MAP SHOWING THE RELATIONSHIP OF SELECTED MAFIC AND ULTRAMAFIC BODIES IN THE CRUST OF THE EASTERN UNITED STATES TO SEISMICALLY ACTIVE AREAS

By Lucy McCartan, Stephen L. Snyder, and Carl W. Stover

INTRODUCTION

The purpose of this map is to show the location of selected spatially associated positive magnetic and gravity anomalies in the eastern United States, and the spatial relationship of these anomalies, which we infer to represent mafic and ultramafic bodies, to seismically active areas. The geophysical anomalies are present in all physiographic provinces except the Valley and Ridge Province (fig. 1), and earthquake epicenters are present in all provinces, but there are few places where the anomalies are within 10 km of the epicenters of earthquakes with body wave magnitudes larger than 5.5. More major earthquakes are within 10 km of the centers of positive anomalies than are clusters of smaller earthquakes. Other major earthquakes occur at the edges of the plutonic complexes that contain the mafic bodies, and these complexes may be as large as several tens of kilometers in diameter.

This map is one product of a study of the possible causal relationship between incompletely cooled mafic (includes ultramafic) plutons and major historic earthquakes in the eastern United States. The hypothesis was suggested by McCartan and Gettings (1991) to explain major earthquakes such as the one in Charleston, S.C. in 1886, for which no large fault has been found. The concept is outlined at the end of this text, and the theoretical basis for the idea, which is a modification of Kane's (1977) hole-in-the-plate concept, is presented by Gettings (1988).

MAFIC BODIES

The map shows the location of 348 discrete shallow mafic and ultramafic bodies inferred from coincident magnetic and gravity anomalies in the eastern United States. A minimum magnetic anomaly diameter of 10 km was chosen because it spans an area that can easily be seen on the 1:2,500,000-scale map but is small enough to discriminate a large number of mafic bodies. Also, only plutons larger than 10 km in diameter could be related to major earthquakes (McCartan and Gettings, 1991). Most of the mafic bodies were located by visually identifying the center of the local maximum closed contour on the magnetic anomaly map that coincides with or is near an anomaly on the gravity anomaly map (Bouguer on land, free-air over water), registered to the magnetic anomaly map. A 10-kilometer (at 1:2,500,000 scale) circular template was placed over the closed contours on the magnetic map to estimate the size of smaller coinciding anomalies. The two geophysical maps were plotted from digital tapes (Godson and Scheibe, 1982; Godson, 1986). Index numbers assigned to the mafic bodies, latitude, longitude, state, county, physiographic province, and proximity to seismically active areas are given in table 1.

The magnetic anomaly map was used as the main location reference because it is more detailed. Because the magnetic anomalies on the map have not been reduced to the magnetic pole, many are slightly offset from their true geographic localities; for many mafic bodies, the gravity anomaly may be a better geographic reference point (figs. 2*A*, 3*A*, and 4*A*). Geomagnetic latitude is the main cause of the offset in magnetic anomalies. Remanent magnetization may also be an important factor in offset of some of the mafic bodies. An approximation of the true geographic location of the point on the earth's surface which is above the center of such a mafic body can be made by reducing the associated magnetic anomaly to the north magnetic pole. This has been done for three areas in the southeastern United States: the New Madrid, Mo., area (fig. 2*B*), parts of South Carolina and Georgia (fig. 3*B*), and east Texas and western Mississippi (fig. 4*B*). The magnetic pole calculations were based on the 1985 declination and inclination at the center of each area (Peddie and Zunde, 1988a,b). In each area, the center of the magnetic anomalies moved northward and changes in the shapes of contours appeared (compare figs. 2*B*, 3*B*, and 4*B* with 2*A*, 3*A*, and 4*A*).

The associated gravity anomalies, which are not affected by the magnetic anomaly shift, can be used as reference points on both sets of figures. The original offsets between gravity and magnetic anomalies and the offsets after reduction to the magnetic pole, are given in table 2. Improvement of fit between the anomalies occurred in eight of the nine cases considered. Although improvement of the magnetic anomaly localities in the three sample areas does not put them in more seismically active categories status, some of the other localities on the map would probably change.

Not all magnetic anomalies have been identified by the process described above. The magnetic and gravity data sets are an amalgamation of data collected over many years at different intervals by several organizations using different types and grades of equipment. Digitization of the original signals was also accomplished in several ways. Some mafic bodies were probably missed in areas with relatively poor original or digital data. Additional mafic bodies can also be inferred by slightly different interpretation of the existing data.

For example, detailed geophysical data for the areas near Charleston, S.C. (J.D. Phillips, U.S. Geological Survey, written commun., 1985) and New Madrid, Mo. (Braile and others, 1982; Hildenbrand and others, 1982) reveal several mafic bodies other than those shown here. Even without more detailed geophysical data, additional mafic bodies can be inferred in the Charleston area from the deflection of magnetic contours over gravity highs (fig. 3*B*). In the New Madrid area, the delineation of other mafic bodies at 1:2,500,000 scale requires the use of a lower local magnetic datum than used here (fig. 4*B*) or a smaller contour interval. Still other bodies may be present but are undetectable in areas of thin crust, where small anomalies would be hidden in the characteristically large positive gravity anomalies of regional extent, or beneath thick sedimentary cover, which is typically indicated by broad, negative gravity and magnetic anomalies. Thick sedimentary sequences are present in several offshore basins on the

Atlantic continental margin and under much of the Gulf Coastal Plain.

Several Proterozoic and Paleozoic plutonic complexes in the Appalachian orogen have been geologically and isotopically dated (Sinha and Zietz, 1982; Sinha, 1988). Some of the complexes contain both gabbroic and granitoid rocks and were emplaced during more than one orogenic period (Sinha, 1988). The ages of such complexes determined on outcrop samples should be considered maximum ages; younger intrusives may be present in deeper parts of the complexes. At least one multiphase, postorogenic igneous complex is present in the Appalachian orogen (Gray and Gottfried, 1986). At that locality in Highland County, Va., both Cretaceous and Tertiary igneous activity have been noted (Fullagar and Bottino, 1969; Gray and Gottfried, 1986).

