UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Some geophysical programs, data bases, and maps from the U.S. Geological Survey, 1971-1989

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INTRODUCTION

Scientists of the U.S. Geological Survey (USGS) have written an extensive amount of computer software in order to process and interpret data using geophysical techniques, including gravity, magnetics, radiometrics, electromagnetics, remote sensing, spectroscopy, borehole geophysics, and a limited amount of seismic processing. In addition, compiled data are available for gravity, magnetics, and aeroradiometrics. This report lists some software and data bases or maps that are currently available. No such list can be complete; however, we hope that this information is useful, even if only to give the reader a scientist's name for further contact. The USGS publishes a free periodical, "New Publications of the U.S. Geological Survey," and all future USGS publications will be listed there. Addresses for sources of data, publications, and other information are listed at the end of this report. Any use of trade, product, or company names in this report is for descriptive purposes only and does not imply endorsement by the U.S. Government.

GRAVITY, MAGNETIC, AND RADIOMETRIC MAPS AND DATA BASES: SMALL SCALE ($\geq$ 1:1,000,000)

Publicly available geophysical data for the United States include original gravity, aeromagnetic, and radiometric data, as well as computer-generated compilations of these data. Compilations are made under cooperative mapping programs with states, other federal agencies, and scientific societies. Two such cooperative products are the gravity and magnetic gridded data that were used to compile the Geological Society of America's 1988 gravity and magnetic anomaly maps of North America. The gridded data that were used to make these maps can be ordered from the National Geophysical Data Center (NGDC). Earlier versions of these gridded data for the United States (Godson, 1986a, 1986b) are available from the National Technical Information Service (NTIS). The gravity grid interval of the NTIS data is 4 km; and of the NGDC data, 4 km or 6 km. The magnetic grid interval of both NTIS and NGDC data is 2 km.

Many other maps have been published that use these data to create derivative maps of the gravity or magnetic field and also isostatic gravity anomaly maps of the conterminous United States. Also included in the references below are maps that cover more than one state.

Bond, K.R., and Zietz, Isidore, 1987, Composite magnetic anomaly map of the conterminous United States west of 96° longitude: U.S. Geological Survey Geophysical Investigations Map GP-977, scale 1:2,500,000.

Cordell, Lindrith, Keller, G.R., and Hildenbrand, T.G., 1982, Complete Bouguer gravity anomaly map of the Rio Grande Rift, Colorado, New Mexico, and Texas: U.S. Geological Survey Geophysical Investigations Map GP-949, scale 1:1,000,000.

Finn, C.A., Williams, D.L., Couch, R.W., Danes, Z.F., Pitts, G.S., and Phillips, W.M., 1986, Gravity anomaly and terrain maps of the Cascade Range, California, Oregon, Washington, and British Columbia: U.S. Geological Survey Geophysical Investigations Map GP-972, scale 1:2,500,000.

Godson, R.H., compiler, 1982, Composite magnetic anomaly map of the United States, part B--Alaska and Hawaii: U.S. Geological Survey Geophysical Investigations Map GP-954-B, scale 1:2,500,000, 9 p.

Godson, R.H., 1986a, Description of magnetic tape containing Alaska magnetic data in a gridded format: National Technical Information Service Report PB86-197399, 5 p., magnetic tape.

_____1986b, Description of magnetic tape containing conterminous United States magnetic data in a gridded format: National Technical Information Service Report PB86-197423, 5 p., magnetic tape.

Godson, R.H., and Schiebe, D.M., 1982, Description of magnetic tape containing conterminous United States gravity data in gridded format: National Technical Information Service Report PB82-254798, 5 p., magnetic tape. [4-km grid, as opposed to NGDC's more recent 6-km grid]

Hildenbrand, T.G., Kucks, R.P., and Johnson, R.W., Jr., 1981, Aeromagnetic map of east-central United States: U.S. Geological Survey Geophysical Investigations Map GP-948, scale 1:1,000,000.

Hildenbrand, T.G., Kucks, R.P., and Sweeney, R.E., 1983, Digital magnetic-anomaly map of central United States--Description of major features: U.S. Geological Survey Geophysical Investigations Map GP-955, scale 1:2,500,000.

Hildenbrand, T.G., Simpson, R.W., Godson, R.H., and Kane, M.F., 1982, Digital colored residual and regional Bouguer gravity maps of the conterminous United States with cut-off wavelengths of 250 km and 1000 km: U.S. Geological Survey Geophysical Investigations Map GP-953-A, scale 1:7,500,000.

Jachens, R.C., Simpson, R.W., Saltus, R.W., and Blakely, R.J., 1985, Isostatic residual gravity anomaly map of the United States (exclusive of Alaska and Hawaii): National Oceanic and Atmospheric Administration, Geophysical Data Center Map, scale 1:2,500,000.

Simpson, R.W., Hildenbrand, T.G., Godson, R.H., and Kane, M.F., 1987, Digital colored Bouguer gravity, free-air gravity, station location, and terrain maps for the conterminous United States: U.S. Geological Survey Geophysical Investigations Map GP-953-B, scale 1:7,500,000.

Simpson, R.W., Jachens, R.C., Saltus, R.W., and Blakely, R.J., 1986, Isostatic residual gravity, topographic, and first-vertical derivative gravity maps of the conterminous United States: U.S. Geological Survey Geophysical Investigations Map GP-975, scale 1:750,000.

Zeitz, Isidore, compiler, 1982, Composite magnetic anomaly map of the United States, part A--Conterminous United States: U.S. Geological Survey Geophysical Investigations Map GP-954-A, scale 1:2,500,000, 59 p.

GRAVITY, MAGNETIC, AND RADIOMETRIC MAPS AND DATA BASES: STATE SCALE

Gravity, magnetic, and radiometric data are being compiled at state scales under the cooperative geologic mapping program (COGEOMAP). A complete state folio consists of (1) black-and-white contour gravity, aeromagnetic, and radiometric maps printed at the scale of the state geologic map; (2) color maps at a reduced scale for the three geophysical data sets and additional derivative products; and (3) a magnetic tape of data and grids. The maps are published through the state geological survey or through the USGS. The data tapes are available through the EROS Data Center (except for Washington, which is available through NTIS; Finn, 1984).

