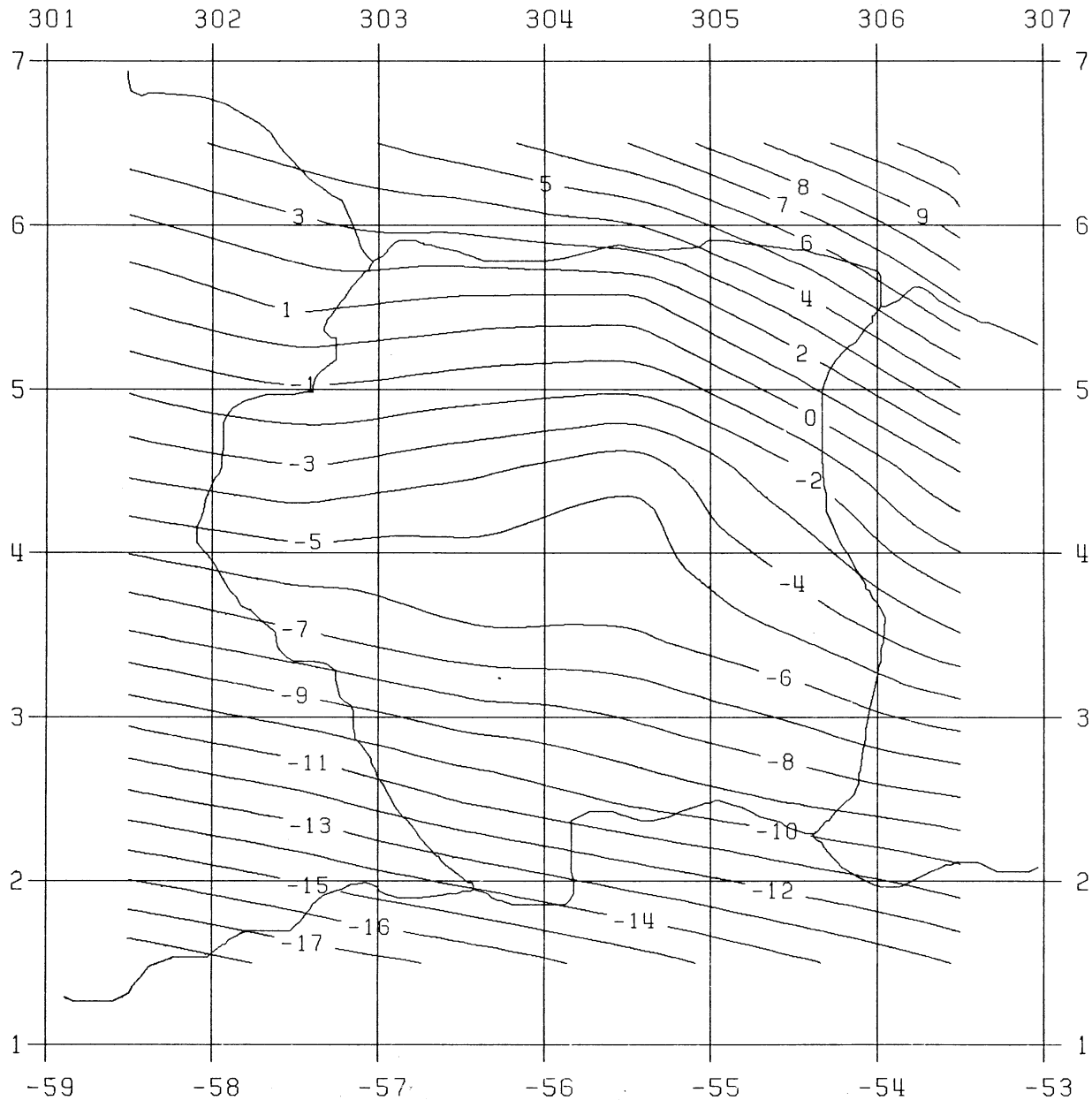

Figure 18.37. DMA-Developed Zanderij Datum Geoid (Referenced to International Ellipsoid; Units = Meters)