We speculate that other multiphase plutonic complexes in the eastern United States outside the Appalachian orogen contain some postorogenic igneous bodies despite significant regional compression for the last 100 m.y. (Zoback and Zoback, 1980; Mixon and Newell, 1977; McCartan, 1989). High heat flow and Tertiary uplift in the vicinity of some of the inferred mafic bodies suggest Tertiary intrusion of mafic magma in the crust beneath the Charleston and New Madrid areas (McCartan and Gettings, 1985). Only incompletely cooled mafic plutons are hypothesized to have caused historic earthquakes (McCartan and Gettings, 1991).

SEISMICITY

The most widely felt earthquakes in U.S. history occurred in 1811–1812 at New Madrid, Mo., and in 1886 at Charleston, S.C. Because many small earthquakes have also occurred in the two areas, as well as in the vicinity of other major eastern U.S. earthquakes, we infer that clusters of small earthquakes may reflect conditions favorable to the occurrence of larger earthquakes in some places.

On the map, epicenters of medium body-wave magnitudes (5.5–6.4 m_b) and large ($\geq$6.4 m_b) earthquakes are shown by black triangles and squares, respectively; clusters of two or more epicenters of small earthquakes ($\leq$5.5 m_b), where adjacent events are within 10 km, are outlined in black. Hundreds of other small earthquake epicenters that are more isolated are not shown on the map. For purposes of this discussion, a seismic area is defined as being within 10 km of a major (medium or large) earthquake epicenter, or a cluster of small earthquake epicenters. All other areas could be described as aseismic, but mafic bodies within 10 km of single epicenters of small earthquakes are noted on table 1. All instrumentally recorded earthquakes were included in the original data base, along with selected major felt earthquakes for which intensity data were reclassified into the three body-wave-magnitude categories. Seismicity that may have been induced by reservoir filling or deep well injection is noted on the map.

One of the questions raised in this study is whether or not historic earthquakes occur in the same areas and with the same range of magnitudes as previous earthquakes. If they do, then the causes of major earthquakes can be sought in relatively small areas, and the geologic circumstances can be inferred to be special rather than general. If evidence suggests that large, prehistoric earthquakes occurred in areas other than those known already, then more general circumstances must be invoked to explain the cause of major earthquakes in the eastern U.S., and larger areas must be considered at risk.

The catalog of historical seismicity covers about 350 years in the eastern U.S. The inclusion of reliable geologic evidence of earthquakes, such as liquefaction features (particularly sand blows), permits extension of the catalog to about 200,000 years. Detailed surveys of such features in the midcontinent and the southeast have shown that large sand blows, which record large earthquakes, have been found in the New Madrid and Charleston areas (Obermeier, 1984, Obermeier and others, 1985). The surveys, conducted over thousands of square kilometers, show decreasing sand blow size and frequency away from the major earthquake epicenters. Sand blows associated with major historic earthquakes in New England have also been reported (Tuttle and Seeber, 1989).

Dating of peat and humate layers disrupted in Charleston area sand blows by ^{14}C suggests that a major earthquake has occurred there about every 2,400 years (Obermeier and others, 1987). Datable materials have not been found near New Madrid, but a prehistoric date on a sand blow within one of the historic meizoseismal sites in Massachusetts implies multiple major events there. Considering the abundance of large sand blows near New Madrid and Charleston and their decreasing size and frequency away from these two major seismic centers, we conclude that large, late Quaternary earthquakes did not occur within the two regions outside of the meizoseismal zones. Sand blows have not been reported from some of the large earthquake centers in the eastern United States (see Kane, 1977, for localities of largest earthquakes), but the unconsolidated materials necessary for sand blow formation are not abundant everywhere. On the other hand, although most of the lower parts of the Atlantic and Gulf Coastal Plains are covered by unconsolidated sand, only one occurrence of multiple large sand blows has been reported outside the Charleston and New Madrid areas (Obermeier and others, 1989, 1991). Based on the present somewhat incomplete data base, it appears that large earthquakes are generally unlikely to occur outside the major historical earthquake zones. Furthermore, there is something geologically unique about the areas that favor major earthquakes.

THE RELATIONSHIP BETWEEN MAFIC BODIES AND SEISMICITY

The association between seismicity and mafic bodies in the eastern U.S. is weak (table 1), although a close spatial relationship between major earthquakes and mafic bodies can be demonstrated (Kane, 1977). The centers of only 9 percent of the 348 mafic bodies on the map are in seismic areas (within 10 km of major earthquake epicenters or a cluster of two or more small earthquakes), and 6 percent of the 237 seismic areas on the map contain mafic bodies. Another 9 percent of the mafic bodies are within 10 km of epicenters of single small earthquakes, areas categorized as aseismic in this report. Of the 12 medium and large events shown, three (25 percent) are within 10 km of the centers of mafic bodies and nine (75 percent) are within 50 km. The other three are more than 100 km from mafic bodies. Of the six major earthquake areas in the eastern U.S. considered by Kane (1977), Charleston and New Madrid are within 10 km of mafic plutons and the seismic areas in eastern Massachusetts and northern New York are within 50 km of mafic plutons. The other two areas, shown on this map as clusters of smaller events in western New York and western Ohio, are within 10 km and 50 km of mafic bodies, respectively. Thus, the present study is in almost complete agreement with Kane's (1977) analysis.

In Charleston and New Madrid, the mafic bodies spatially associated with ongoing seismicity are also associated with relatively high heat flow; a causal relationship may exist between warm plutons and seismicity (Gettings, 1988; McCartan and Gettings, 1991). Thermal anomalies are significant because, unlike granitoid rocks, few mafic bodies have a large enough proportion of radioactive minerals to create high heat flow. If we have correctly interpreted coinciding gravity and magnetic anomalies as representing mafic bodies, those with high heat flow must be in either a partly magmatic or incompletely cooled crystalline state. In order to assess the regional association of seismicity and mafic bodies, major seismic events and clusters of smaller events were plotted on the map.

CONCLUSIONS

Several hundred discrete mafic bodies occur in the eastern United States, mainly in the upper crust. The centers of a few of these bodies are within 10 km of the epicenters of major historical earthquakes or earthquake clusters, but most earthquakes in the eastern U.S. are not spatially related to mafic bodies discernible at a scale of 1:2,500,000. Earthquakes larger than 5.5 m_b have a higher correlation to mafic bodies.

REFERENCES CITED

Braile, L.W., Hinze, W.J., Keller, G.R., and Lidiak, E.G., 1982, The northeastern extension of the New Madrid seismic zone: U.S. Geological Survey Professional Paper 1236-L, 11 p.

Fenneman, N.M., 1946, Physical divisions of the United States: Washington, D.C., U.S. Geological Survey, scale 1:17,00,000.