Bankey, Viki, and Kleinkopf, M.D., 1988, Bouguer gravity anomaly map and four derivative maps of Idaho: U.S. Geological Survey Geophysical Investigations Map GP-978, scale 1:1,000,000.

Bankey, Viki, Webring, Michael, Mabey, D.R., Kleinkopf, M.D., and Bennett, E.H., 1985, Complete Bouguer gravity anomaly map of Idaho: U.S. Geological Survey Miscellaneous Field Studies Map MF-1773, scale 1:500,000.

Cordell, Lindrith, 1983, Geothermal resources of New Mexico--composite residual total intensity aeromagnetic map of New Mexico: New Mexico Energy Institute Map, clear overlay, scale 1:500,000.

Duval, J.S., 1985, Aerial radiometric contour maps of surface concentrations of uranium, potassium, and thorium in Ohio: U.S. Geological Survey Geophysical Investigations Map GP-968, scale 1:500,000.

_____1987, Aerial radiometric color contour maps and composite color map of regional surface concentrations of uranium, potassium, and thorium in Ohio: U.S. Geological Survey Geophysical Investigations Map GP-966, scale 1:1,000,000.

_____1988, Aerial gamma-ray contour maps of regional surface concentrations of potassium, uranium, and thorium in Nevada: U.S. Geological Survey Geophysical Investigations Map GP-982, scale 1:750,000.

_____1989, Aerial gamma-ray color contour maps of regional surface concentrations of potassium, uranium, and thorium, and composite-color maps of U, K, Th, and their ratios in New Mexico: U.S. Geological Survey Geophysical Investigations Map GP-979, scale 1:1,000,000.

Finn, C.A., 1984, Description of magnetic tape containing Washington state gravity anomaly data: National Technological Information Service Report USGS-GD-85-001, magnetic tape.

Finn, C.A., Phillips, W.M., and Williams, D.L., 1984, Gravity maps of the state of Washington and adjacent areas: U.S. Geological Survey Open-File Report 84-416, scale 1:250,000.

Godson, R.H., Zablocki, C.J., Pierce, H.A., Frayser, J.B., Mitchell, C.M., and Sneddon, R.A., 1981, Aeromagnetic map of the Island of Hawaii: U.S. Geological Survey Geophysical Investigations Map GP-946, scale 1:250,000.

Hildenbrand, T.G., 1984, Complete Bouguer gravity anomaly map of Ohio: U.S. Geological Survey Geophysical Investigations Map GP-962, scale 1:500,000.

_____1986, Gravity anomaly maps of Ohio: U.S. Geological Survey Geophysical Investigations Map GP-963, scale 1:1,000,000.

_____1987, Filtered magnetic anomaly maps of Ohio: U.S. Geological Survey Geophysical Investigations Map GP-967, scale 1:1,000,000.

Hildenbrand, T.G., and Kucks, R.P., 1984, Residual total intensity magnetic map of Ohio: U.S. Geological Survey Geophysical Investigations Map GP-961, scale 1:500,000

_____1988a, Total intensity magnetic anomaly map of Nevada: Nevada Bureau of Mines and Geology Map 93A, scale 1:750,000.

_____1988b, Filtered magnetic anomaly maps of Nevada: Nevada Bureau of Mines and Geology Map 93B, scale 1:1,000,000.

Keller, G.R., and Cordell, Lindrith, 1983, Geothermal resources of New Mexico--Bouguer gravity anomaly map of New Mexico: New Mexico Energy Institute Map, clear overlay, scale 1:500,000.

Saltus, R.W., 1988, Bouguer gravity anomaly map of Nevada: Nevada Bureau of Mines and Geology Map 94A, scale 1:750,000.

_____1989, Regional, residual, and derivative gravity maps of Nevada: Nevada Bureau of Mines and Geology Map 94B, scale 1:1,000,000.

STATE GEOPHYSICAL DATA AVAILABLE ON MAGNETIC TAPE FROM EROS DATA CENTER

Idaho: Gravity data

Ohio: Gravity, aeromagnetic, and radiometric data

Nevada: Gravity, aeromagnetic, and radiometric data

MAGNETIC AND RADIOMETRIC DATA: LARGE SCALE (≤1:250,000)

The USGS has flown or contracted many large-scale aeromagnetic surveys. Following is a list of open-file reports that reference these surveys by area:

Hill, P.L., 1986a, Bibliographies and location maps of aeromagnetic and aeroradiometric publications for the states west of approximately 104° longitude (exclusive of Alaska and Hawaii): U.S. Geological Survey Open-File Report 86-525-A, 130 p.

_____1986b, Bibliographies and location maps of aeromagnetic and aeroradiometric publications of the states west of the Mississippi River and east of approximately 104° longitude: U.S. Geological Survey Open-File Report 86-525-B, 50 p.

_____1986c, Bibliographies and location maps of aeromagnetic and aeroradiometric publications for the states east of the Mississippi River and north of the Ohio and Potomac Rivers: U.S. Geological Survey Open-File Report 86-525-C, 92 p.

_____1986d, Bibliographies and location maps of aeromagnetic and aeroradiometric publications for the states east of the Mississippi River and south of the Ohio and Potomac Rivers: U.S. Geological Survey Open-File Report 86-525-D, 58 p.

_____1986e, Bibliographies and location maps of aeromagnetic and aeroradiometric publications for Alaska and Hawaii: U.S. Geological Survey Open-File Report 86-525-E, 27 p.

_____1986f, Bibliographies and location maps of aeromagnetic and aeroradiometric publications for Puerto Rico and large areas of the conterminous United States: U.S. Geological Survey Open-File Report 86-525-F, 30 p.

_____1986g, Lists and location maps of aeromagnetic and aeroradiometric publications from the Department of Energy NURE Program: U.S. Geological Survey Open-File Report 86-525-G, 23 p.

POTENTIAL FIELDS PROGRAMS

Two recent open-file reports (U.S. Geological Survey, 1989; Godson and Mall, 1989) contain numerous data reduction and data interpretation programs for either IBM-PC compatible computers or VAX computers and are available on 5 1/4" diskettes. The open-file report for IBM-PC-compatible computers (Godson and Mall, 1989) includes only major programs. Two other open-file reports (Godson and Plouff, 1988; Godson and others, 1988) are available on diskettes. The remainder of programs were published earlier as written reports that contain a program listing. If a program is not available on diskette, a copy on magnetic tape may be available from the program's author, to whom inquiries should be directed.