SECTION 19

LOCAL GEODETIC SYSTEM-TO-WGS 84

DATUM TRANSFORMATION MULTIPLE REGRESSION EQUATIONS ($\Delta\phi$, $\Delta\lambda$, ΔH)

FOR MAJOR DATUMS *

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* THE $\Delta\phi$, $\Delta\lambda$, ΔH VALUES MAY BE USED IN THE FORMULAS:

$$\phi_{WGS\ 84} = \phi_{LGS} + \Delta\phi$$

$$\lambda_{WGS\ 84} = \lambda_{LGS} + \Delta\lambda$$

$$H_{WGS\ 84} = H_{LGS} + \Delta H$$

ϕ, λ, H = GEODETIC LATITUDE, LONGITUDE, HEIGHT
LGS = LOCAL GEODETIC SYSTEM

NAD 83-TO-WGS 84 DATUM TRANSFORMATION MULTIPLE REGRESSION EQUATIONS WERE NOT DEVELOPED DUE TO THE GOOD AGREEMENT BETWEEN NAD 83 and WGS 84. ALSO, SEE TABLE 7.1.

Table 19.1

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- North American Datum 1927 (NAD 27)* to WGS 84 -

$$\Delta\phi'' = 0.16984 - 0.76173\,U + 0.09585\,V + 1.09919\,U^2 - 4.57801\,U^3 - 1.13239\,U^2V + 0.49831\,V^3 - 0.98399\,U^3V + 0.12415\,UV^3 + 0.11450\,V^4 + 27.05396\,U^5 + 2.03449\,U^4V + 0.73357\,U^2V^3 - 0.37548\,V^5 - 0.14197\,V^6 - 59.96555\,U^7 + 0.07439\,V^7 - 4.76082\,U^8 + 0.03385\,V^8 + 49.04320\,U^9 - 1.30575\,U^6V^3 - 0.07653\,U^3V^9 + 0.08646\,U^4V^9$$

$$\Delta\lambda'' = -0.88437 + 2.05061\,V + 0.26361\,U^2 - 0.76804\,UV + 0.13374\,V^2 - 1.31974\,U^3 - 0.52162\,U^2V - 1.05853\,UV^2 - 0.49211\,U^2V^2 + 2.17204\,UV^3 - 0.06004\,V^4 + 0.30139\,U^4V + 1.88585\,UV^4 - 0.81162\,UV^5 - 0.05183\,V^6 - 0.96723\,UV^6 - 0.12948\,U^3V^5 + 3.41827\,U^9 - 0.44507\,U^8V + 0.18882\,UV^8 - 0.01444\,V^9 + 0.04794\,UV^9 - 0.59013\,U^9V^3$$

$$\Delta H_m = -36.526 + 3.900\,U - 4.723\,V - 21.553\,U^2 + 7.294\,UV + 8.886\,V^2 - 8.440\,U^2V - 2.930\,UV^2 + 56.937\,U^4 - 58.756\,U^3V - 4.061\,V^4 + 4.447\,U^4V + 4.903\,U^2V^3 - 55.873\,U^6 + 212.005\,U^5V + 3.081\,V^6 - 254.511\,U^7V - 0.756\,V^8 + 30.654\,U^8V - 0.122\,UV^9$$

* Contiguous United States (CONUS)

Table 19.1 (Cont'd)

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- North American Datum 1927 (NAD 27)* to WGS 84 -

In the preceding equations:

$$U = K (\phi - 37)$$

$$V = K (\lambda - 265)$$

$$K = 0.05235988$$

ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)

λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 447, 425, and 428 comparison points to the following root-mean-square (RMS) differences, respectively:

ϕ: ±1.3 m; λ: ±1.3 m; H (geodetic height): ±1.2 m

Test Case:

Input data for NAD 27 test point:	ϕ = 34°47'08.833"N	$\Delta\phi$ = 0.356"
	λ = 273°25'07.825"E	$\Delta\lambda$ = 0.080"
		ΔH = -38.06 m