Fullagar, P.D., and Bottino, M.L., 1969, Tertiary felsite intrusions in the Valley and Ridge province, Virginia: Geological Society of America Bulletin, v. 80, p. 1853–1858.

Gettings, M.E., 1988, Variations of depth to the brittle-ductile transition due to cooling of a midcrustal intrusion: Geophysical Research Letters, v. 15, p. 213–216.

Godson, R.H., 1986, Magnetic tape containing conterminous U.S. magnetic data in a gridded format: U.S. Department of Commerce National Technical Information Service PB86–197423, 5 p. [documentation with tape].

Godson, R.H., and Scheibe, D.M., 1982, Magnetic tape containing conterminous U.S. free-air gravity data in a gridded format: U.S. Department of Commerce National Technical Information Service PD82–253378, 5 p. [documentation with tape].

Gray, K.J., and Gottfried, David, 1986, A geochemical study of three contrasting magma types of central Virginia emplaced at 195, 149, and 47 Ma: tectonic implications: Geological Society of America Abstracts with Programs, v. 18, p. 224.

Hildenbrand, T.G., 1983, FFTFIL; A filter program based on two-dimensional Fourier analysis: U.S. Geological Survey Open-File Report 83–237, 61 p.

Hildenbrand, T.G., Kane, M.F., and Hendricks, J.D., 1982, Magnetic basement in the upper Mississippi embayment region—a preliminary report: U.S. Geological Survey Professional Paper 1236-E, 16 p.

Kane, M.F., 1977, Correlation of major eastern earthquake centers with mafic/ultramafic basement masses: U.S. Geological Survey Professional Paper 1028-O, 6 p.

Lourenco, J.S., 1973, Analysis of three-component magnetic data: Berkeley, California, University of California Ph.D. dissertation, 153 p.

McCartan, Lucy, 1989, Atlantic Coastal Plain sedimentation and basement tectonics southeast of Washington, D.C.: 28th International Geological Congress Field Trip Guidebook T214, 25 p.

McCartan, Lucy, and Architzel, R.C., 1988, Heat flow map of the eastern United States: U.S. Geological Survey Miscellaneous Field Studies Map MF-2057, scale 1:2,500,000.

McCartan, Lucy, and Gettings, M.E., 1985, Stratigraphic and geophysical evidence for a Cenozoic intrusion near Beaufort, S.C.: Geological Society of America Abstracts with Programs, v. 17, p. 657.

———1991, Possible relationship between seismicity and warm intrusive bodies in the Charleston, South Carolina, and New Madrid, Missouri, areas: U.S. Geological Survey Bulletin 1953, 18 p.

Mixon, R.B., and Newell, W.L., 1977, Stafford fault system—Structures documenting Cretaceous and Tertiary deformation along the Fall Line in northeastern Virginia: Geology, v. 5, p. 437-440.

Nicholson, Craig, and Wesson, R.L., 1990, Earthquake hazard associated with deep well injection—A report to the U.S. Environmental Protection Agency: U.S. Geological Survey Bulletin 1951, 74 p.

Obermeier, S.F., 1984, Liquefaction potential in the central Mississippi Valley, *in* Gori, P.H., and Hays, W.W., eds, Proceedings of the Symposium on "The New Madrid Seismic Zone": U.S. Geological Survey Open-File Report 84–770, p. 391-446.

Obermeier, S.F., Gohn, G.S., Weems, R.E., Gelinas, R.L., and Rubin, Meyer, 1985, Geologic evidence for recurrent moderate to large earthquakes near Charleston, South Carolina: Science, v. 227, p. 408–411, 1985.

Obermeier, S.F., Weems, R.E., and Jacobson, R.B., 1987, Earthquake-induced liquefaction features in the coastal South Carolina region: U.S. Geological Survey Open-File Report 87–504, 13 p.

Obermeier, S.F., Weems, R.E., Jacobson, R.B., and Gohn, G.S., 1989, Liquefaction evidence for repeated Holocene earthquakes in the coastal region of South Carolina, *in* Jacob, K.H., and Turkstra, C.J., eds., Earthquake hazards and the design of contructed facilities in the eastern United States: New York Academy of Sciences Annals, v. 558, p.183–195.

Obermeier, S.F., Bleuer, N.R., Munson, C.A., Munson, P.J., Martin, W.S., McWilliams, K.M., Tabaczyuski, D.A., Odum J.K., Rubin, Meyer, and Eggert, D.L., 1991, Evidence of strong earthquake shaking in the lower Wabash Valley from prehistoric liquefaction features: Science v. 251, p. 1061–1063.

Packer, D.R., Cluff, L.S., Kneupfer, P.L., and Withers, R.J., 1980, Study of reservoir induced seismicity, final technical report, appendix A: U.S. Geological Survey Open-File Report 80-1092, 286 p.

Peddie, N.W., and Zunde, A.K., 1986a, The magnetic field in the United States, 1985—declination chart: U.S. Geological Survey Geophysical Investigation Map GP-986-D, scale 1:5,000,000.

———1988b, The magnetic field in the United States, 1985—inclination chart: U.S. Geological Survey Geophysical Investigation Map GP-986-I, scale 1:5,000,000.

Sinha, A.K., 1988, Plutonism in the U.S. Appalachians, *in* Sinha, A.K., Hewitt, D.A., Tracy, R.J., eds, Frontiers in petrology, a special volume of the American Journal of Science (v. 288-A) in memory of David R. Wones: ix-xii and 2 preceding unnumbered plates.

Sinha, A.K., and Zietz, Isidore, 1982, Geophysical and geochemical evidence for a Hercynian magmatic arc, Maryland to Georgia: Geology, v. 10, p. 593–596.

Tuttle, M.P., and Seeber, Leonardo, 1989, Earthquake-induced liquefaction in the northeastern United States: Historical effects and geological constraints, *in* Jacob, K.H., and Turkstra, C.J., eds., Earthquake hazards and the design of constructed facilities in the Eastern United States: The New York Academy of Scinces Annals, v. 558, p. 196–207.

Zoback, M.L., and Zoback, Mark, 1980, State of stress in the conterminous United States: Journal of Geophysical Research, v. 85, p. 6113–6156.