Blakely, R.J., 1981, A program for rapidly computing the magnetic anomaly over digital topography: U.S. Geological Survey Open-File Report 81-298, 46 p.

_____1990, MEPDEP--A program to estimate depth to source along magnetic profiles: U.S. Geological Survey Open-File Report 90- (in press)

Campbell, D.L., 1983, BASIC programs to calculate gravity and magnetic anomalies for 2 1/2-dimensional prismatic bodies: U.S. Geological Survey Open-File Report 83-154, 37 p.

Chuchel, B.A., 1985, POLYGON--An interactive program for constructing and editing the geometries of polygons using a color graphics terminal: U.S. Geological Survey Open-File Report 85-233-A-B, 91 p.

Frischknecht, F.C., Muth, L., Grette, R., Buckley, T., and Kornegay, B., 1983, Geophysical methods for locating abandoned wells: U.S. Geological Survey Open-File Report 83-702, 211 p. [program CASING included]

Godson, R.H., 1983a, GRAVPOLY--A modification of a three-dimensional gravity modeling program: U.S. Geological Survey Open-File Report 83-346, 53 p.

_____1983b, MAGPOLY--A modification of a three-dimensional magnetic modeling program: U.S. Geological Survey Open-File Report 83-345, 62 p.

Godson, R.H., Bracken, R.E., and Webring, M.W., 1988, PCCONTUR version 1.0, a microcomputer general purpose contouring program: U.S. Geological Survey Open-File Report 88-593, A--Documentation paper copy, 30 p.; B--Executable code and test data disk; C--Source code disk; D--Plot system source code and library disk.

Godson, R.H, and Mall, M.R., 1989, Potential-field geophysical programs for IBM compatible microcomputers, version 1.0: U.S. Geological Survey Open-File Report 89-197-A-F, 23 p., 5 diskettes.

Godson, R.H., and Plouff, Donald, 1988, BOUGUER, version 1.0--A microcomputer gravity-terrain-correction program: U.S. Geological Survey Open-File Report 88-644-A-B, 13 p., 1 diskette.

Godson, R.H., and Webring, M.W., 1982, CONTOUR--A modification of G.I. Evendon's general purpose contouring program: U.S. Geological Survey Open-File Report 82-797, 73 p.

Grauch, V.J.S., 1984, TAYLOR--A Fortran program using Taylor series expansion for level-surface or surface-level continuation of potential-field data: U.S. Geological Survey Open-File Report 84-501, 31 p.

_____1986, VARMAG--A Fortran program to implement the variable-magnetization terrain-correction method for aeromagnetic data: U.S. Geological Survey Open-File Report 86-268, 52 p.

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

Jachens, R.C., and Roberts, C.W., 1981, Documentation for a Fortran program, ISOCOMP, for computing isostatic residual gravity: U.S. Geological Survey Open-File Report 81-574, 26 p.

Phillips, J.D., 1979, ADEPT--A program to estimate depth to magnetic basement from sampled magnetic profiles: U.S. Geological Survey Open-File Report 79-367, 37 p.

Plouff, Donald, 1977, Preliminary documentation for a Fortran program to compute gravity terrain corrections based on topography digitized on a geographic grid: U.S. Geological Survey Open-File Report 77-535, 43 p.

Simpson, R.W., Jachens, R.C., and Blakely, R.J., 1983, AIRYROOT--A Fortran program for calculating the gravitational attraction of an Airy isostatic root out to 166.7 km: U.S. Geological Survey Open-File Report 83-883, 66 p.

Saltus, R.W., and Blakely, R.J., 1983, HYPERMAG--An interactive, two-dimensional gravity and magnetic modeling program: U.S. Geological Survey Open-File Report 83-241, 84 p.

Sweeney, R.E., 1990, IGRFGRID--A program for creation of a total magnetic field (international Geomagnetic Reference Field) grid representing the earth's main magnetic field: U.S. Geological Survey Open-File Report 90-45A-B.

U.S. Geological Survey, 1989, Potential field geophysical programs for VAX 7xx computers: U.S. Geological Survey Open-File Report 89-115-A-D, 21 p., 3 diskettes.

Wagini, Alexander, 1985, An automatic program for the interpretation of two-dimensional gravity and magnetic anomalies: U.S. Geological Survey Open-File Report 85-377, 68 p.

Webring, M.W., 1981, MINC--A gridding program based on minimum curvature: U.S. Geological Survey Open-File Report 81-1224, 41 p.
_____1985, SAKI--A Fortran program for generalized linear inversion of gravity and magnetic profiles: U.S. Geological Survey Open-File Report 85-122, 104 p.

RADIOMETRIC PROGRAMS

Duval, J.S., 1984, Computer program useful for quality control of an image-processing laboratory: U.S. Geological Survey Open-File Report 84-218, 18 p.
_____1985, Data processing programs for aerial gamma-ray data: U.S. Geological Survey Open-File Report 85-359, 83 p.

REMOTE SENSING PROGRAMS

The REMAPP (remote sensing array processing procedures) system is a series of programs for processing satellite and aircraft imagery, such as Landsat Multi-Spectral Scanner (MSS) and Thematic Mapper (TM), SPOT, NOAA, or other GIS (Geographical Information System) data. TM and MSS data are available from EOSAT (Earth Observation Satellite Company), NCIC (National Cartographic Information Center), or EROS Data Center (addresses at the end of this report). SPOT data are available from SPOT Image Corporation. NOAA operational polar-orbiting satellite data, such as AVHRR (Advanced Very High Resolution Radiometer) are available from the Satellite Data Services Division. Image processing routines include mathematical operations, image statistics, contrast and edge enhancements, spatial and color coordinate transformations, band ratioing, and masking. Processed imagery can be output to film, paper, or magnetic media.

Livo, K.E., 1990, REMAPP PC Remote Sensing Image Processing software for MS-DOS personal computers, version 1.00: U.S. Geological Survey Open-File Report 90-88A-E.
Sawatzky, D.L., 1985, Programmer's guide to REMAPP, REMote sensing Array Processing Procedures: U.S. Geological Survey Open-File Report 85-231, 21 p.
Simpson, S.L., 1986, Selected geological and geophysical remote sensing publications by U.S. Geological Survey authors, 1961-1984: U.S. Geological Survey Open-File Report 86-41, 60 p.