*Contiguous United States (CONUS)

Table 19.2

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- South American Datum 1969 (SAD 69) to WGS 84 -

$$
\begin{aligned}
\Delta\phi'' = \; & -1.67504 - 0.05209\,U + 0.25158\,V + 1.10149\,U^2 + 0.24913\,UV - 1.00937\,U^2V - 0.74977\,V^3 \\
& - 1.54090\,U^4 + 0.14474\,V^4 + 0.47866\,U^5 + 0.36278\,U^3V^2 - 1.29942\,UV^4 + 0.30410\,V^5 \\
& + 0.87669\,U^6 - 0.27950\,U^5V - 0.46367\,U^7 + 4.31466\,U^4V^3 + 2.09523\,U^2V^5 + 0.85556\,UV^6 \\
& - 0.17897\,U^8 - 0.57205\,UV^7 + 0.12327\,U^9 - 0.85033\,U^6V^3 - 4.86177\,U^4V^5 + 0.06085\,U^9V \\
& - 0.21518\,U^3V^8 + 0.31053\,U^5V^7 - 0.09228\,U^8V^5 - 0.22996\,U^9V^5 + 0.58774\,U^6V^9 \\
& + 0.87562\,U^9V^7 + 0.39001\,U^8V^9 - 0.81697\,U^9V^9
\end{aligned}
$$

$$
\begin{aligned}
\Delta\lambda'' = \; & -1.77967 + 0.40405\,U + 0.50268\,V - 0.05387\,U^2 - 0.12837\,UV - 0.54687\,U^2V \\
& - 0.17056\,V^3 - 0.14400\,U^3V + 0.11351\,U^5V - 0.62692\,U^3V^3 - 0.01750\,U^8 + 1.18616\,U^3V^5 \\
& + 0.01305\,U^9 + 1.01360\,U^7V^3 - 0.29059\,U^8V^3 + 5.12370\,U^6V^5 - 5.09561\,U^7V^5 - 5.27168\,U^6V^7 \\
& + 4.04265\,U^7V^7 - 1.62710\,U^8V^7 + 1.68899\,U^9V^7 + 2.07213\,U^8V^9 - 1.76074\,U^9V^9
\end{aligned}
$$

$$
\begin{aligned}
\Delta H_m = \; & 9.570 - 6.834\,U - 30.016\,V - 4.015\,U^2 - 20.812\,UV - 21.963\,U^3 + 16.430\,U^2V + 18.938\,UV^2 \\
& + 64.770\,V^3 + 54.885\,U^3V - 42.988\,UV^3 + 16.338\,U^5 - 15.557\,U^4V - 20.455\,U^2V^3 - 27.201\,UV^4 \\
& - 83.152\,V^5 + 0.520\,U^6 - 40.493\,U^5V + 101.490\,UV^5 - 3.423\,U^7 + 32.506\,V^7 + 20.338\,U^7V \\
& - 42.081\,UV^7 + 1.670\,U^8V + 23.697\,U^3V^6 + 17.596\,U^2V^7 - 4.342\,U^9V - 42.782\,U^3V^7 \\
& + 5.778\,U^6V^5 - 1.734\,U^8V^4 - 6.902\,U^5V^8 + 16.305\,U^5V^9 - 4.599\,U^8V^7
\end{aligned}
$$

Table 19.2 (Cont'd)

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- South American Datum 1969 (SAD 69) to WGS 84 -

In the preceding equations:

$$U = K (\phi + 20)$$

$$V = K (\lambda - 300)$$

$$K = 0.05235988$$

ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)

λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 133, 134, and 132 comparison points to the following root-mean-square (RMS) differences, respectively:

ϕ: ±1.4 m; λ: ±1.5 m; H (geodetic height): ±1.8 m.

