Digital aeromagnetic data and derivative products from a helicopter survey over the Town of Taos and surrounding areas, Taos County, New Mexico.

By Viki Bankey, V.J.S. Grauch, and Fugro Airborne Surveys Corporation

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Abstract

This CD-ROM contains digital data, image files, and text files describing data formats and survey procedures for aeromagnetic data collected during a helicopter geophysical survey in northern New Mexico during October 2003. The survey covers the Town of Taos, Taos Pueblo, and surrounding communities in Taos County. Several derivative products from these data are also presented, including reduced-to-pole, horizontal gradient magnitude, and downward continued grids and images.

Introduction

This report describes data collected from a helicopter aeromagnetic survey flown over the Town of Taos and surrounding areas in northern New Mexico (Taos survey on Fig. 1). It is one of two surveys conducted in the San Luis Basin in October 2003 by Fugro Airborne Surveys Corporation under contract with the U. S. Geological Survey (USGS). The overall objective of these surveys is to improve knowledge of the subsurface geologic framework as part of multi-disciplinary and multi-agency efforts to understand ground-water systems in populated alluvial basins along the Rio Grande. Data for the Blanca survey in southern Colorado is contained in a companion report (Bankey and others, 2004).

Acquisition of the Taos survey was made possible through the coordination efforts of the New Mexico Bureau of Geology and Mineral Resources, with funding provided by U. S. Bureau of Reclamation, U. S. Bureau of Indian Affairs, Taos Soil and Water Conservation District, the Town of Taos, and Taos County. Additional interpretative work is being conducted under a project jointly funded by USGS and the New Mexico Office of the State Engineer.

Organization of CD-ROM

The files on this CD-ROM and the contents of the four folders (directories) are briefly explained in Table 1. The "readme.txt" file provides summaries of the contents of the CD-ROM. The four folders (directories) are organized as follows. Files pertaining to this report are contained in the

"report" folder; files pertaining to the gridded data are contained in the "grids" folder; files pertaining to the flight-line data are contained in the "linedata" folder; and files pertaining to the color shaded-relief images are contained in the "images" folder. In each folder, ASCII files with the extension ".txt" describe the format and contents of the data files. Please read the ".txt" files before using the data files.

Description of Data

Aeromagnetic data are collected during airborne geophysical surveys that measure subtle variations in the Earth's magnetic field. Aeromagnetic surveys are designed to map variations caused by the magnetic properties of underlying rocks. High-resolution surveys are flown closer to the ground and with narrower line spacing than conventional aeromagnetic surveys to better detect weakly magnetic rocks. A helicopter was used to collect data to maintain low clearance over the high-relief range fronts.

The aeromagnetic survey for the Taos area (Fig. 1) employed a helicopter flying along traverse lines oriented east-west, spaced 200 m (about 650 ft) apart, and flown a nominal 150 m (500 ft) above ground. Orthogonal lines were flown north-south at a 1000-m (3280 ft) spacing. Total line-kilometers flown was 140.8 km. The east-west orientation of traverse lines was chosen because it is oblique to the predominant northerly to northeasterly geologic strike of the area. The flight-line data from the contractor are included in this report. Further details of the flight specifications, survey procedures, and data processing are included in Appendix A.

Derivative Products

Reduced-to-pole Magnetic Data

The residual magnetic field channel had already been properly corrected using the Definitive Geomagnetic Reference Field by the contractors, so no further main field corrections were necessary before gridding. The data were interpolated onto a grid at 50-m intervals. Projection is UTM, zone 13 N (central meridian of -105° W. long., a false easting of 500,000 m., a false northing of 0 m, and using the NAD27 datum). The reduction-to-pole (RTP) transformation corrects for the offset between the locations of anomalies (closed highs or lows on a contour map) and their sources that is a consequence of the vector nature of the Earth's magnetic field (Blakely, 1995). To apply the reduced-to-pole transformation, one must assume that the total magnetizations of most rocks in the study area align parallel or anti-parallel to the Earth's main field (declination=10°, inclination=64° for the study area). Based on considerations of rock type and age in the area, this assumption is generally valid (Grauch and others, 2004).

