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By Viki Bankey, V.J.S. Grauch, Ank Webbers, and PRJ, Inc.

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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 high-resolution aeromagnetic survey in southern Colorado and northern New Mexico during October, 2004. The survey covers the central San Luis basin in Alamosa, Conejos, Costilla, and Rio Grande Counties, Colorado, and Taos County, New Mexico. Several derivative products from these data are also presented as grids and images, including reduced-to-pole data, first vertical derivative, and data continued to a reference surface. Images are presented in various formats, intended as input to geographic information systems, standard graphics software, or map plotting packages. The variety of formats also accommodates viewing at 1:100,000 or 1:24,000 map scales.

Introduction

This report describes data collected from a high-resolution aeromagnetic survey flown over the central San Luis basin during October, 2004, by PRJ, Inc., on contract to the U.S. Geological Survey (USGS). The survey extends from just north of Alamosa, Colorado, southward to just northwest of Taos, New Mexico. It covers large parts of the San Luis Valley in Alamosa, Conejos, Costilla, and Rio Grande Counties, southern Colorado, and the Taos Plateau in Taos County, northern New Mexico (fig. 1). The survey was designed to complement two surveys previously acquired along the eastern borders of the San Luis Basin over the vicinities of Taos, New Mexico (Bankey and others, 2004a) and Blanca, Colorado (Bankey and others, 2004b). Our overall objective in conducting these surveys is to improve knowledge of the subsurface geologic framework in order to understand ground-water systems in populated alluvial basins along the Rio Grande. These USGS efforts are conducted in collaboration with other federal, state, and local governmental entities where possible.

Organization of CD-ROM

The files on this CD-ROM and the contents of the folders (directories) are briefly explained in Table 1. The "readme.txt" file provides summaries of the contents of the CD-ROM. The 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 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 variations caused by differences in the magnetic properties of 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.

The aeromagnetic survey for the central San Luis basin (fig. 1) employed a fixed-wing aircraft 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 1,000 m (3,280 ft) spacing. Total flight-line coverage involved 2,522 line kilometers (1,567 line miles). The east-west orientation of traverse lines was chosen because it is oblique to the predominant northerly geologic strike of the area. The flight-line data from the contractor are included in this report. Contractor-provided details of the flight specifications, survey procedures, and data processing are included in Appendix A.

Topographic and radar altimeter gridded data are also provided. The topographic grid was created from 1-arc-second (30 m) digital elevation data that were resampled to 50 m.

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^{o} 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^{o}, inclination=64^{o} for the study area). Based on considerations of rock type and age in the area, this assumption is generally valid (Grauch and others, 2004).

Continued Reduced-to-pole Magnetic Data

To enhance details, the gridded RTP magnetic data were continued from the variable observation surface to a reference surface 100 m above ground, using the chessboard method of Cordell (1985) as implemented by the commercial software package, OASIS Montaj™, augmented with USGS-developed algorithms (Phillips and others, 2003). 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 leveled using the tie-line data to better approximate the flight surface. Because the chessboard operation for this study mostly involves downward continuation, a lowpass filter (created using a cosine-squared rolloff function) was applied to minimize the amplification of noise. The severity of the filter was adjusted to account for the amount of downward continuation required in different areas. The continued, reduced-to-pole aeromagnetic data are presented as color shaded-relief images.

The continuation (reference) surface (cslcontsurfgrd.gxf) was constructed by adding both 100 meters and the difference between the actual radar altimeter and the levelled radar value to the terrain elevation.

Continuation surface = terrain + 100 + (actual radar – levelled radar)

First Vertical Derivative

To enhance detailed patterns and linear features even further, we computed the first vertical derivative of the continued RTP data. The first vertical derivative is a standard geophysical technique based on potential-field theory and commonly computed using FFT techniques (e.g., Blakely, 1995). To minimize amplification of noise during the operation, a Butterworth filter with a cutoff wavelength of 200 m was applied. The first vertical derivative data are presented as color shaded-relief images.

Merged Data for 1:24,000-scale Images

The continued RTP data were merged with analogous data from the two pre-existing aeromagnetic surveys (Blanca and Taos helicopter surveys) to complete several of the images presented at 1:24,000 map scale (fig. 2) along the eastern side of the survey area. The data were merged using the suture method of knitting grids together in the Oasis Montaj program from Geosoft, Inc. Where data sets overlap, data from the helicopter surveys took priority.