Test Case:

Input data for SAD 69 test point:	ϕ = -31°56'33.954"S	$\Delta\phi$ = -1.356"
	λ = 294°53'41.342"E	$\Delta\lambda$ = -2.158"
		ΔH = 20.27 m

Table 19.3

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- European Datum 1950 (ED 50)* to WGS 84 -

$$\Delta\phi'' = -2.65261 + 2.06392\,U + 0.77921\,V + 0.26743\,U^2 + 0.10706\,UV + 0.76407\,U^3 - 0.95430\,U^2V + 0.17197\,U^4 + 1.04974\,U^4V - 0.22899\,U^5V^2 - 0.05401\,V^8 - 0.78909\,U^9 - 0.10572\,U^2V^7 + 0.05283\,UV^9 + 0.02445\,U^3V^9$$

$$\Delta\lambda'' = -4.13447 - 1.50572\,U + 1.94075\,V - 1.37600\,U^2 + 1.98425\,UV + 0.30068\,V^2 - 2.31939\,U^3 - 1.70401\,U^4 - 5.48711\,UV^3 + 7.41956\,U^5 - 1.61351\,U^2V^3 + 5.92923\,UV^4 - 1.97974\,V^5 + 1.57701\,U^6 - 6.52522\,U^3V^3 + 16.85976\,U^2V^4 - 1.79701\,UV^5 - 3.08344\,U^7 - 14.32516\,U^6V + 4.49096\,U^4V^4 + 9.98750\,U^8V + 7.80215\,U^7V^2 - 2.26917\,U^2V^7 + 0.16438\,V^9 - 17.45428\,U^4V^6 - 8.25844\,U^9V^2 + 5.28734\,U^8V^3 + 8.87141\,U^5V^7 - 3.48015\,U^9V^4 + 0.71041\,U^4V^9$$

$$\Delta H_m = 36.393 - 28.239\,U - 16.575\,V + 12.889\,U^2 + 9.678\,UV + 2.497\,V^2 + 6.850\,U^3 - 5.219\,U^4 - 2.765\,UV^4 + 7.029\,U^2V^5 - 5.205\,U^6V^2 - 0.938\,UV^9$$

---

* Western Europe Only

Table 19.3 (Cont'd)

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- European Datum 1950 (ED 50)* to WGS 84 -

In the preceding equations:

$$U = K (\phi - 52)$$

$$V = K (\lambda - 10)$$

$$K = 0.05235988$$

ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)

λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 180° and negative west from 0° to -180°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 103, 106, and 110 comparison points to the following root-mean-square (RMS) differences, respectively:

ϕ: ±1.1 m; λ: ±1.0 m; H (geodetic height): ±1.4 m.

Test Case:

Input data for ED 50 test point:	ϕ = 46°41'42.893"N	$\Delta\phi$ = -3.081"
	λ = 13°54'54.088"E	$\Delta\lambda$ = -3.486"
		ΔH = 41.21 m

* Western Europe Only

[Revised: 30 September 1988]

Table 19.4

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- European Datum 1950 (ED 50)* to WGS 84 -

$$\Delta\phi'' = -2.85283 + 1.03873\,U + 0.37255\,V + 0.37918\,U^2 - 0.08366\,V^2 + 2.79510\,U^2V^2 + 3.95456\,U^4V + 3.25139\,U^2V^3 - 2.24817\,U^2V^9$$

$$\Delta\lambda'' = -5.27853 - 1.18834\,U + 0.74334\,V - 0.73180\,U^2 - 0.79053\,U^2V - 0.17149\,V^9 + 95.11569\,U^8V^2 - 15.47503\,U^4V^6$$

$$\Delta H_m = 45.252 - 9.464\,U - 7.532\,V - 4.551\,U^2 + 13.000\,UV + 6.317\,U^2V + 65.157\,U^3V^2$$

In the preceding equations:

$U = K\,(\phi - 54)$
$V = K\,(\lambda - 0)$
$K = 0.10471975$
ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)
λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 180° and negative west from 0° to -180°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 67, 68, and 68 comparison points to the following root-mean-square (RMS) differences, respectively:

ϕ: ±0.7 m; λ: ±1.0 m; H (geodetic height): ±1.0 m.