SEISMIC DATA REDUCTION AND BOREHOLE GEOPHYSICAL PROGRAMS

This report includes a limited number of seismic processing programs. Programs by Ackermann and others (1982, 1983) can be obtained through Jackie Williams (address at end of this report). Coal-seismic programs are available through Bill Hasbrouck (address at the end of this report), who can help with unpublished modifications to his programs.

Ackermann, H.D., 1985, Shallow geological investigations with personal computers: Geocompuphysics, v. 36, no. 5, p. 1569-1605.
Ackermann, H.D., Pankratz, L.W., and Dansereau, D.A., 1982, A comprehensive system for interpreting seismic-refraction arrival-time data using interactive computer methods: U.S. Geological Survey Open-File Report 82-1065, 268 p.
_____1983, Computer program modifications of Open-File Report 82-1065; a comprehensive system for interpreting seismic-refraction arrival-time data using interactive computer methods: U.S. Geological Survey Open-File Report 83-604, 2 p. [updated for DEC PDP11-34A]

Hasbrouck, W.P., 1979, Coal-seismic computer programs in BASIC; Part 1, Store, plot, and edit array data: U.S. Geological Survey Open-File Report 79-242, 35 p.

_____1980a, Coal-seismic, desktop computer programs in BASIC; Part 2, Enter, compute, edit, and store results of downhole, inhole, and crosshole investigations: U.S. Geological Survey Open-File Report 80-669, 89 p.

_____1980b, Coal-seismic, desktop computer programs in BASIC; Part 3, Compute, tabulate, and plot normal moveout time: U.S. Geological Survey Open-File Report 80-670, 21 p.

_____1980c, Coal-seismic, desktop computer programs in BASIC; Part 4, Transfer, edit, and display observed data: U.S. Geological Survey Open-File Report 80-668, 46 p.

_____1983a, Coal-seismic, desktop computer programs in BASIC; Part 5, Perform X-square/T-square analyses and plot normal moveout lines on a seismogram overlay: U.S. Geological Survey Open-File Report 83-350, 21 p.

_____ 1983b, Coal-seismic, desktop computer programs in BASIC; Part 6, Develop rms velocity functions and apply mute and normal moveout: U.S. Geological Survey Open-File Report 83-341, 29 p.

_____1983c, Coal-seismic, desktop computer programs in BASIC; Part 7, Display and compute shear-pair seismograms: U.S. Geological Survey Open-File Report 83-348, 41 p.

_____1984a, Coal-seismic, desktop computer programs in BASIC; Part 8, Pick first arrivals and align events on screen: U.S. Geological Survey Open-File Report 84-175, 23 p.

_____1984b, Coal-seismic, desktop computer programs in BASIC; Part 9, Compute static corrections using an ABC method applied to six-fold, two-way field data: U.S. Geological Survey Open-File Report 84-334, 44 p.

_____1985, Coal-seismic, desktop computer programs in BASIC; part 10, Construct and apply one-dimensional synthetic seismograms: U.S. Geological Survey Open-File Report, 85-226, 99 p.

Hasbrouck, W.P., and Bailey, L.F., 1984, The Lanczos-preconditioned, folded (sinx)/x interpolator--Discussion and desktop-computer program in BASIC: U.S. Geological Survey Open-File Report 84-226, 17 p.

Muller, D.C., 1985, Computer method to detect and correct cycle skipping on sonic logs, in 26th Annual Logging Symposium, Transactions: Society of Professional Well Log Analysts, Paper R, v. 1, p. 1-18.

Scott, J.H., 1977, SIPT--A seismic refraction inverse modeling program for timeshare terminal computer systems: U.S. Geological Survey Open-File Report 77-365, 108 p.

_____1978, A computer program for borehole compensation of dual-detector density well logs: U.S. Geological Survey Open-File Report 78-515, 7 p.

ELECTRICAL AND ELECTROMAGNETIC PROGRAMS

The USGS has many programs for reduction of electrical and electromagnetic data collected using various methods, including Schlumberger, Slingram, magnetotellurics (MT), audiomagnetotellurics (AMT), very low frequency (VLF), time-domain electromagnetics (TDEM), and other methods. Data interpretation programs use forward and inverse modeling, digital filtering, and mathematical transforms. Also see separate listing in Appendix A.

Anderson, W.L., 1971, Application of Bicubic Spline Functions to Two-Dimensional Gridded Data: National Technical Information Service No. PB 203 579.

_____1974, Electromagnetic fields about a finite electric wire source: National Technical Information Service report PB 238-199/4WC, 205 p.

_____1975, Improved digital filters for evaluating Fourier and Hankel transform integrals: U.S. Geological Survey Report USGS GD-75-012 available as National Technical Information Service report PB-242-800/1WC, 223 p.

_____1976a, An optimal method for evaluating a class of convolution integrals with related kernels: National Technical Information Service report, PB-251-156/6WC, 15 p.

_____1976b, Electromagnetic scattering by multiple conductors in the earth due to a plane wave source: National Technical Information Service report PB-261-183/AS, 75 p.

_____1977, Marquardt inversion of vertical magnetic field measurements from a grounded wire source, National Technical Information Service report, PB-263-924/AS, 76 p.

_____1979a, Numerical integration of related Hankel transforms of orders 0 and 1 by adaptive digital filtering: Geophysics, v. 44, no. 7, p. 1287-1305.

_____1979b, Program IMSLPW: Marquardt inversion of plane-wave frequency soundings: U.S. Geological Survey Open-File Report 79-586, 37 p.

_____1979c, Program MARQDCLAG: Marquardt inversion of DC Schlumberger soundings by lagged-convolution: U.S. Geological Survey Open-File Report 79-1432, 58 p.

_____1979d, Program MARQLOOPS: Marquardt inversion of loop-loop frequency soundings: U.S. Geological Survey Open-File Report 79-240, 75 p.

_____1979e, Programs TRANS-HCLOOP and TRANS-HZWIRE: Calculation of transient horizontal coplanar loop soundings and transient wire-loop soundings: U.S. Geological Survey Open-File Report 79-590, 46 p.