Table 1.--*Locations of geophysically identified mafic and ultramafic bodies in the eastern United States and proximity of the bodies to seismically active areas*

[Seismicity (+, present; -, not present) refers to earthquakes with magnitudes larger than 5.5 and clusters of two or more of less than 5.5 magnitude earthquakes with epicenters less than 10 km apart; distances are from the centers of the bodies to the epicenters of earthquakes larger than 5.5 magnitude or to the edge of circumscribed seismic centers. Other symbol used: *, indicates the center of a body within 10 km of the epicenter of a single earthquake with a magnitude smaller than 5.5. Physiographic provinces after McCartan and Architzel (1988): A, Adirondack Province; AP, Appalachian Plateaus; BR, Blue Ridge; CP, Coastal Plain; CL, Central Lowland; ILP, Interior Low Plateau; LU, Laurentian Upland; NE, New England; O, Ouachita; OP, Ozark Plateau; P, Piedmont; SLV, St. Lawrence Valley]

Number of mafic body	Location Latitude N	Location Longitude W	Seismicity				County	Physiographic province
326	32°51'07"	85°21'14"	+	-	-	AL	Chambers	P
335	34°37'31"	87°51'58"	-	-	-*	AL	Colbert	ILP
327	32°08'08"	87°12'01"	-	-	-	AL	Dallas	CP
333	33°47'48"	88°03'21"	-	-	-	AL	Lamar	CP
331	34°18'43"	87°21'58"	+	-	-	AL	Lawrence	AP
330	34°43'33"	87°14'15"	-	-	-	AL	Lawrence	ILP
329	34°48'53"	86°52'43"	-	-	-	AL	Limestone	ILP
328	32°01'11"	88°00'18"	+	-	-	AL	Marengo	CP
334	34°06'23"	87°57'49"	-	-	-	AL	Marion	CP
332	34°09'56"	87°23'17"	+	+	-	AL	Winston	AP
207	36°21'06"	94°26'03"	-	-	-	AR	Benton	OP
217	35°47'56"	90°42'06"	+	+	-	AR	Craighead	CP
211	34°19'19"	92°22'47"	+	-	-	AR	Grant	CP
218	36°11'33"	90°22'11"	+	+	-	AR	Greene	CP
210	34°26'23"	92°51'14"	+	+	-*	AR	Hot Spring	O
214	35°37'49"	91°27'29"	+	-	-	AR	Independence	O
213	35°27'45"	91°20'39"	+	-	-	AR	Jackson	CP
212	34°05'08"	92°07'53"	+	-	-	AR	Jefferson	CP
208	35°33'38"	93°27'20"	-	-	-	AR	Johnson	O
209	35°12'58"	92°57'26"	-	-	-	AR	Pope	O
216	36°08'36"	90°56'34"	+	+	+	AR	Randolph	CP
215	36°27'27"	91°23'16"	+	+	-	AR	Sharp	OP
19	41°48'57"	72°55'04"	+	+	+	CT	Hartford	NE
20	41°41'46"	72°59'21"	+	+	+	CT	Hartford	NE
45	39°48'06"	75°33'32"	+	+	+	DE	New Castle	P
325	29°49'42"	83°13'52"	-	-	-	FL	Lafayette	CP
322	31°10'04"	82°57'41"	-	-	-	GA	Atkinson	CP
321	31°20'34"	83°21'02"	-	-	-	GA	Berrien	CP
313	33°10'56"	82°09'33"	-	-	-	GA	Burke	CP
318	32°13'23"	84°48'01"	+	-	-	GA	Chattahoochee	CP

Table 1.--Continued.

Number of mafic body	Location Latitude N	Longitude W	Seismicity				County	Physiographic province
323	31°29'10"	82°48'08"	-	-	-	GA	Coffee	CP
316	33°10'46"	83°38'33"	+	-	-	GA	Jasper	P
312	32°59'34"	82°17'26"	-	-	-	GA	Jefferson	CP
311	32°41'49"	81°58'59"	-	-	-	GA	Jenkins	CP
324	31°22'17"	82°05'01"	-	-	-	GA	Pierce	CP
314	33°16'59"	82°09'53"	+	-	-	GA	Richmond	CP
315	33°18'43"	82°15'37"	+	-	-	GA	Richmond	CP
310	32°49'47"	81°35'43"	+	+	-	GA	Screven	CP
319	32°07'29"	84°58'48"	+	-	-	GA	Stewart	CP
317	32°47'29"	84°20'15"	+	-	-	GA	Upson	P
320	31°49'06"	83°57'17"	-	-	-	GA	Worth	CP
169	42°43'15"	95°31'47"	-	-	-	IA	Cherokee	CL
168	42°47'35"	95°41'40"	-	-	-	IA	Cherokee	CL
179	42°48'47"	91°28'18"	-	-	-	IA	Clayton	CL
175	40°45'23"	93°45'41"	-	-	-	IA	Decatur	CL
180	42°22'59"	91°26'33"	-	-	-	IA	Delaware	CL
178	42°55'58"	91°40'31"	-	-	-	IA	Fayette	CL
174	41°53'34"	94°17'42"	-	-	-	IA	Greene	CL
171	42°15'43"	95°37'56"	-	-	-	IA	Ida	CL
184	41°30'38"	92°09'40"	-	-	-	IA	Iowa	CL
181	42°05'17"	93°01'01"	-	-	-	IA	Marshall	CL
176	43°26'08"	92°44'20"	-	-	-	IA	Mitchell	CL
167	43°28'19"	95°40'22"	-	-	-	IA	Osceola	CL
172	41°10'07"	95°48'16"	-	-	-	IA	Pottawattamie	CL
173	41°16'34"	95°32'32"	-	-	-	IA	Pottawattamie	CL
183	41°40'52"	92°26'51"	-	-	-	IA	Poweshiek	CL
182	42°06'16"	92°32'57"	-	-	-	IA	Tama	CL
177	43°14'48"	91°49'57"	-	-	-	IA	Winneshiek	CL
170	42°18'11"	95°47'18"	-	-	-	IA	Woodbury	CL
193	39°39'22"	87°43'25"	+	+	-	IL	Edgar	CL
186	42°19'11"	89°59'42"	-	-	-	IL	Jo Davies	CL
188	41°59'51"	88°35'55"	+	+	-	IL	Kane	CL
189	41°35'38"	88°21'33"	+	-	-	IL	Kendall	CL
190	41°02'20"	88°29'07"	-	-	-	IL	Livingston	CL
192	39°50'19"	89°10'55"	-	-	-	IL	Macon	CL
187	42°06'08"	89°20'45"	-	-	-	IL	Ogle	CL
185	41°21'52"	90°56'36"	+	-	-	IL	Rock	CL
191	40°39'40"	89°09'59"	+	+	-	IL	Woodford	CL
68	41°04'30"	85°11'28"	-	-	-	IN	Allen	CL
66	40°19'41"	87°01'51"	-	-	-	IN	Tippecanoe	CL

Table 1.--Continued.