Description of Digital Files

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 figures.
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.
cslmaggrd.gxf csl83maggrd.gxf	grid exchange format	Leveled total-intensity magnetic data. (NAD27 and NAD83 projections)
cslrtpgrd.gxf csl83rtpgrd.gxf	grid exchange format	Reduced-to-pole (RTP) magnetic data. (NAD27 and NAD83 projections)
cslrtpcontgrd.gxf csl83rtpcontgrd.gxf	grid exchange format	Continued, reduced-to-pole (RTP) magnetic data. Data were continued to a surface 100 m above ground. (NAD27 and NAD83 projections)
cslrdrgrd.gxf csl83rdrgrd.gxf	grid exchange format	Leveled radar altimeter measurements. (NAD27 and NAD83 projections)
cslcontsurfgrd.gxf csl83contsurfgrd.gxf	grid exchange format	100 m continuation surface (NAD27 and NAD83 projections)
cslrtpcont1stvergrd.gxf csl83rtpcont1stvergrd.gxf	grid exchange format	First vertical derivative of the continued, reduced-to-pole (RTP) magnetic data (NAD27 and NAD83 projections).
csltopomgrd.gxf csl83topomgrd.gxf	grid exchange format	Topography data from 1-arc-second digital elevation data (NAD27 and NAD83 projections).
-----LINEDATA folder -----		
linedata_info.txt	ASCII format	Description of the information and format of the flight-line data file.
centralsanluis.asc	ASCII format	Final information from the contractor 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.
cslmag.tif cslmag.tfw	Tagged image format Geotif ASCII header file	Color shaded-relief image of leveled total-intensity magnetic data, and georegistration file. No text annotation or scales.
cslrtp.tif cslrtp.tfw	Tagged image format Geotif ASCII header file	Color shaded-relief image of reduced-to-pole (RTP) magnetic data, and georegistration file. No text annotation or scales.
cslrtpcont.tif cslrtpcont.tfw	Tagged image format Geotif ASCII header file	Color shaded-relief image of continued, reduced-to-pole (RTP) magnetic data, and georegistration file. No text annotation or scales.
cslrtpcont1stver.tif cslrtpcont1stver.tfw	Tagged image format Geotif ASCII header file	Color shaded-relief image of first vertical derivative of the continued, reduced-to-pole (RTP) magnetic data, and georegistration file. No text annotation or scales.

FILE NAME	FORMAT TYPE	DESCRIPTION
csltopom.tif csltopom.tfw	Tagged image format Geotif ASCII header file	Color shaded-relief image of topography data from 1-arc-second digital elevation data, and georegistration file. No text annotation or scales.
cslmag.pdf	portable document format	Color shaded-relief image of leveled total-intensity magnetic data, with annotations.
cslrtp.pdf	portable document format	Color shaded-relief image of reduced-to-pole (RTP) magnetic data, with annotations.
cslrtpcont.pdf	portable document format	Color shaded-relief image of continued, reduced-to-pole (RTP) magnetic data, with annotations.
cslrtpcont1stver.pdf	portable document format	Color shaded-relief image of first vertical derivative of continued, reduced-to-pole (RTP) magnetic data, with annotations.
cslfllines.pdf	portable document format	Flight-line locations with flight-line numbers.
csltopom.pdf	portable document format	Color shaded-relief image of topography, with annotations.

Table 2. List of 1:24,000-scale filenames, area names, and quadrangles (fig. 2)

Filename	**Quads covered**	**preview filename (.pdf)**	**geotif filename (.tif/.tfw)**
Alamosa East	Alamosa East, Hooper SE	cslAlamosaE	cslAlamosaE
Alamosa West	Alamosa West, Mount Pleasant School	cslAlamosaW	cslAlamosaW
Arroyo Hondo	Arroyo Hondo, Arroyo Seco, Los Cordovas, Taos	cslArroyoHndo	cslArroyoHndo
Baldy	Baldy, Dry Lakes	cslBaldy	cslBaldy
Blanca	Blanca, Twin Peaks	cslBlanca	cslBlanca
Blanca SE	Blanca SE	cslBlancaSE	cslBlancaSE
Capulin	Capulin, Centro	cslCapulin	cslCapulin
Cerro De La Olla	Cerro De La Olla	cslCerDLaOlla	cslCerDLaOlla
Cerro De Los Taoses	Cerro De Los Taoses, Tres Orejas	cslCerroDLTaoses	cslCerroDLTaoses
Costilla	Costilla	cslCostilla	cslCostilla
Fort Garland	Fort Garland, Blanca Peak	cslFtGarland	cslFtGarland
Fort Garland SW	Fort Garland SW, Ojito Peak, San Luis, Taylor Ranch	cslFtGarlandSW	cslFtGarlandSW
Garcia	Garcia	cslGarcia	cslGarcia
Goshawk Dam	Goshawk Dam, Vicente Canyon	cslGshkDam	cslGshkDam
Guadalupe Mountain	Guadalupe Mountain, Questa	cslGuadlpeMtn	cslGuadlpeMtn
Kiowa Hill	Kiowa Hill	cslKiowaHill	cslKiowaHill
La Jara	La Jara	cslLaJara	cslLaJara
La Segita Peaks	La Segita Peaks, San Antonio Mountain	cslLaSegPks	cslLaSegPks