Enhanced Reduced-to-pole Magnetic Data

The RTP magnetic grid was downward continued to a reference surface 100 m above ground, using the chessboard method of Cordell and Grauch (1985). In the chessboard method, the continued data are extrapolated from a series of parallel continuation surfaces that each have been computed using standard Fast Fourier transform (FFT) techniques (e.g., Blakely, 1995). The radar-altimeter channel was used to create the terrain clearance grid, which, in turn, determined the distances to continue the data. Radar-altimeter data from the contractor were

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leveled using the tie-line data to better approximate the flight surface. Downward continuation significantly enhances details in aeromagnetic maps, but also amplifies noise. The downward continued, reduced-to-pole aeromagnetic data are presented as a color shaded-relief image. The zero level (datum) of these data is arbitrary.

Horizontal Gradient Magnitude

The edges of magnetic sources represent abrupt lateral rock-property contrasts that may occur at faults or steeply dipping contacts. The horizontal-gradient method is commonly used to detect magnetic source edges semi-automatically, using the horizontal gradient magnitude of pseudogravity data (Cordell and Grauch, 1985; Blakely and Simpson, 1986) or reduced-to-pole magnetic data (Phillips, 2000; Grauch and others, 2001). Pseudogravity data, or the magnetic potential, is a vertical integral of the reduced-to-pole magnetic data (Baranov, 1957; Blakely, 1995). The pseudogravity data (which have nothing to do with the observed gravity field) are derived from the original aeromagnetic data and enhance broad features at the expense of shorter-wavelength details. The slopes of pseudogravity or reduced-to-pole curves over magnetic sources are steepest over near-vertical edges. The steepest slopes are found from the maximum of the magnitude of the horizontal gradient, analogous to computing a derivative to find the inflection point of a curve.

Acknowledgments

Table 1. List of files, formats and descriptions in this report.

FILE NAME	FORMAT TYPE	DESCRIPTION
readme.txt	ASCII text	Text file explaining how to read and use the files of this CD-ROM.
----- REPORT folder ----		
report.pdf	portable document format	A file containing the text of this report, with hyperlink to the appendix and figure.
appendix.pdf	portable document format	Contractor's report on the aeromagnetic data collection.
----- GRIDS folder ----		
gxfinfo.txt	ASCII text	Description of grids with the extension .gxf and explanation of grid exchange format.
tmaggrd.gxf	grid exchange format	Leveled total-intensity magnetic data for the Taos survey.
trtpgrd.gxf	grid exchange format	Reduced-to-the-pole (RTP) magnetic data for the Taos survey.
trdrgrd.gxf	grid exchange format	Leveled radar altimeter measurements for the Taos survey.
trcgrd.gxf	grid exchange format	Continued, reduced-to-the-pole (RTP) magnetic data for the Taos survey. Data were continued to a surface 100 m above ground.
t83rcgrd.gxf	grid exchange format	Continued, reduced-to-the-pole (RTP) magnetic data for the Taos survey. Data were continued to a surface 100 m above ground. Datum used is NAD83
tpdhggrd.gxf	grid exchange format	Magnitude of the horizontal gradient of pseudogravity for the Taos survey. Pseudogravity was derived from continued RTP magnetic data.
trchggrd.gxf	grid exchange format	Magnitude of the horizontal gradient of continued RTP magnetic data for the Taos survey.
E00info.txt	ASCII text	Description of grids with the extension .e00 and explanation of ARC exchange format.
tmaggrd.e00	ARC exchange format	Leveled total-intensity magnetic data for the Taos survey.
trtpgrd.e00	ARC exchange format	Reduced-to-the-pole (RTP) magnetic data for the Taos survey.
trdrgrd.e00	ARC exchange format	Leveled radar altimeter measurements for the Taos survey.