Number of mafic body	Location Latitude N	Location Longitude W	Seismicity				County	Physiographic province
67	41°12'59"	85°32'01"	-	-	-	IN	Whitley	CL
198	39°53'22"	95°20'53"	-	-	-	KS	Brown	CL
199	39°49'01"	95°17'06"	-	-	-	KS	Doniphan	CL
200	39°20'36"	95°31'53"	-	-	-	KS	Jefferson	CL
201	38°58'11"	95°33'32"	-	-	-	KS	Shawnee	CL
226	36°50'56"	86°08'20"	-	-	-	KY	Allen	ILP
227	36°45'10"	86°08'07"	-	-	-	KY	Allen	ILP
228	36°49'50"	85°56'22"	-	-	-*	KY	Barren	ILP
229	36°44'27"	85°57'13"	-	-	-	KY	Barren	ILP
223	37°05'04"	87°20'57"	+	-	-	KY	Christian	ILP
58	38°29'02"	83°39'36"	+	-	-	KY	Fleming	ILP
222	36°41'16"	88°42'58"	+	+	-*	KY	Graves	CP
224	36°52'42"	86°54'16"	+	-	-	KY	Logan	ILP
245	36°49'11"	84°25'48"	-	-	-	KY	McCreary	AP
225	36°58'56"	86°18'46"	-	-	-	KY	Warren	ILP
347	32°35'56"	91°22'14"	-	-	-	LA	East Carroll	CP
16	41°39'55"	70°24'40"	+	+	-	MA	Barnstable	NE
17	41°44'13"	70°08'57"	+	-	-*	MA	Barnstable	NE
13	42°36'51"	70°57'08"	+	+	+	MA	Essex	NE
14	42°31'53"	70°54'11"	+	+	+	MA	Essex	NE
18	42°02'38"	72°53'21"	+	-	-	MA	Hampden	NE
48	39°23'26"	77°01'45"	-	-	-	MD	Carroll	P
46	39°39'20"	76°15'22"	-	-	-	MD	Harford	P
47	39°19'45"	75°58'32"	-	-	-	MD	Kent	CP
49	39°03'22"	77°15'25"	-	-	-	MD	Montgomery	P
50	38°21'21"	76°38'26"	-	-	-*	MD	St. Marys	CP
4	45°24'31"	70°33'37"	-	-	-*	ME	Franklin	NE
5	45°01'55"	70°37'40"	-	-	-*	ME	Franklin	NE
1	46°33'49"	69°06'46"	-	-	-	ME	Piscataquis	NE
2	46°14'37"	69°33'24"	-	-	-	ME	Piscataquis	NE
6	45°28'26"	69°42'07"	+	-	-	ME	Piscataquis	NE
7	45°33'13"	69°20'35"	+	+	-*	ME	Piscataquis	NE
3	45°35'21"	70°25'14"	-	-	-	ME	Somerset	NE
8	44°49'19"	67°03'49"	+	+	-*	ME	Washington	NE
9	44°33'51"	67°52'52"	+	-	-*	ME	Washington	NE
75	44°55'39"	85°26'32"	-	-	-	MI	Antrim	CL
71	46°09'15"	84°15'07"	-	-	-	MI	Chippewa	CL
76	45°47'42"	86°28'24"	-	-	-	MI	Delta	CL
79	45°45'10"	87°17'41"	-	-	-	MI	Delta	CL
80	45°48'57"	88°01'09"	-	-	-	MI	Dickinson	CL

Table 1.--Continued.

Number of mafic body	Location Latitude N	Longitude W	Seismicity				County	Physiographic province
85	46°27'15"	89°24'57"	-	-	-	MI	Gogebic	LU
74	44°42'02"	85°38'14"	-	-	-	MI	Grand Traverse	CL
88	46°59'03"	88°48'06"	+	+	-	MI	Houghton	LU
84	46°22'44"	88°31'02"	-	-	-	MI	Iron	LU
91	48°03'22"	88°38'12"	-	-	-	MI	Isle Royale	LU
92	47°48'06"	89°11'10"	+	-	-	MI	Isle Royale	LU
90	47°26'50"	88°07'08"	+	+	-	MI	Keweenaw	LU
72	44°02'49"	85°58'07"	-	-	-	MI	Lake	CL
70	44°22'20"	83°08'40"	-	-	-	MI	Lake Huron	CL
73	44°32'46"	86°27'37"	-	-	-	MI	Lake Michigan	CL
81	46°31'35"	86°42'01"	-	-	-	MI	Lake Superior	CL
89	47°14'55"	87°06'34"	-	-	-	MI	Lake Superior	LU
69	42°28'40"	83°55'20"	-	-	-	MI	Livingston	CL
82	46°29'04"	87°38'58"	-	-	-*	MI	Marquette	LU
83	46°30'46"	87°53'38"	-	-	-	MI	Marquette	LU
78	45°40'27"	87°24'32"	-	-	-	MI	Menominee	CL
86	46°43'03"	89°32'09"	-	-	-	MI	Ontonagon	LU
87	46°47'11"	89°03'54"	+	-	-	MI	Ontonagon	LU
77	45°57'27"	86°26'20"	-	-	-	MI	Schoolcraft	CL
143	46°48'58"	95°23'28"	-	-	-	MN	Becker	CL
137	47°49'06"	94°47'31"	-	-	-	MN	Beltrami	CL
120	48°17'12"	95°35'31"	-	-	-	MN	Beltrami	LU
160	43°58'05"	94°21'29"	-	-	-	MN	Blue Earth	CL
154	44°51'19"	95°36'08"	-	-	-	MN	Chippewa	CL
122	48°01'49"	90°40'23"	-	-	-	MN	Cook	LU
123	47°56'38"	90°36'18"	-	-	-	MN	Cook	LU
124	47°51'47"	90°32'56"	-	-	-	MN	Cook	LU
125	47°55'05"	90°58'51"	-	-	-	MN	Cook	LU
155	44°08'14"	95°21'14"	-	-	-	MN	Cottonwood	CL
144	46°46'32"	93°48'22"	-	-	-	MN	Crow Wing	CL
145	46°20'32"	94°09'42"	-	-	-	MN	Crow Wing	CL
146	46°11'41"	94°21'11"	-	-	-	MN	Crow Wing	CL
159	43°46'07"	91°54'49"	-	-	-	MN	Fillmore	CL
133	47°19'01"	93°17'06"	-	-	-	MN	Itasca	CL
136	47°47'20"	93°29'39"	-	-	-	MN	Itasca	CL
134	47°39'21"	93°13'11"	-	-	-	MN	Itasca	LU
162	43°33'22"	94°52'37"	-	-	-	MN	Jackson	CL
163	43°43'56"	95°01'13"	-	-	-	MN	Jackson	CL
164	43°33'23"	95°08'19"	-	-	-	MN	Jackson	CL
121	48°28'42"	94°21'42"	-	-	-	MN	Koochiching	LU

Table 1.--Continued.