Test Case:

Input data for ED 50 test point:

ϕ = 49°42'40.562"N $\Delta\phi$ = -3.348"

λ = 357°48'11.987"E $\Delta\lambda$ = -5.019"

ΔH = 51.05 m

* United Kingdom (UK)/Ireland; ED 50 coordinates developed from OSGB Scientific Network 1980 (SN 80) coordinates

[Revised: 30 September 1988]

Table 19.5

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- European Datum 1950 (ED 50)* to WGS 84 -

$$\Delta\phi'' = -2.85015 + 0.92725\,U + 0.28642\,V - 7.65303\,U^3V - 7.96754\,U^3V^2 + 1.74155\,U^6 + 14.59802\,U^5V + 2.56074\,U^2V^5 - 638.59010\,U^8V^7$$

$$\Delta\lambda'' = -5.27005 - 1.18558\,U + 0.85411\,V - 0.85857\,U^2 - 1.86437\,U^2V + 43.65251\,U^4V^5 - 2.52387\,V^9 + 92.91554\,U^8V^2$$

$$\Delta H_m = 45.473 - 9.046\,U - 4.695\,V - 7.034\,U^2 + 13.533\,UV - 13.235\,U^2V + 52.433\,U^3V^2$$

In the preceding equations:

$U = K\,(\phi - 54)$
$V = K\,(\lambda - 0)$
$K = 0.10471975$
ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)
λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 180° and negative west from 0° to -180°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 56, 57, and 57 comparison points to the following root-mean-square (RMS) differences, respectively:

ϕ: ±0.8 m; λ: ±1.0 m; H (geodetic height): ±1.0 m.

Test Case:

Input data for ED 50 test point:

ϕ = 49°42'40.562"N $\Delta\phi$ = -3.378"
λ = 357°48'11.987"E $\Delta\lambda$ = -5.014"
ΔH = 50.96 m

* United Kingdom (UK) Only; ED 50 coordinates developed from OSGB Scientific Network 1980 (SN 80) coordinates. The equations in Table 19.4 are recommended for all transformations for United Kingdom (UK)/Ireland.

[Revised: 30 September 1988

Table 19.6

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- Tokyo Datum (TD) to WGS 84 -

$$\Delta\phi'' = 11.42838 + 0.38110\,U + 0.66055\,V - 2.85156\,U^2 - 7.90920\,U^3 + 2.66055\,U^2V - 1.44720\,UV^2 - 0.55880\,V^3 + 17.02465\,U^4 - 13.83455\,U^3V + 2.24425\,UV^3 + 4.26478\,U^5 + 10.19286\,U^4V - 12.27058\,U^3V^2 + 1.72169UV^4 - 10.70332\,U^6 + 9.42547\,U^4V^2 - 0.04957\,U^3V^3 - 1.63710\,U^7 - 3.31782\,U^4V^3 + 5.58416\,U^3V^4 + 2.17642\,U^8 - 3.44749\,U^4V^4 - 0.18249\,V^8 - 0.40958\,U^2V^7 - 0.08997\,V^9 + 0.75251\,U^3V^7 - 0.14797\,U^2V^8 - 0.00866\,U^9V^5$$

$$\Delta\lambda'' = -9.41485 - 4.14394\,V - 0.20672\,UV - 1.37944\,V^2 - 1.23235\,U^3 - 0.83040\,U^2V + 5.62308\,V^3 + 1.80683\,V^4 - 4.51075\,V^5 + 0.09944\,U^6 - 0.91183\,V^6 + 0.90813\,U^7 + 0.28770\,U^2V^5 + 1.48962\,V^7 + 0.16266\,V^8 - 0.27918\,U^9 - 0.16036\,V^9 - 0.03918\,U^5V^8 + 0.01027\,U^7V^8$$

$$\Delta H_m = 17.498 - 5.767\,U - 30.032\,V + 93.585\,U^2 - 23.478\,UV + 20.307\,U^2V + 11.444\,UV^2 + 12.581\,V^3 - 235.503\,U^4 + 48.615\,U^3V + 76.860\,U^5 - 2.569\,V^5 + 170.295\,U^6 - 39.287\,U^5V - 73.837\,U^7 - 11.695\,U^3V^4 - 38.249\,U^8 + 9.382\,U^7V + 18.230\,U^9 + 3.445\,U^4V^5 + 0.329\,UV^9 - 0.147\,U^3V^9$$

