Digital Data from the Great Sand Dunes and Poncha Springs Aeromagnetic Surveys, South-Central Colorado

Open-File Report 2009–1089

U.S. Department of the Interior
U.S. Geological Survey

U.S. Department of the Interior
KEN SALAZAR, Secretary

U.S. Geological Survey
Suzette M. Kimbell, Acting Director

U.S. Geological Survey, Reston, Virginia 2009

For product and ordering information:
World Wide Web: http://www.usgs.gov/pubprod

For more information on the USGS—the Federal source for science about the Earth, its natural and living resources, natural hazards, and the environment:
World Wide Web: http://www.usgs.gov
Telephone: 1-888-ASK-USGS

Suggested citation:
Drenth, B.J., Grauch, V.J.S., Bankey, Viki, and New Sense Geophysics, Ltd., 2009, Digital data from the Great Sand Dunes and Poncha Springs aeromagnetic surveys, south-central Colorado: U.S. Geological Survey Open-File Report 2009–1089.

Digital data from the Great Sand Dunes and Poncha Springs Aeromagnetic Surveys, South-Central Colorado

By B.J. Drenth[1], V.J.S. Grauch[1], Viki Bankey[1], and New Sense Geophysics, Ltd.[2]

Abstract

This report contains digital data, image files, and text files describing data formats and survey procedures for two high-resolution aeromagnetic surveys in south-central Colorado: one in the eastern San Luis Valley, Alamosa and Saguache Counties, and the other in the southern Upper Arkansas Valley, Chaffee County. In the San Luis Valley, the Great Sand Dunes survey covers a large part of Great Sand Dunes National Park and Preserve and extends south along the mountain front to the foot of Mount Blanca. In the Upper Arkansas Valley, the Poncha Springs survey covers the town of Poncha Springs and vicinity.

Several derivative products from these data are also presented as grids and images, including reduced-to-pole aeromagnetic data. Images are presented in various formats and are intended to be used as input to geographic information systems, standard graphics software, or map-plotting packages.

Introduction

This report describes data collected from high-resolution aeromagnetic surveys flown over two areas in south-central Colorado. In the San Luis Valley, the Great Sand Dunes survey covers a large part of Great Sand Dunes National Park and Preserve (GRSA) and extends south along the mountain front to the foot of Blanca Peak (fig. 1). In the Upper Arkansas Valley, the Poncha Springs survey covers the town of Poncha Springs and vicinity (fig. 2). Both surveys were flown in October 2008 by Upper Limit Aviation, Inc., for New Sense Geophysics, Ltd., on contract to the U.S. Geological Survey (USGS). Scientific objectives for the Great Sand Dunes survey are to investigate the subsurface structural framework that may influence ground-water hydrology, seismic hazards, or geothermal resources. Funding was provided by the USGS, National Park Service, and Colorado Geological Survey. The southern portion of this survey area connects with high-resolution aeromagnetic surveys flown previously in the southern San Luis basin (Bankey and others, 2004a, b; 2005; 2006; 2007). The surveys are part of an ongoing USGS project called "Geologic Framework of Rio Grande Basins," with an overall goal to understand the subsurface geologic framework of the San Luis basin in order to improve input to regional ground-water models. The main objective of the Poncha Springs survey is to map concealed faults that may be related to geothermal resources, such as hot springs. Funding was provided by the Colorado Governor's Energy Office and the USGS, in partnership with the Colorado Geological Survey.

[1] U.S. Geological Survey, Denver, CO.
[2] Contractor, Toronto, Ontario, Canada.

Organization of Data

The "readme.txt" file provides summaries of the file contents. The folders 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 the data folders, 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 using airborne geophysical sensors that measure subtle variations in the Earth's magnetic field. Aeromagnetic surveys are designed to map the variations caused by the irregular distribution of naturally occurring magnetic minerals associated with geologic features. High-resolution surveys such as these are flown closer to the ground and with narrower line spacing than conventional aeromagnetic surveys to better detect weakly magnetic rocks and sediments, as well as anomalies of smaller aerial extent. Mapping the three-dimensional underground distribution of these features helps scientists understand the geologic controls on regional ground-water systems.