_____1980a, Program IMSLEXY: Marquardt inversion of Ex and Ey frequency soundings from a grounded wire source: U.S. Geological Survey Open-File Report 80-1073, 87 p.

_____1980b, Program MARQHXY: Marquardt inversion of Hx and Hy frequency soundings from a grounded wire source: U.S. Geological Survey Open-File Report 80-901, 111 p.

_____1981, Calculation of transient soundings for a central induction loop system (Program TCILOOP): U.S. Geological Survey Open-File Report 81-1309, 80 p.

_____1982a, Adaptive nonlinear least-squares solution for constrained or unconstrained minimization problems (Subprogram NLSOL): U.S. Geological Survey Open-File Report 82-68, 65 p.

_____1982b, Calculation of transient soundings for a coincident loop system (Program TCOLOOP): U.S. Geological Survey Open-File Report 82-378, 77 p.

_____1982c, Fast evaluation of squared-Hankel transforms of order-1 by linear digital filtering (Subprogram SQJ1): U.S. Geological Survey Open-File Report 82-224, 13 p.

_____1982d, Fast Hankel transforms using related and lagged convolutions: Association for Computing Machinery Transactions on Mathematical Software, v. 8, no. 4, p. 344-368.

_____1982e, Nonlinear least-squares inversion of transient soundings for a central induction loop system (Program NLSTCI): U.S. Geological Survey Open-File Report 82-1129, 85 p.

_____1982f, Nonlinear least-squares inversion of transient soundings for a coincident loop system (Program NLSTCO): U.S. Geological Survey Open-File Report 82-1064, 81 p.

_____1983, Fourier cosine and sine transforms using lagged convolutions in double-precision (Subprograms DLAGF0/DLAGF1): U.S. Geological Survey Open-File Report 83-320, 38 p.

_____1984a, A general interface for producing forward solution programs (Subprogram FWDSOL): U.S. Geological Survey Open-File Report 84-348, 43 p.
_____1984b, Computation of Green's tensor integrals for three-dimensional electromagnetic problems using fast Hankel transforms: Geophysics, v. 49, no. 10, p. 1754-1759.
_____1984c, Fast evaluation of Hr and Hz field soundings near a rectangular loop source on a layered earth (Program HRZRECT): U.S. Geological Survey Open-File Report 84-257, 80 p.
_____1985a, Computation of transient soundings for the time-derivative of Hz near a rectangular loop source on a layered earth (Program FWDTHZ): U.S. Geological Survey Open-File Report 85-270, 44 p.
_____1985b, Fast evaluation of radial and vertical magnetic fields near a rectangular loop source on a layered earth: Geophysical Transactions, Eotvos Lorand Geophysical Institute of Hungary, Budapest, v. 31, no. 4, p. 339-357.
_____1987, Nonlinear least-squares inversion of bipole-bipole direct-current data (Program NLSBPBP): U.S. Geological Survey Open-File Report 87-95, 35 p.
_____1989, A hybrid fast Hankel transform algorithm for electromagnetic modeling: Geophysics, v. 54, no. 2, p. 263-266.
_____1989, Nonlinear least-squares inversion of infinite line source data (program NLSINF): U.S. Geological Survey Open-File Report 89-555, 30 p.
Anderson, W.L., and Kauahikaua, J., 1979, Program MARQ-TRANS-HCLOOP: Marquardt inversion of transient horizontal coplanar loop soundings: U.S. Geological Survey Open-File Report 79-773, 75 p.
Anderson, W.L., and Smith, B.D., 1984, Nonlinear least-squares inversion of transient induced polarization data (Program NLSTIP): U.S. Geological Survey Open-File Report 84-514, 63 p.
_____1986, Nonlinear least-squares inversion of frequency-domain induced polarization data (Program NLSIP): U.S. Geological Survey Open-File Report 86-280, 33 p.
Bisdorf, R.J., 1980, Hewlett-Packard 9845 computer programs to compute Hankel transforms by convolution: U.S. Geological Survey Open-File Report 80-806, 26 p.
Bradley, Jerry, and Raab, Paul, 1983, SIROTEM II IEEE 488-1978 interface and controlling software: U.S. Geological Survey Open-File Report 83-249, 17 p.
Fitterman, D.V., and Anderson, W.L., 1987, Effect of transmitter turnoff time on transient soundings: Geoexploration, v. 24, p. 131-146.
Kauahikaua, J., and Anderson, W.L., 1977, Calculation of standard transient and frequency sounding curves for a horizontal wire source of arbitrary length: National Technical Information Service report PB-274-119/7WC.
_____1979, Programs EMCUPL and SCHCOPL: Computation of electromagnetic coupling on a layered halfspace with complex conductivities: U.S. Geological Survey Open-File Report 79-1430, 91 p.
Long, C.L., and Pierce, H.A., 1986, BASIC program to reduce audio-magnetotelluric data and calculate apparent resistivity: U.S. Geological Survey Open-File Report 86-200, 17 p.
Murakami, Yutaka, Zerilli, Andrea, and Bisdorf, R.J., 1984, Improved digital filters for the calculation of Schlumberger sounding curves by convolution: U.S. Geological Survey Open-File Report 84-280, 18 p.
_____1986, A computer program for the automatic inversion of Schlumberger soundings using multi-layer interpretation followed by Dar Zarrouk reduction: U.S. Geological Survey Open-File Report 86-288, 45 p.
Olhoeft, G.R., 1988, Geophysics advisor expert system: U.S. Geological Survey Open-File Report 88-399 A-B, 2 p., 1 diskette.

Raab, P.V., 1983, Slingram data processing and profiling programs for the HP-85 desktop computer: U.S. Geological Survey Open-File Report 83-461, 55 p.
Watts, R.D., 1975, A Fortran IV program for analytic continuation of VLF electromagnetic data: U.S. Geological Survey Open-File Report 75-159, 28 p.
Zohdy, A.A.R., 1978, Field procedures and data reduction methods (with HP-97-67 programs) for total field resistivity surveys: U.S. Geological Survey Open-File Report 78-424, 35 p.
_____1980, HP-9845 program for computing and plotting full Schlumberger sounding curves and master sets over three vertical layers: U.S. Geological Survey Open-File Report 80-248, 29 p.
Zohdy, A.A.R., and Bisdorf, R.J., 1989, Programs for the automatic processing and interpretation of Schlumberger sounding curves in QuickBASIC 4.0: U.S. Geological Survey Open-File Report 89-137-A-B, 64 p., 1 diskette.