Table 19.6 (Cont'd)

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- Tokyo Datum (TD) to WGS 84 -

In the preceding equations:

$$U = K (\phi - 35)$$

$$V = K (\lambda - 135)$$

$$K = 0.15707963$$

ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)

λ = geodetic longitude, local geodetic system, in degrees and part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 56,55, and 58 comparison points to the following root-mean-square (RMS) differences, respectively:

ϕ: ±2.1 m; λ: ±2.3 m; H (geodetic height): ±2.8 m.

Test Case:

Input data for TD test point:

ϕ = 40°42'38.260"N $\Delta\phi$ = 9.634"

λ = 141°22'23.979"E $\Delta\lambda$ = -12.598"

ΔH = 20.99 m

Table 19.7

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- Australian Geodetic Datum 1966 (AGD 66) to WGS 84 -

$$\Delta\phi'' = 5.19238 + 0.12666\,U + 0.52309\,V - 0.42069\,U^2 - 0.39326\,UV + 0.93484\,U^2V + 0.44249\,UV^2 - 0.30074\,UV^3 + 1.00092\,U^5 - 0.07565\,V^6 - 1.42988\,U^9 - 16.06639\,U^4V^5 + 0.07428\,V^9 + 0.24256\,UV^9 + 39.27946\,U^6V^7 - 62.06403\,U^7V^8 + 89.19184\,U^9V^8$$

$$\Delta\lambda'' = 4.69250 - 0.87138\,U - 0.50104\,V + 0.12678\,UV - 0.23076\,V^2 - 0.61098\,U^2V - 0.38064\,V^3 + 2.89189\,U^6 + 5.26013\,U^2V^5 - 2.97897\,U^8 + 5.43221\,U^3V^5 - 3.40748\,U^2V^6 + 0.07772\,V^8 + 1.08514\,U^8V + 0.71516\,UV^8 + 0.20185\,V^9 + 5.18012\,U^2V^8 - 1.72907\,U^3V^8 - 1.24329\,U^2V^9$$

$$\Delta H_m = 6.953 + 54.753\,U + 38.295\,V + 15.913\,U^2 + 12.922\,UV - 2.616\,V^2 - 24.663\,U^3 - 13.250\,U^2V + 105.716\,U^3V^2 - 467.812\,U^3V^3 + 79.981\,U^7V - 1225.777\,U^4V^4 + 2184.222\,U^3V^5 + 353.713\,U^2V^6 + 1026.749\,U^4V^5 - 228.175\,U^2V^7 - 20.283\,UV^8 + 1202.073\,U^4V^6 - 3578.264\,U^3V^7 - 513.229\,U^2V^8 - 12.141\,UV^9 - 1407.128\,U^5V^6 + 522.507\,U^8V^4 + 1519.599\,U^3V^9 - 6318.177\,U^6V^9$$

Table 19.7 (Cont'd)

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- Australian Geodetic Datum 1966 (AGD 66) to WGS 84 -

In the preceding equations:

$$U = K (\phi + 27)$$

$$V = K (\lambda - 134)$$

$$K = 0.05235988$$

ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)

λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 133, 135, and 127 comparison points to the following root-mean-square (RMS) differences, respectively:

ϕ: ±1.2 m; λ: ±1.3 m; H (geodetic height): ±1.1 m.