The aeromagnetic surveys (figs. 1 and 2) employed a helicopter with an attached stinger flying along traverse lines spaced 150 m (about 500 ft) apart and oriented roughly east-west (90^{o}–270^{o} for the Great Sand Dunes area and 23^{o}–203^{o} for the Poncha Springs area). Over most of the survey area, the pilot followed a preplanned flight surface that was generally 100 m (328 ft) above ground for the Great Sand Dunes area and 150 m (about 500 ft) above ground for the Poncha Springs area. The aircraft smoothly increased in flight height, subject to safety precautions, to equalize rates of climb and descent over high topography. Orthogonal tie lines were flown roughly north-south at a 1,500 m (4,920 ft) spacing at the same elevation as the flight lines. Total flight-line coverage was 3,609.5 line-kilometers for the Great Sand Dunes area and 960.5 line-kilometers for the Poncha Springs area. The orientation of traverse lines was chosen to be oblique to the predominant geologic strike of the area.

Data Processing

Contractor-provided details of the flight specifications, survey procedures, and data processing are included in Appendix 1. The flight-line data from the contractor are also included in this report.

Problems arose in the radar altimeter measurements in the Great Sand Dunes area, caused by the scattering effect of the sand dunes on the radar signal. For those flight lines, laser altimeter measurements were substituted. The problem and solution are described in more detail by the contractor in Appendix 1. For the Poncha Springs block, laser altimeter data were not needed for data processing.

The magnetic and radar data were interpolated onto a grid at 50-m intervals. The map projection used is Universal Transverse Mercator (UTM), zone 13 (central meridian of 105^{o} W longitude, a false easting of 500,000 m, a false northing of 0 m), and North American Datum of 1927 (NAD27). Gridded magnetic and radar data, as well as digital elevation model data, are also included that use the WGS84 datum.

The gridded altitude data, whether radar alone or a combination of radar and laser, are included in the 'grids' directory and contain the phrase 'radar' in the file name. From these altimeter data, a digital terrain model was calculated, and these grids contain the phrase 'topo' in the file name.

To enhance details and provide better consistency for interpretation, the final magnetic grid was continued to a simulated flight surface of 100 m above the ground, using the "chessboard" draping method of Cordell (1985). In this continuation method, the continued data are extrapolated from a series of parallel continuation surfaces that have each been computed using standard FFT techniques. The grid of radar-altimeter values determined the distances to upward or downward continue the data to a common terrain clearance of 100 m. A low-pass filter was applied during downward continuation based on a cosine-squared roll-off function that increases the wavelength cutoff with greater continuation distance. As implemented by OASIS Montaj™, the wavelength cutoff is inversely proportional to the continuation distance. A high-cut factor of 1.5 was applied to reduce high-frequency noise produced by downward continuation.

A standard reduction-to-pole operator was applied to the residual magnetic data. This operation, resulting in reduced-to-pole (RTP) data, corrects for shifts of the main anomaly from the center of the magnetic source that occur at most latitudes owing to the oblique orientation of the measured magnetic field with respect to the Earth's surface (the field is vertical only at the magnetic poles). From geomagnetic field models, the declination and inclination of the Earth's field are 9.2^{o} and 64.8^{o}, respectively, for the Great Sand Dunes survey, and 9.7^{o} and 65.4^{o}, respectively, for the Poncha Springs survey. 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. Based on considerations of rock type and age in the area, this assumption is generally valid (Grauch and others, 2004).

References Cited

Bankey, Viki, Grauch, V.J.S., and Fugro Airborne Surveys Corp., 2004a, Digital aeromagnetic data and derivative products from a helicopter survey over the town of Taos and surrounding areas, Taos County, New Mexico: U.S. Geological Survey Open-File Report 2004–1229A, CD–ROM.

Bankey, Viki, Grauch, V.J.S., and Fugro Airborne Surveys Corp., 2004b, Digital aeromagnetic data and derivative products from the Blanca airborne survey, covering areas in Costilla and Alamosa County, Colorado: U.S. Geological Survey Open-File Report 2004–1229B, CD–ROM.

Bankey, Viki, Grauch, V.J.S., Webbers, Ank, and PRJ, Inc., 2005, Digital data and derivative products from a high-resolution aeromagnetic survey of the central San Luis basin, covering parts of Alamosa, Conejos, Costilla, and Rio Grande Counties, Colorado, and Taos County, New Mexico: U.S. Geological Survey Open-File Report 2005–1200, CD–ROM.