SPECTROSCOPY PROGRAMS

The USGS maintains a spectroscopy laboratory under the direction of Roger Clark. His array processing software (Clark, 1980) is geared toward processing large amounts of spectrophotometric astronomical data, but it can also be used for general one-dimensional array processing. More information, copies of the program, and a user's manual may be obtained by supplying a 2,400-ft tape to Clark (address at the end of this report).

Clark, R.N., 1980, A large-scale interactive one-dimensional array processing system: Astronomical Society of the Pacific Publications, v. 92, p. 221-224.
Theisen, A.F., 1985, Computer graphics--Mini-computer results from a micro: U.S. Geological Survey Open-File Report 85-675, 9 p.
_____1989, Porting the excitation-emission-matrix 3-D plotting program from Applesoft BASIC to IBM-compatable GW-BASIC: U.S. Geological Survey Open-File Report 89-312, 23 p.
Theisen, A.F., and Hemphill, W.R., 1985, Microcomputers in the luminescence laboratory--A technique for automating spectrometers: American Laboratory, v. 17, no. 9, p. 166-171.

ADDRESSES FOR AGENCIES AND INDIVIDUALS MENTIONED IN REPORT

New Publications of U.S. Geological Survey
582 National Center
Reston, VA 22092

U.S. Geological Survey
Open-File Services Section
Box 25425, Federal Center
Denver, CO 80225 (303) 236-7476

EROS Data Center
Data Services Officer
Sioux Falls, SD 57198 (605) 594-6507

National Cartographic Information Center
U. S. Geological Survey
507 National Center
Reston, VA 22092 (703) 860-6045

National Climatic Data Center
Satellite Data Services Division
Room 100, World Weather Bldg.
Washington, DC 20233 (301-763-8111)

National Geophysical Data Center
NOAA, Code E/GC4
325 Broadway
Boulder, CO 80303
magnetic data: Ronald Buhmann (303) 497-6128
gravity data: David Dater (303) 497-6120
topo, gravity, magnetics on CD-ROM: Allen Hittelman (303) 497-6591

National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Rd.
Springfield, VA 22161 (703) 487-4650
or (800) 336-4700

EOSAT (Earth Observation Satellite Company)
4300 Forbes Boulevard
Lanham, MD 20706 1-800-344-9933

SPOT Image Corporation
1897 Preston White Drive
Reston, VA 22091-4326 (703) 620-2200

U.S. Geological Survey
Branch of Geophysics
Box 25046, MS 964, Federal Center
Denver, CO 80225 (303) 236-1212

Roger Clark:	236-1332
Bill Hasbrouck:	236-1327
Pat Hill:	236-1343
Jackie Williams:	236-1203
Walt Anderson:	236-1395

Appendix A

EM Program List

U.S. Geological Survey

Oct. 18, 1989

The enclosed list contains Electromagnetic (EM) programs currently available from the U.S. Geological Survey. To obtain source codes of any programs listed, a computer magnetic tape (large 2400' reel is preferred) should be sent to Walter L. Anderson (address below); the requested programs will be reproduced to tape and returned free of charge. The source code will be written onto tape as 9-track, 1600-bpi density, ASCII-format, with standard ANSI-labeled files (unless otherwise requested). Any updates to the codes will be included on the tape and noted in the form of "VAX Help Notes", if it applies to a requested VAX program. VAX Help Notes are short summaries of new parameter definitions and/or changes to the original published program. We cannot provide the corresponding USGS or NTIS program documentation reports; however, Xerox or Microfiche copies may be obtained at nominal page charges by contacting the appropriate organization listed below.

USGS referenced open-file reports may be obtained from:

U.S. Geological Survey
Branch of Distribution
Open-File Services Section
Box 25425, Federal Center
Denver, CO 80225 Phone: (303) 236-7476

NTIS referenced reports may be obtained from:

National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Road
Springfield, VA 22161 Phone: (703) 487-4650
-or- (800) 336-4700

"VAX Help Notes" and source tape (user supplied) may be obtained from:

Walter L. Anderson
U.S. Geological Survey
Mail Stop 964
Box 25046, Federal Center
Denver, CO 80225 Phone: (303) 236-1395

NOTATIONS and OTHER INFORMATION (Please read before making any program request):

1. All program reference numbers ending in "v" (e.g., 004v) are later VAX-versions of the corresponding REF numbers without a suffix. The VAX-version program NAME may or may not differ from the original published program; also, the VAX-version may contain updates not included in the published non-VAX versions. (All updates will be noted in a "VAX Help Note" for the programs requested.)

2. REF numbers ending in "d" (e.g., 017d) indicates a double-precision version of the corresponding single-precision numbered program.

3. All VAX inverse programs (denoted by names starting with NLS---) have been significantly improved using subprogram NLSOL2 (see REF 018).

4. A new forward (FWD) program series is easily obtained by interfacing any NLS-inversion program with subprogram FWDSOL (see REF 028). Thus, new stand-alone FWD-programs will contain the same updates as in the current NLS-inversion program; the original non-FWD forward programs will not necessarily contain the latest updates as in the corresponding NLS-inversion program. (See REF 028 on how to generate FWD-programs from NLS-programs, or conversely, NLS-programs from FWD-programs.)

   NOTE: Most of the original non-FWD forward programs are now considered obsolete, but are still available if requested. Whenever any NLS-inversion program is requested, the corresponding FWD-program will also be included on the tape; hence, FWD-programs are not listed immediately below the corresponding NLS-inversion program.

5. Some of the VAX/VMS programs are being converted to an HP-9000/Unix system; however, they are not available for distribution at this date, except for two new programs (see REF 035). I plan to replace some of the older VMS programs with corresponding Unix versions (time permitting). Other VMS programs and Multics programs will not be converted to Unix, but will still be available as noted in this list.