Test Case:

Input data for AGD 66 test point:

ϕ = -17°00'32.776"S $\Delta\phi$ = 5.480"

λ = 144°11'37.245"E $\Delta\lambda$ = 3.922"

ΔH = 57.28 m

Table 19.8

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- Australian Geodetic Datum 1984 (AGD 84) to WGS 84 -

$$\Delta\phi'' = 5.20604 + 0.25225\ U + 0.58528\ V - 0.41584\ U^2 - 0.38620\ UV - 0.06820\ V^2 + 0.38699\ U^2V + 0.07934\ UV^2 + 0.37714\ U^4 - 0.52913\ U^4V + 0.38095\ V^7 + 0.68776\ U^2V^6 - 0.03785\ V^8 - 0.17891\ U^9 - 4.84581\ U^2V^7 - 0.35777\ V^9 + 4.23859\ U^2V^9$$

$$\Delta\lambda'' = 4.67877 - 0.73036\ U - 0.57942\ V + 0.28840\ U^2 + 0.10194\ U^3 - 0.27814\ UV^2 - 0.13598\ V^3 + 0.34670\ UV^3 - 0.46107\ V^4 + 1.29432\ U^2V^3 + 0.17996\ UV^4 - 1.13008\ U^2V^5 - 0.46832\ U^8 + 0.30676\ V^8 + 0.31948\ U^9 + 0.16735\ V^9 - 1.19443\ U^3V^9$$

$$\Delta H_m = 7.083 + 55.757\ U + 36.306\ V + 21.288\ U^2 + 15.111\ UV - 3.814\ V^2 - 34.056\ U^3 + 3.325\ V^3 - 18.113\ U^2V^2 + 54.055\ U^3V^2 - 201.077\ U^6V - 34.759\ U^2V^5 - 30.667\ UV^6 - 167.018\ U^6V^2 + 333.184\ U^8V + 20.740\ UV^8 - 3.650\ V^9 - 662.590\ U^3V^7 + 546.536\ U^3V^9$$

Table 19.8 (Cont'd)

Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations ($\Delta\phi$, $\Delta\lambda$, ΔH)
- Australian Geodetic Datum 1984 (AGD 84) to WGS 84 -

In the preceding equations:

$$U = K (\phi + 27)$$

$$V = K (\lambda - 134)$$

$$K = 0.05235988$$

ϕ = geodetic latitude, local geodetic system, in degrees and decimal part of a degree; positive north (0° to 90°), negative south (0° to -90°)

λ = geodetic longitude, local geodetic system, in degrees and decimal part of a degree; positive east from 0° to 360°

The preceding equations reproduced Doppler-derived WGS 84 geodetic coordinates at 112, 112, and 111 comparison points to the following root-mean-square (RMS) differences, respectively:

ϕ: ±1.0 m; λ: ±1.0 m; H (geodetic height): ±1.5 m

Test Case:

Input data for AGD 84 test point:

ϕ = -20°38'00.673"S $\Delta\phi$ = 5.505"

λ = 144°24'29.288"E $\Delta\lambda$ = 4.109"

ΔH = 47.84 m

Table 19.9

RMS Differences Between "True" WGS 84 Coordinates
and WGS 84 Coordinates Computed Using Local Geodetic System-to-WGS 84
Datum Transformation Multiple Regression Equations

Local Geodetic System	- RMS Differences - "True" Minus Computed Coordinates			Comparison Points (Average Number)
	$\Delta\phi$	$\Delta\lambda$	ΔH	
NAD 27*	±1.3 m	±1.3 m	±1.2 m	433
SAD 69	1.4	1.5	1.8	133
ED 50 (Western Europe)**	1.1	1.0	1.4	106
ED 50 (UK/Ireland)***	0.7	1.0	1.0	68
ED 50 (UK Only)***	0.8	1.0	1.0	57
TD	2.1	2.3	2.8	56
AGD 66	1.2	1.3	1.1	132
AGD 84	1.0	1.0	1.5	112

* Contiguous United States (CONUS)

** Austria, Belgium, Denmark, Finland, France, FRG (Federal Republic of Germany), Gibraltar, Greece, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, and Switzerland

*** European Datum 1950 coordinates developed from OSGB Scientific Network 1980 (SN 80) coordinates

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