Number of mafic body	Location Latitude N	Location Longitude W	Seismicity				County	Physiographic province
126	47°58'05"	91°25'31"	-	-	-	MN	Lake	LU
127	47°55'22"	91°43'57"	-	-	-	MN	Lake	LU
129	47°25'28"	91°31'59"	-	-	-	MN	Lake	LU
130	47°03'36"	91°45'37"	-	-	-	MN	Lake	LU
141	47°29'45"	95°52'53"	-	-	-	MN	Mahomen	CL
119	48°27'55"	95°49'44"	-	-	-	MN	Marshall	LU
161	43°41'43"	94°30'41"	-	-	-	MN	Martin	CL
150	45°04'26"	94°21'47"	-	-	-	MN	Meeker	CL
149	45°56'55"	93°41'44"	-	-	-	MN	Mille Lacs	CL
147	46°00'56"	94°32'29"	-	-	-	MN	Morrison	CL
148	46°02'12"	94°14'52"	-	-	-	MN	Morrison	CL
156	44°19'26"	94°00'45"	-	-	-*	MN	Nicollet	CL
165	43°42'29"	95°34'43"	-	-	-	MN	Nobles	CL
166	43°42'19"	95°51'27"	-	-	-	MN	Nobles	CL
142	46°32'16"	95°48'10"	-	-	-	MN	Otter Tail	CL
140	47°46'05"	95°35'20"	-	-	-	MN	Polk	CL
151	45°42'12"	95°12'22"	-	-	-*	MN	Pope	CL
157	44°12'32"	93°21'31"	-	-	-	MN	Rice	CL
138	47°11'43"	94°52'54"	-	-	-	MN	Rubbard	CL
139	47°09'32"	95°07'07"	-	-	-	MN	Rubbard	CL
128	47°49'54"	92°02'23"	-	-	-	MN	St. Louis	LU
131	47°28'09"	92°29'48"	-	-	-	MN	St. Louis	LU
132	47°28'10"	92°51'13"	-	-	-	MN	St. Louis	LU
135	47°52'24"	93°01'44"	-	-	-	MN	St. Louis	LU
152	45°12'00"	95°43'25"	-	-	-	MN	Swift	CL
153	45°10'10"	95°53'34"	-	-	-	MN	Swift	CL
158	44°06'32"	91°56'28"	-	-	-	MN	Winona	CL
202	36°29'45"	89°53'18"	+	+	+	MO	New Madrid	CP
204	36°45'53"	91°38'41"	+	+	+	MO	Oregon	OP
206	36°37'08"	92°38'01"	-	-	-	MO	Ozark	OP
196	39°11'05"	92°55'20"	-	-	-	MO	Saline	CL
197	39°14'48"	93°02'59"	-	-	-	MO	Saline	CL
195	38°51'05"	90°56'17"	+	+	-	MO	St. Charles	CL
194	38°41'45"	90°34'59"	+	+	+	MO	St. Charles	CL
203	36°45'19"	89°47'59"	+	+	+	MO	Stoddard	CP
205	37°16'17"	92°27'05"	-	-	-	MO	Wright	OP
341	33°59'36"	89°29'43"	-	-	-	MS	Calhoun	CP
339	33°46'16"	88°45'12"	-	-	-	MS	Clay	CP
340	34°22'29"	89°28'20"	-	-	-	MS	Lafayette	CP
342	33°43'13"	89°52'40"	-	-	-	MS	Grenada	CP

Table 1.--Continued.

Number of mafic body	Location Latitude N	Longitude W	Seismicity				County	Physiographic province
338	32°15'55"	90°09'15"	-	-	-	MS	Jackson	CP
337	32°03'11"	88°58'58"	-	-	-	MS	Jasper	CP
345	33°41'03"	90°20'57"	-	+	-	MS	Leflore	CP
346	33°01'47"	90°47'41"	-	-	-	MS	Sharkey	CP
343	33°58'56"	89°56'47"	-	-	-	MS	Tallahatchie	CP
344	33°59'24"	90°26'56"	-	-	-	MS	Tallahatchie	CP
336	34°53'02"	88°08'47"	-	-	-	MS	Tishomingo	CP
260	36°03'58"	79°20'14"	-	-	-	NC	Alamance	P
261	36°12'20"	79°19'30"	-	-	-	NC	Alamance	P
272	35°56'43"	76°57'24"	-	-	-	NC	Bertie	CP
278	34°17'04"	78°06'08"	-	-	-	NC	Brunswick	CP
279	33°59'48"	78°10'04"	-	-	-	NC	Brunswick	CP
254	35°23'00"	80°26'45"	+	+	-	NC	Cabarrus	P
262	36°14'43"	79°10'50"	-	-	-	NC	Caswell	P
280	34°15'54"	78°22'45"	-	-	-	NC	Columbus	CP
281	34°23'35"	78°35'00"	-	-	-	NC	Columbus	CP
282	34°29'50"	78°46'34"	-	-	-	NC	Bladen	CP
263	36°11'33"	78°41'47"	-	-	-*	NC	Granville	P
264	36°10'08"	78°35'46"	-	-	-*	NC	Granville	P
265	35°46'36"	79°09'26"	-	-	-	NC	Chatham	P
259	36°09'06"	79°33'19"	-	-	-	NC	Guilford	P
246	35°19'42"	82°57'14"	+	+	-	NC	Haywood	BR
267	35°31'45"	78°31'18"	-	-	-	NC	Johnston	CP
268	35°15'58"	78°38'50"	-	-	-	NC	Harnett	CP
248	35°04'55"	80°56'18"	-	-	-	NC	Mecklenberg	P
249	35°01'30"	80°47'41"	-	-	-	NC	Mecklenberg	P
250	34°54'11"	79°54'53"	-	-	-	NC	Anson	P
251	35°40'50"	80°40'03"	+	-	-	NC	Rowan	P
252	35°29'22"	80°46'28"	+	-	-	NC	Iredell	P
253	35°21'28"	80°39'42"	+	-	-	NC	Cabarrus	P
247	35°59'52"	82°11'35"	+	+	-	NC	Mitchell	BR
273	35°40'28"	76°34'34"	-	-	-	NC	New Hyde	CP
274	35°04'40"	76°40'31"	-	-	-	NC	Pamlico	CP
275	35°10'39"	76°06'54"	-	-	-	NC	Pamlico Sound	CP
276	34°33'49"	77°50'03"	-	-	-	NC	Pender	CP
277	34°26'54"	77°53'41"	-	-	-	NC	Pender	CP
255	35°30'11"	80°24'30"	+	+	-	NC	Rowan	P
256	35°26'28"	80°11'20"	+	+	-	NC	Stanly	P
257	35°43'13"	80°17'08"	+	-	-	NC	Davidson	P
258	35°41'00"	80°01'02"	+	-	-*	NC	Randolph	P