REF NO.	PROGRAM NAME	TITLE/PURPOSE/SCOPE	NUMERICAL METHODS	DOCUMENTATION AVAILABLE	SOURCE-CODE:MACHINE (OPERATING SYSTEM)	PROGRAM CLASSIFICATION
001	EMFIN4	EM fields about a finite electric wire source. Computes all E,H fields for layered models in freq. or time domains.	Numerical integration by convolution or Gaussian quadrature.	NTIS Report PB-238-199 (1974) Rev. 1977	Fortran-IV:HONEYWELL-68/80 (Multics)	Forward modeling
001v	EMFIN4	"	"	VAX Help Notes	Fortran-77:VAX-11/780 (VMS)	Forward modeling
002	HANKEL/ FOURIER PACKAGE	Improved digital filters for evaluating Hankel and Fourier transforms.	Numerical integration by convolution and lagged convolution.	NTIS Report PB-242-800 (1975)	Fortran-IV:HONEYWELL-68/80 (Multics)	Subroutine package
002v	"	"	"	"	Fortran-77:VAX-11/780	Subr. package
003	EMLOOPS	EM fields for loop-loop freq. forward solutions for layered models.	Numerical integration by related convolution.	VAX Help Notes	Fortran-77:VAX-11/780 (VMS)	Forward modeling
004	MARQHZP	Inversion of Hz-freq. soundings from a finite wire source (or electric dipole).	Nonlinear least-squares using convolution (or Gaussian quadrature).	NTIS Report PB-263-924 (1977) Rev. 1979	Fortran-IV:HONEYWELL 68/80 (Multics)	Inverse modeling
004v	NLSHZ	"	"	VAX Help Notes	Fortran-77:VAX-11/780 (VMS)	Inverse modeling
005	SCATPW2	EM scattering by multiple conductors in a halfspace for plane wave source and 2D bodies.	Integral equation approx. and numerical integration by convolution.	NTIS Report PB-261-183 (1976)	Fortran-IV:HONEYWELL-68/80 (Multics)	Forward modeling
006	SCATLN2	EM scattering by multiple conductors in a halfspace for a line source and 2D bodies.	Integral equation approx. and numerical integration by convolution.	GEOPHYSICS, v.36,no.1, p.101-131 (Feb 1971)	Fortran-IV:HONEYWELL-68/80 (Multics)	Forward modeling
007	MARQ-LOOPS	Inversion of loop-loop frequency soundings for 5 loop types and/or Schlumberger soundings.	Nonlinear least-squares using num. integration by related convolution.	USGS Open-File Report 79-240 (1979)	Fortran-IV:HONEYWELL-68/80 (Multics)	Inverse modeling
007v	NLS-LOOP3	"	"	VAX Help Notes	Fortran-77:VAX-11/780 (VMS)	Inverse modeling
008	TRANS-HCLOOP/ HZWIRE	Transient horiz. coplanar loop-loop / wire-loop forward solutions for layered models.	Numerical integration by lagged convolution and cubic splines.	USGS Open-File Report 79-590 (1979)	Fortran-IV:HONEYWELL-68/80 (Multics)	Forward modeling
008v	THCLOOP/ THZWIRE	"	"	VAX Help Notes	Fortran-77:VAX-11/780 (VMS)	Forward modeling

REF NO.	PROGRAM NAME	TITLE/PURPOSE/SCOPE	NUMERICAL METHODS	DOCUMENTATION AVAILABLE	SOURCE-CODE:MACHINE (OPERATING SYSTEM)	PROGRAM CLASSIFICATION
009	IMSLPW	Inversion of MT/AMT plane wave frequency soundings (1D layered models).	Nonlinear least-squares.	USGS Open-File Report 79-586 (1979)	Fortran-IV:HONEYWELL-68/80 (Multics)	Inverse modeling
009v	NLSPW	"	"	VAX Help Notes	Fortran-77:VAX-11/780 (VMS)	Inverse modeling
010	TRANS-PACKAGE	Computes transient soundings for horizontal finite wire source for all E,H fields over layered models.	Numerical integration by lagged convolution and cubic splines.	NTIS Report PB-274-119 (1977) Rev. 1979	Fortran-IV:HONEYWELL-68/80 (Multics)	Forward modeling
011	MARQ-TRANS-HCLOOP	Inversion of transient horiz. coplanar loop-loop soundings.	Nonlinear least-squares using lagged convolution and cubic splines.	USGS Open-File Report 79-773 (1979)	Fortran-IV:HONEYWELL-68/80 (Multics)	Inverse modeling
011v	NLSTHC	"	"	VAX Help Notes	Fortran-77:VAX-11/780 (VMS)	Inverse modeling
012	ZHANKS	Numerical integration of related Hankel transforms of orders 0 and 1 by adaptive digital filtering.	Numerical integration by convolution for related transforms.	GEOPHYSICS, v.44,no.7, p.1287-1305 (July 1979)	Fortran-IV:HONEYWELL-68/80 (Multics)	Subroutine psckage
012v	ZHANKS	"	"	"	Fortran-77:VAX-11/780 (VMS)	Subroutine package
013	MARQ-DCLAG	Inversion of DC Schlumberger soundings by lagged convolution.	Nonlinear least-squares using lagged convolution and cubic splines.	USGS Open-File Report 79-1432 (1979)	Fortran-IV:HONEYWELL-68/80 (Multics)	Inverse modeling
013v	NLSDCLAG	"	"	VAX Help Notes	Fortran-77:VAX-11/780 (VMS)	Inverse modeling
014	EMCUPL/ SCHCOPL	EM coupling on a layered halfspace with complex conductivities (general arrays and Schlumberger).	Numerical integration by lagged convolution, adaptive quadrature, and splines.	USGS Open-File Report 79-1430 (1979) Rev. 1984 VAX Help	Fortran-77:VAX-11/780 (VMS)	Forward modeling
015	MARQHXY	Inversion of Hx and Hy frequency soundings from a finite wire source.	Nonlinear least-squares using related convolution.	USGS Open-File Report 80-901 (1980)	Fortran-IV:HONEYWELL-68/80 (Multics)	Inverse modeling
015v	NLSHXY	"	"	VAX Help Notes	Fortran-77:VAX-11/780 (VMS)	Inverse modeling