Bankey, Viki, Grauch,V.J.S., Drenth, B.J., and Geophex, Ltd., 2006, Digital data from the Questa-San Luis and Santa Fe East helicopter magnetic surveys in Santa Fe and Taos Counties, New Mexico, and Costilla County, Colorado: U.S. Geological Survey Open-File Report 2006–1170. Available online at *http://pubs.usgs.gov/of/2006/1170/* .

Bankey, Viki, Grauch, V.J.S., Drenth, B.J., and EDCON–PRJ Inc., 2007, Digital data from the Taos West aeromagnetic survey in Taos County, New Mexico: U.S. Geological Survey Open-File Report 2007–1248.

Cordell, L., 1985, Techniques, applications, and problems of analytical continuation of New Mexico aeromagnetic data between arbitrary surfaces of very high relief: Proceedings of the International Meeting on Potential Fields in Rugged Topography, Institute of Geophysics, University of Lausanne, Switzerland, Bulletin no. 7, p. 96–101.

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, p. 244–256.

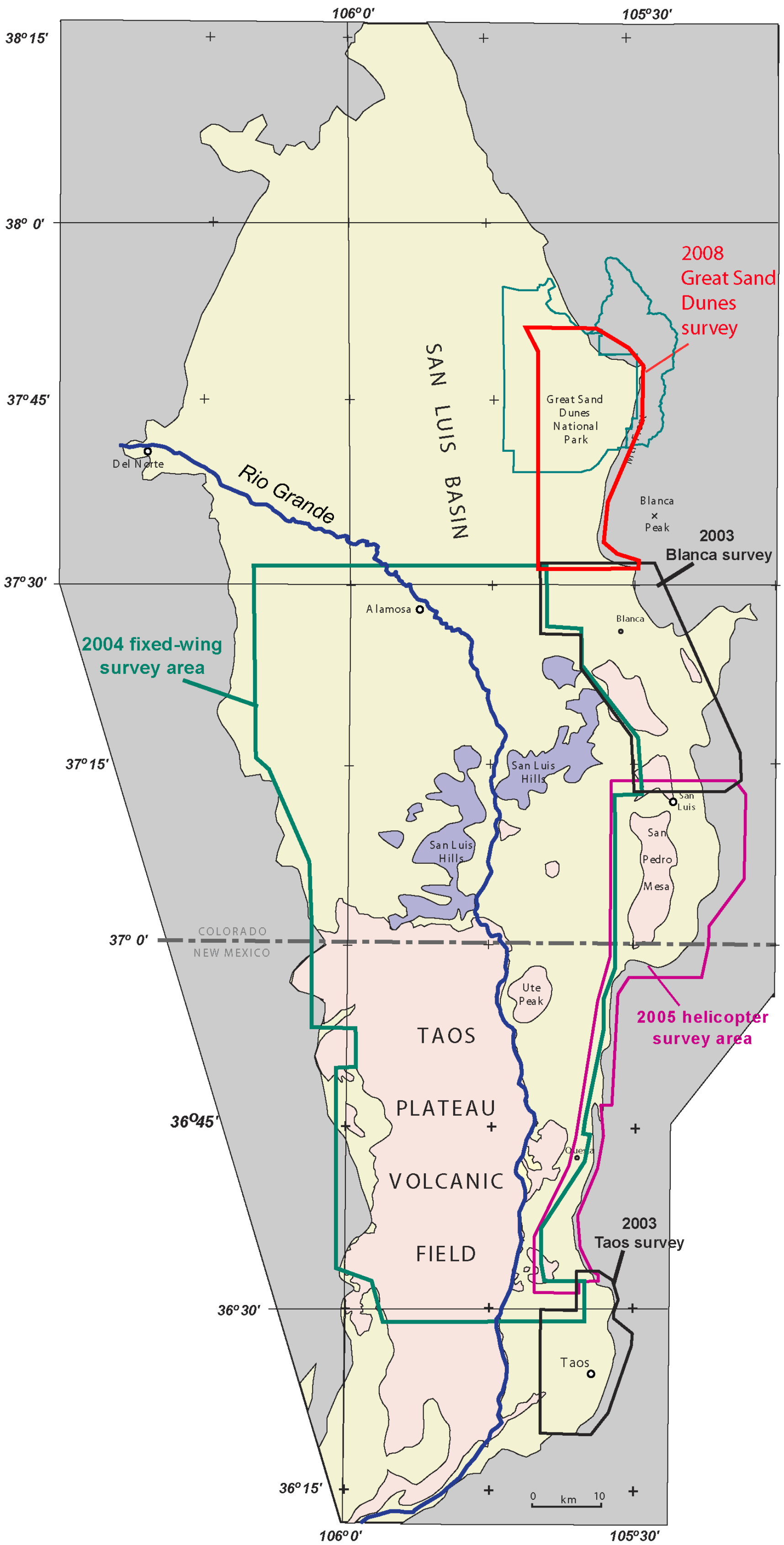

Figure 1. Location map of the Great Sand Dunes survey.