FILE NAME	FORMAT TYPE	DESCRIPTION
trcgrd.e00	ARC exchange format	Continued, reduced-to-the-pole (RTP) magnetic data for the Taos survey. Data were continued to a surface 100 m above ground.
t83rcgrd.e00	ARC exchange format	Continued, reduced-to-the-pole (RTP) magnetic data for the Taos survey. Data were continued to a surface 100 m above ground. Datum used is NAD83.
tpdhggrd.e00	ARC exchange format	Magnitude of the horizontal gradient of pseudogravity for the Taos survey. Pseudogravity was derived from continued RTP magnetic data.
trchggrd.e00	ARC exchange format	Magnitude of the horizontal gradient of continued RTP magnetic data for the Taos survey.
-----LINEDATA folder ----		
linesinfo.asc	ASCII format	Description of the information and format of the flight-line data file.
tlines.asc	ASCII format	Final information from the contractor for the Taos survey as sampled along the flight lines.
-----IMAGES folder ----		
imginfo.txt	ASCII text	Description of the files containing color-shaded relief images developed in ERMapper from the magnetic data.
tmagimg.tif tmagimg.tfw	Tagged image format Geotif ASCII header file	Color shaded-relief image of leveled total-intensity magnetic data for the Taos survey, and georegistration file. No text annotation or scales.
trcwlimg.tif trcwlimg.tfw	Tagged image format Geotif ASCII header file	Color shaded-relief image of continued, reduced-to-the-pole (RTP) magnetic data for the Taos survey, and georegistration file. Image uses shading from the west and a linear color scale. No text annotation or scales.
trcwqimg.tif trcwqimg.tfw	Tagged image format Geotif ASCII header file	Color shaded-relief image of continued, reduced-to-the-pole (RTP) magnetic data for the Taos survey, and georegistration file. Image uses shading from the west and a histogram-equalized color scale. No text annotation or scales.
tpdhgimg.tif tpdhgimg.tfw	Tagged image format Geotif ASCII header file	Color shaded-relief image of magnitude of the horizontal gradient of pseudogravity for the Taos survey, and georegistration file. No text annotation or scales.

FILE NAME	FORMAT TYPE	DESCRIPTION
trchgimg.tif trchgimg.tfw	Tagged image format Geotif ASCII header file	Color shaded-relief image of magnitude of the horizontal gradient of continued RTP magnetic data for the Taos survey, and georegistration file. No text annotation or scales.
tmagprn.pdf	portable document format	Color shaded-relief image of leveled total-intensity magnetic data for the Taos survey.
trdrprn.pdf	portable document format	Color image of leveled radar altimeter measurements for the Taos survey. Flight-line locations are shown.
trcwlprn.pdf	portable document format	Color shaded-relief image of continued, reduced-to-the-pole (RTP) magnetic data for the Taos survey. Image uses shading from the west and a linear color scale.
trcwqprn.pdf	portable document format	Color shaded-relief image of continued, reduced-to-the-pole (RTP) magnetic data for the Taos survey. Image uses shading from the west and a histogram-equalized color scale.
tpdhgprn.pdf	portable document format	Color shaded-relief image of magnitude of the horizontal gradient of pseudogravity for the Taos survey.
trchgprn.pdf	portable document format	Color shaded-relief image of magnitude of the horizontal gradient of continued RTP magnetic data for the Taos survey.

References cited

Bankey, Viki, Grauch, V.J.S., and Fugro Airborne Surveys Corp., 2004, Digital aeromagnetic data and derivative products from a helicopter survey over the Town of Blanca and surrounding areas, Alamosa and Costilla Counties, Colorado: U.S. Geological Survey Open-File Report 2004-1229B.

Baranov, V., 1957, A new method for interpretation of aeromagnetic maps: pseudo-gravimetric anomalies: Geophysics, v. 22, p. 359-383.

Blakely, R.J., 1995, Potential theory in gravity and magnetic applications: Cambridge University Press, 441 pp.

Blakely, R.J., and Simpson, R.W., 1986, Approximating edges of source bodies from magnetic or gravity anomalies: Geophysics, v. 51, p. 1494-1498.

Cordell, L., and Grauch, V.J.S., 1985, Mapping basement magnetization zones from aeromagnetic data in the San Juan Basin, New Mexico, *in* Hinze, W.J., ed., The Utility of Regional Gravity and Magnetic Anomaly Maps: Society of Exploration Geophysicists: Tulsa, Oklahoma, p. 181-197.

Grauch, V.J.S., Bauer, P.W., and Kelson, K.I., 2004, Preliminary interpretation of high-resolution aeromagnetic data collected near Taos, New Mexico: New Mexico Geological Society Guidebook 55, in press.

Grauch, V.J.S., Hudson, M.R., and Minor, S.A., 2001, Aeromagnetic expression of faults that offset basin fill, Albuquerque basin, New Mexico: Geophysics, v. 66, p. 707-720.