Table 1.--Continued.

Number of mafic body	Location Latitude N	Location Longitude W	Seismicity				County	Physiographic province
266	35°35'57"	78°43'17"	-	-	-	NC	Wake	P
269	35°38'18"	77°55'21"	-	-	-	NC	Wilson	CP
270	35°42'32"	77°48'24"	-	-	-	NC	Wilson	CP
271	35°47'38"	77°03'27"	-	-	-	NC	Martin	CP
10	43°46'26"	71°17'40"	+	+	+	NH	Carroll	NE
11	43°31'26"	71°07'10"	+	+	+	NH	Carroll	NE
12	43°07'30"	71°11'19"	+	+	+	NH	Rockingham	NE
22	40°17'39"	74°20'36"	+	+	-*	NJ	Monmouth	CP
26	44°50'34"	73°50'12"	+	+	+	NY	Clinton	A
27	44°30'31"	73°37'55"	+	+	-	NY	Clinton	A
28	44°36'27"	73°54'54"	+	+	+	NY	Clinton	A
25	44°45'50"	73°27'55"	+	+	+	NY	Clinton	SLV
43	43°00'09"	78°25'30"	+	+	+	NY	Genesee	CL
29	44°03'50"	74°17'35"	+	+	+	NY	Hamilton	A
30	44°00'51"	74°38'28"	+	+	-*	NY	Hamilton	A
33	44°20'44"	75°46'27"	+	-	-*	NY	Jefferson	CL
34	44°08'15"	75°59'13"	+	-	-	NY	Jefferson	CL
36	43°50'28"	76°29'05"	-	-	-	NY	Lake Ontario	CL
37	43°37'36"	76°25'53"	-	-	-	NY	Lake Ontario	CL
32	44°22'41"	75°29'09"	+	+	-	NY	Lawrence	A
31	44°07'41"	75°19'07"	+	-	-	NY	Lewis	A
38	43°09'33"	77°25'12"	+	+	-	NY	Monroe	CL
39	43°08'22"	77°46'29"	+	+	+	NY	Monroe	CL
40	43°19'26"	77°51'15"	+	+	-	NY	Monroe	CL
41	43°10'05"	78°39'09"	+	+	+	NY	Niagara	CL
42	43°07'20"	78°29'49"	+	+	+	NY	Niagara	CL
35	43°24'25"	75°38'07"	+	-	-	NY	Oneida	AP
21	41°15'25"	73°55'39"	+	+	+	NY	Westchester	NE
63	40°07'32"	83°36'46"	+	-	-	OH	Champaign	CL
60	39°13'57"	83°49'59"	-	-	-	OH	Clinton	CL
61	39°33'47"	83°29'03"	-	-	-	OH	Fayette	CL
62	39°49'18"	83°09'54"	-	-	-	OH	Franklin	CL
64	40°33'13"	83°28'30"	-	-	-	OH	Hardin	CL
59	38°53'26"	83°08'52"	+	-	-	OH	Sciotto	AP
65	41°13'40"	83°13'34"	+	+	+	OH	Seneca	CL
44	41°38'11"	80°14'29"	+	-	-	PA	Crawford	AP
15	41°57'37"	71°26'31"	+	+	-*	RI	Providence	NE
299	34°05'20"	82°34'02"	+	+	-	SC	Abbeville	P
305	33°02'56"	81°34'12"	+	+	-*	SC	Allendale	CP
303	33°14'04"	81°08'35"	+	+	-*	SC	Bamberg	CP

Table 1.--Continued.