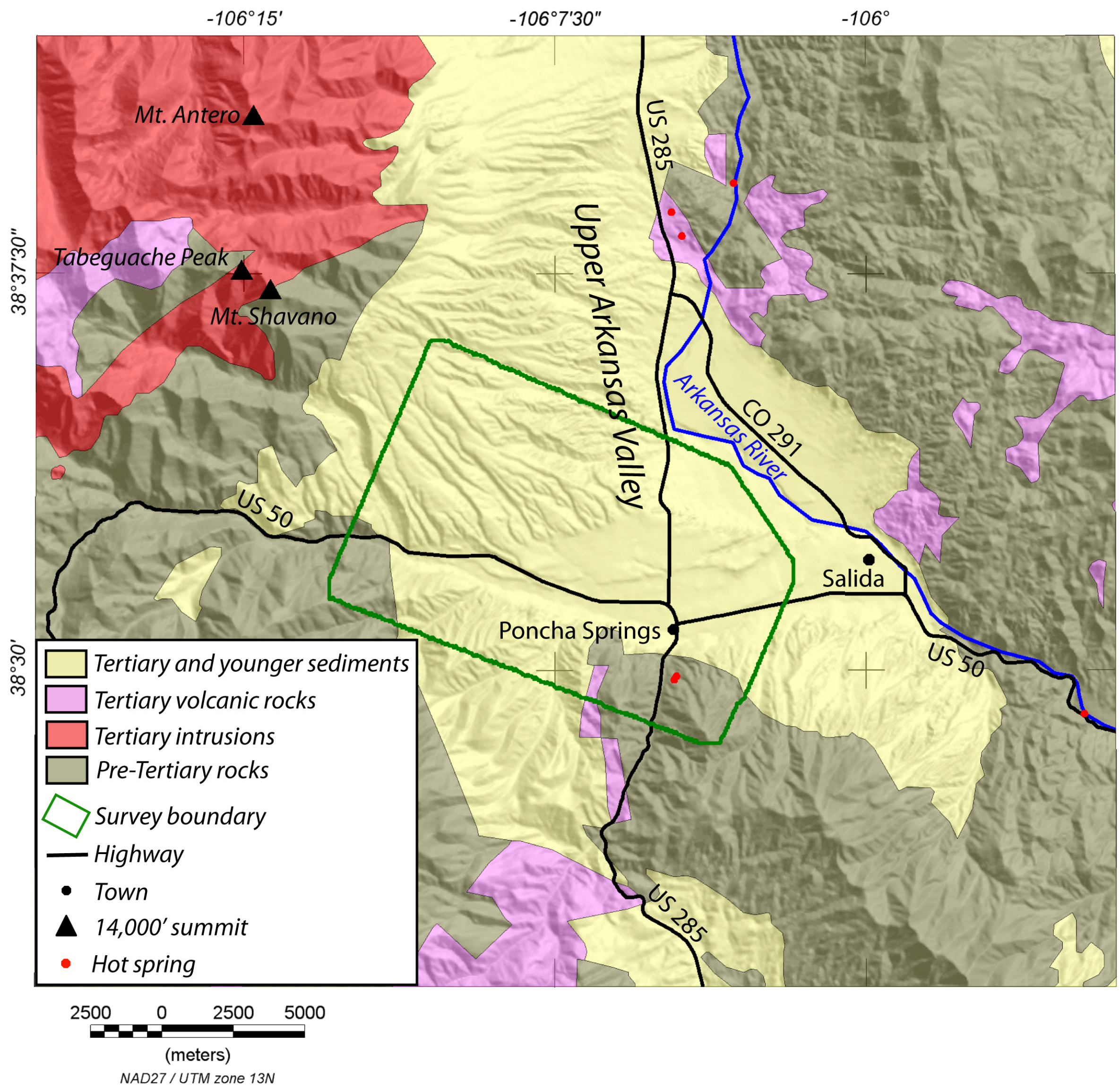

Figure 2. Location map of the Poncha Springs survey.