REF NO.	PROGRAM NAME	TITLE/PURPOSE/SCOPE	NUMERICAL METHODS	DOCUMENTATION AVAILABLE	SOURCE-CODE:MACHINE (OPERATING SYSTEM)	PROGRAM CLASSIFICATION
016	IMSLEXY	Inversion of Ex and Ey frequency soundings from s finite wire source.	Nonlinear least-squares using related convolution.	USGS Open-File Report 80-1073 (1980)	Fortran-IV:HONEYWELL-68/80 (Multics)	Inverse modeling
016v	NLSEXY	"	"	VAX Help Notes	Fortran-77:VAX-11/780 (VMS)	Inverse modeling
017	TCILOOP	Trsnsient soundings for central-induction loop; forward solutions for layered models.	Numerical integration by lagged convolution and cubic splines.	USGS Open-File Report 81-1309 (1981)	Fortran-77:VAX-11/780 (VMS)	Forward modeling
017d	DTCILOOP	" (in double-precision)	"	VAX Help Notes	Fortran-77:VAX-11/780 (VMS)	Forward modeling
018	NLSOL2	Adaptive nonlinear least-squares for constrained, unconstrained minimization problems.	Adsptive Hessian approximation for general nonlinear least-squares.	USGS Open-File Report 82-68 (1982)	Fortrsn-77:VAX-11/780 (VMS)	Subroutine Package
019	SQJ1	Fast evaluation of squared-Hankel transforms of order-1.	Numerical integration by convolution.	USGS Open-File Report 82-224 (1982)	Fortran-77:VAX-11/780 (VMS)	Subroutine
020	TCOLOOP	Transient soundings for coincident loop system; forward solutions for layered models.	Numerical integration by lagged convolution and cubic splines.	USGS Open-File Report 82-378 (1982)	Fortran-77:VAX-11/780 (VMS)	Forward modeling
021	NLSTCO	Inversion of transient soundings using a coincident loop system for layered models.	Nonlinear least-squares using lagged convolution and cubic splines.	USGS Open-File Report 82-1064 (1982)	Fortran-77:VAX-11/780 (VMS)	Inverse modeling
022	NLSTCI	Inversion of transient soundings using a central induction loop system for layered models.	Nonlinear least-squares using lagged convolution and cubic splines.	USGS Open-File Report 82-1129 (1982)	Fortran-77:VAX-11/780 (VMS)	Inverse modeling
023	FINEGRID	2D-bicubic spline fine-grid interpolation prior to smooth contouring (with subgrid options)	Bicubic splines over rectangular dats grids.	NTIS Report PB-203-579 (1971). Also VAX Help Notes	Fortran-77:VAX-11/780 (VMS)	Utility Package
024	SECDER	2nd-vertical derivstive grid using FINEGRID's bicubic spline output (also gradient grid)	Bicubic splines over rectangular data grids and Lsplace's eq.	NTIS Report PB-203-579 (1971). Also VAX Help Notes	Fortran-77:VAX-11/780 (VMS)	Utility Package

REF NO.	PROGRAM NAME	TITLE/PURPOSE/SCOPE	NUMERICAL METHODS	DOCUMENTATION AVAILABLE	SOURCE-CODE:MACHINE (OPERATING SYSTEM)	PROGRAM CLASSIFICATION
025	HANKEL/ DHANKL	Fast Hankel transforms using related & lagged convolutions (single/ double precision)	Numerical integration by related & lagged convolution methods	ACM Trans.Math. Software, v.8, no.4, p.344-368 (Dec 1982)	Fortran-77:VAX-11/780 (VMS)	Subroutine package
026	DLAGF0/ DLAGF1	Fourier cosine/sine transforms (in double-precision)	Numerical integration by lagged convolution	USGS Open-File Report 83-320 (1983)	Fortran-77:VAX-11/780 (VMS)	Subroutine Package
027	DTHCLOOP	Transient horiz. coplanar loop-loop forward models (double-precision THCLOOP in REF 008v)	Numerical integration by lagged convolution	VAX Help Notes	Fortran-77:VAX-11/780 (VMS)	Forward modeling
028	FWDSOL	General interface for producing forward solution programs	Uses NLSOL2 (REF 018) subprogram require-ments	USGS Open-File Report 84-348 (1984)	Fortran-77:VAX-11/780 (VMS)	Subroutine Package
029	HRZRECT	Freq. Hr, Hz soundings near a rectangular loop on a layered earth	Numerical integration by lagged convolution and cubic splines.	USGS Open-File Report 84-257 (1984)	Fortran-77:VAX-11/780 (VMS)	Forward modeling
030	NLSTIP	Inversion of transient induced polarization data	Nonlinear least-squares using convolution and/or numerical integration.	USGS Open-File Report 84-514 (1984)	Fortran-77:VAX-11/780 (VMS)	Inverse modeling
031	FWDTHZ	Transient Hz soundings near a rectangular loop on a layered earth	Numerical integration by lagged convolution and cubic splines.	USGS Open-File Report 85-270 (1985)	Fortran-77:VAX-11/780 (VMS)	Forward modeling
032	NLSIP	Inversion of frequency induced polarization data	Nonlinear least-squares	USGS Open-File Report 86-280 (1986)	Fortran-77:VAX-11/780 (VMS)	Inverse modeling
033	NLSBPBP	Inversion of bipole-bipole direct-current data	Nonlinear least-squares using lagged convolution	USGS Open-File Report 87-95 (1987)	Fortran-77:VAX-11/780 (VMS)	Inverse modeling
034	HYBFHT/ HY2FHT (+DOC file)	Hybrid fast Hankel trans-form by filtering and quadrature (single/ double precision)	Numerical integration by related & lagged convolution and quadrature methods	GEOPHYSICS v.54,no.2, p.263-266 (Feb 1989)	Fortran-77:VAX-11/780 (VMS)	Subroutine package

REF NO.	PROGRAM NAME	TITLE/PURPOSE/SCOPE	NUMERICAL METHODS	DOCUMENTATION AVAILABLE	SOURCE-CODE:MACHINE (OPERATING SYSTEM)	PROGRAM CLASSIFICATION
035	NLSINF/ FWDINF (+test files)	Inversion of infinite line source data /or forward soundings for infinite line source	Numerical integration by lagged convolution	USGS Open-file Report 89-555 (1989)	Fortran-77:HP-9000 (Unix)	Inverse/Forward modeling