Number of mafic body	Location Latitude N	Longitude W	Seismicity				County	Physiographic province
304	33°07'46"	81°19'01"	+	+	-*	SC	Barnwell	CP
309	32°26'07"	80°24'17"	+	-	-	SC	Beaufort	CP
290	33°22'49"	79°58'11"	+	-	-	SC	Berkeley	CP
291	33°22'41"	80°13'50"	+	-	-	SC	Berkeley	CP
308	32°51'25"	80°00'31"	+	+	+	SC	Charleston	CP
292	33°37'00"	80°29'18"	+	-	-	SC	Clarendon	CP
306	32°52'18"	80°20'53"	+	+	+	SC	Dorchester	CP
307	32°56'20"	80°08'44"	+	+	+	SC	Dorchester	CP
301	34°04'20"	82°01'21"	+	-	-*	SC	Greenwood	P
285	33°58'26"	79°07'30"	-	-	-	SC	Horry	CP
283	33°52'59"	78°46'12"	-	-	-	SC	Horry	CP
284	34°01'20"	78°58'34"	-	-	-	SC	Horry	CP
294	34°47'50"	80°45'28"	-	-	-	SC	Lancaster	P
295	34°41'40"	80°52'22"	-	-	-	SC	Lancaster	P
296	34°48'19"	81°07'25"	+	-	-	SC	York	P
297	34°29'45"	80°59'22"	+	-	-	SC	Fairfield	P
298	34°09'38"	82°37'51"	+	+	+	SC	Abbeville	P
293	34°02'01"	80°12'30"	+	-	-	SC	Lee	CP
302	33°39'54"	81°11'02"	+	-	-*	SC	Lexington	CP
300	33°57'28"	82°15'59"	+	+	-	SC	McCormick	P
286	33°45'38"	79°32'40"	-	-	-	SC	Williamsburg	CP
287	33°38'15"	79°36'48"	-	-	-	SC	Williamsburg	CP
288	33°34'38"	79°48'52"	-	-	-	SC	Williamsburg	CP
289	33°24'00"	79°47'57"	+	-	-	SC	Williamsburg	CP
235	35°36'16"	86°31'54"	-	-	-	TN	Bedford	ILP
236	35°26'38"	86°29'30"	-	-	-	TN	Bedford	ILP
241	35°50'11"	84°58'05"	-	-	-	TN	Cumberland	AP
242	36°05'16"	84°52'04"	-	-	-	TN	Cumberland	AP
240	35°22'25"	85°38'55"	+	-	-	TN	Grundy	AP
220	35°40'08"	88°28'53"	-	-	-	TN	Henderson	CP
237	35°05'52"	86°44'47"	-	-	-	TN	Lincoln	ILP
238	35°09'40"	86°29'45"	-	-	-*	TN	Lincoln	ILP
239	34°59'55"	86°25'48"	-	-	-	TN	Lincoln	ILP
234	35°33'09"	87°01'49"	-	-	-	TN	Maury	ILP
221	35°40'18"	87°57'52"	-	-	-	TN	Perry	ILP
244	36°33'21"	84°47'19"	-	-	-	TN	Pickett	AP
233	35°59'14"	86°27'31"	-	-	-*	TN	Rutherford	ILP
243	36°17'39"	84°36'05"	-	-	-	TN	Scott	AP
230	36°31'27"	86°25'09"	-	-	-	TN	Sumner	ILP
231	36°27'14"	86°17'58"	-	-	-	TN	Sumner	ILP

Table 1.--Continued.

Number of mafic body	Location Latitude N	Location Longitude W	Seismicity				County	Physiographic province
219	35°37'02"	89°40'34"	+	+	+	TN	Tipton	CP
232	36°15'24"	86°12'21"	-	-	-	TN	Wilson	ILP
348	31°51'23"	93°54'52"	-	-	-	TX	Shelby	CP
56	37°38'00"	78°34'17"	+	+	+	VA	Buckingham	P
57	37°33'32"	78°36'55"	+	+	-	VA	Buckingham	P
52	37°21'10"	77°11'18"	+	+	-	VA	Charles City	CP
51	37°54'08"	77°00'47"	+	-	-*	VA	Essex	CP
55	37°50'01"	78°20'14"	+	+	+	VA	Fluvanna	P
54	37°57'11"	78°10'00"	+	+	-*	VA	Louisa	P
53	38°09'10"	78°15'20"	+	-	-*	VA	Orange	P
23	44°34'11"	72°50'03"	+	-	-	VT	Chittenden	NE
24	44°41'28"	73°17'05"	+	+	+	VT	Lamoille	NE
94	46°08'59"	91°33'55"	-	-	-	WI	Bayfield	LU
118	44°32'39"	91°45'14"	-	-	-	WI	Buffalo	CL
102	45°10'34"	91°02'27"	-	-	-	WI	Chippewa	LU
103	45°11'20"	91°38'44"	-	-	-	WI	Chippewa	LU
117	44°52'12"	91°23'54"	-	-	-	WI	Chippewa	CL
113	43°21'08"	89°22'04"	+	+	-	WI	Columbia	LU
112	43°12'29"	89°06'55"	+	+	-	WI	Dane	LU
95	45°57'37"	88°49'36"	-	-	-	WI	Forest	LU
93	46°25'31"	90°19'55"	-	-	-	WI	Iron	LU
116	44°23'50"	91°08'23"	-	-	-	WI	Jackson	CL
115	43°58'47"	90°03'24"	-	-	-	WI	Juneau	LU
109	43°39'46"	87°36'36"	+	+	+	WI	Lake Michagan	LU
108	44°29'26"	87°12'37"	-	-	-	WI	Lake Michigan	LU
96	45°10'11"	89°20'58"	-	-	-	WI	Langlade	LU
105	45°23'40"	88°01'47"	-	-	-	WI	Marinette	LU
106	45°12'02"	87°57'11"	-	-	-	WI	Marinette	LU
107	44°58'45"	87°43'07"	-	-	-*	WI	Marinette	LU
97	45°34'44"	89°35'40"	-	-	-	WI	Oneida	LU
98	45°37'02"	89°50'37"	-	-	-	WI	Oneida	LU
104	45°20'40"	92°23'03"	-	-	-	WI	Polk	LU
99	45°28'03"	90°16'09"	-	-	-	WI	Price	LU
100	45°34'20"	90°22'43"	-	-	-	WI	Price	LU
101	45°26'34"	90°48'33"	-	-	-	WI	Rusk	LU
114	43°36'29"	90°03'50"	-	-	-	WI	Sauk	LU
111	42°41'07"	88°38'21"	-	-	-	WI	Walworth	LU
110	43°01'13"	88°22'16"	+	-	-	WI	Waukesha	LU

Table 2.--*Effect of reducing magnetic anomalies to the magnetic pole*

Number of inferred mafic body	Locality	Offset of geophysical anomaly maxima[1]				Reduction to the magnetic pole (Laurenco, 1973; Hildenbrand, 1983)
		Before reduction to the pole		After reduction to the pole		
		Direction (degrees)	Magnitude (kilometers)	Direction (degrees)	Magnitude (kilometers)	Inclination; declination[2]
306	Charleston, S.C.	340	5	306	2	
307	Charleston, S.C.	316	10	309	8	63; 3.5 W.
323	South Georgia	326	17	305	4	
322	South Georgia	6	15	70	7	
321	South Georgia	327	15	285	8	
338	Jackson dome, Miss.	315	5	287	4	62; 4 E.
348	Sabine uplift, Texas	5	5	none	none	
202	Bloomfield pluton, Mo.	354	10	none	none	66.5; 2 E.
203	Malden pluton, Mo.	none	none	342	4	

[1]Offset direction and distance are measured from the center of the magnetic anomaly to the center of the associated gravity anomaly
[2]Inclination is measured in degrees down from horizontal; declination is measured in degrees east or west of geographic latitude; values are from 1985 datums (Peddie and Zunde, 1988a, 1988b)