Phillips, J.D., 2000, Locating magnetic contacts: a comparison of the horizontal gradient, analytic signal, and local wavenumber methods: 70th Meeting, Society of Exploration Geophysicists, Calgary, Expanded Abstracts.
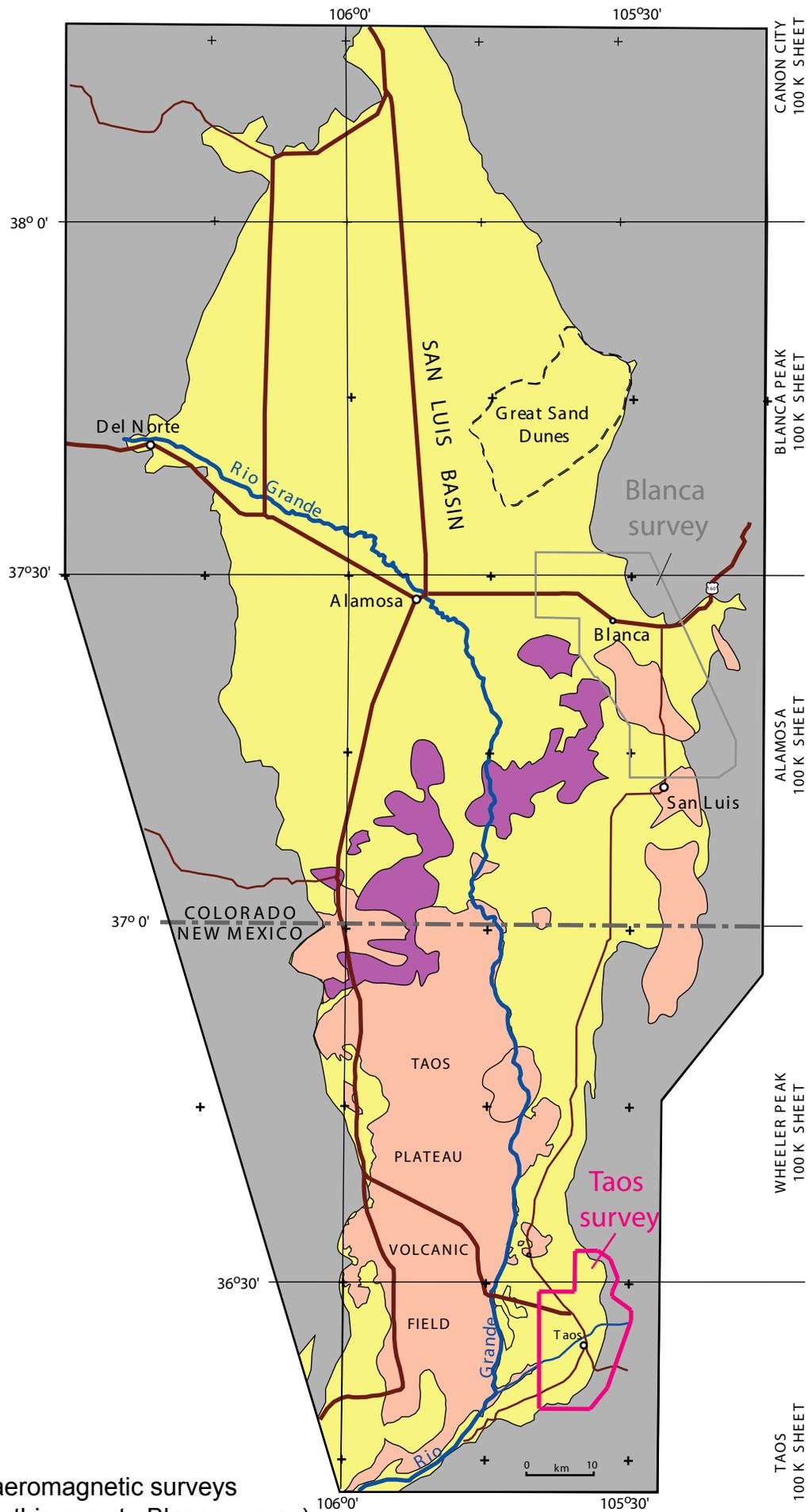
Figure 1. Location of aeromagnetic surveys
(Taos = red, this report, Blanca = gray)