La Segita Peaks NE	La Segita Peaks NE	cslLaSegPksNE	cslLaSegPksNE
Lasauses	Lasauses	cslLasauses	cslLasauses
Lobatos	Lobatos, Antonito	cslLobatos	cslLobatos
Manassa	Manassa	cslManassa	cslManassa
Manassa NE	Manassa NE	cslManassaNE	cslManassaNE
Mesito Reservoir	Mesito Reservoir	cslMesitoRsvr	cslMesitoRsvr
Petaca Peak	Petaca Peak, Las Tablas, Servilleta Plaza	cslPetacaPk	cslPetacaPk
Pikes Stockade	Pikes Stockade	cslPksStckade	cslPksStckade
Pinabetoso Peaks	Pinabetoso Peaks, Los Pinos	cslPinabtsPk	cslPinabtsPk
San Acacio	San Acacio	cslSanAcacio	cslSanAcacio
Sky Valley Ranch	Sky Valley Ranch	cslSkyVlyRnch	cslSkyVlyRnch
Sunshine	Sunshine, Cerro	cslSunshine	cslSunshine
Tres Piedras	Tres Piedras, Mule Canyon	cslTresPiedras	cslTresPiedras
Tres Piedras NE	Tres Piedras NE	cslTresPiedrasNE	cslTresPiedrasNE
Ute Mountain	Ute Mountain	cslUteMtn	cslUteMtn
Waverly	Waverly, Fulcher Gulch, Home Lake, Monte Vista	cslWaverly	cslWaverly

Acknowledgments

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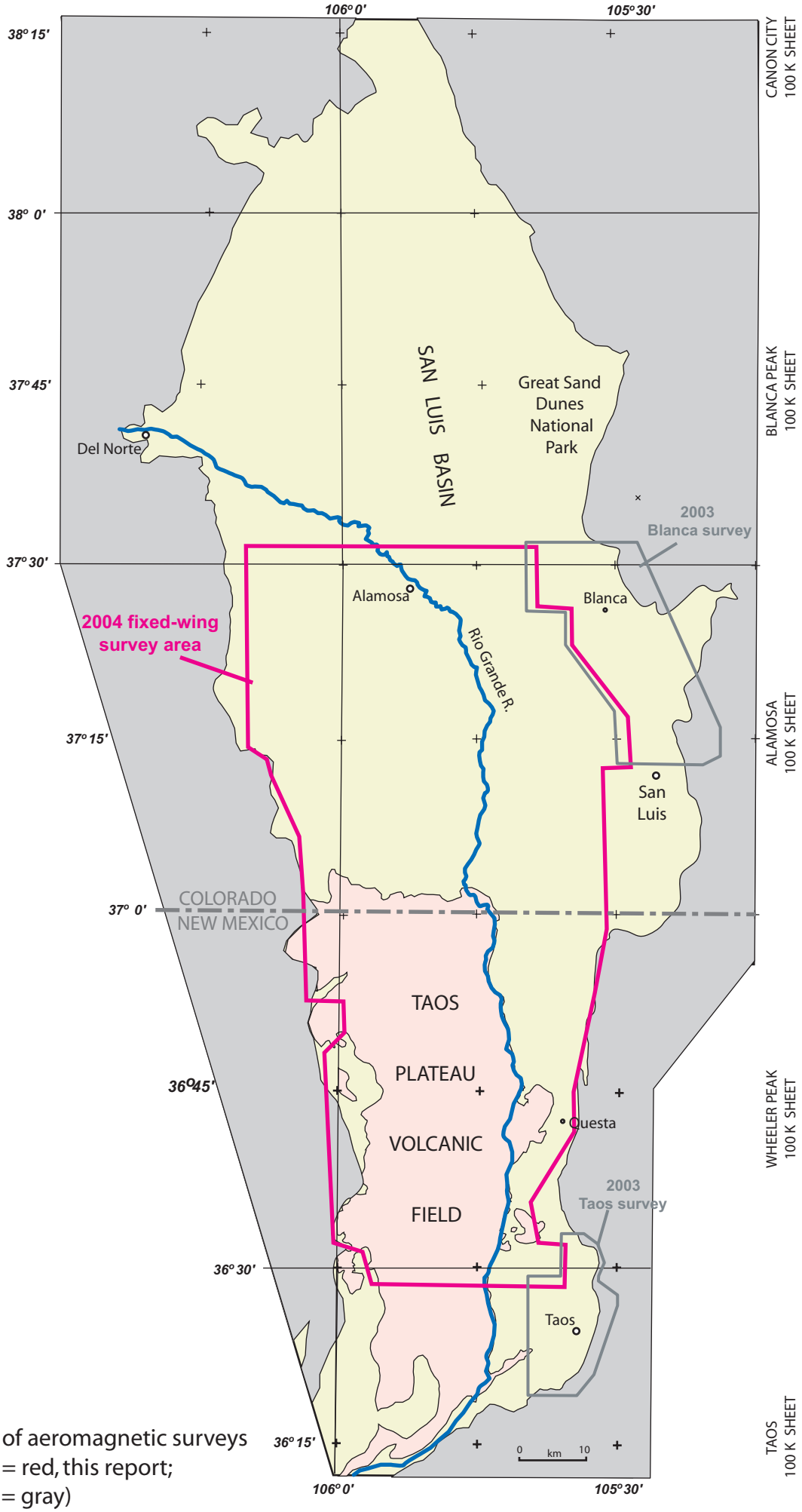

Figure 1. Location of aeromagnetic surveys (Central San Luis = red, this report; Blanca and Taos = gray)

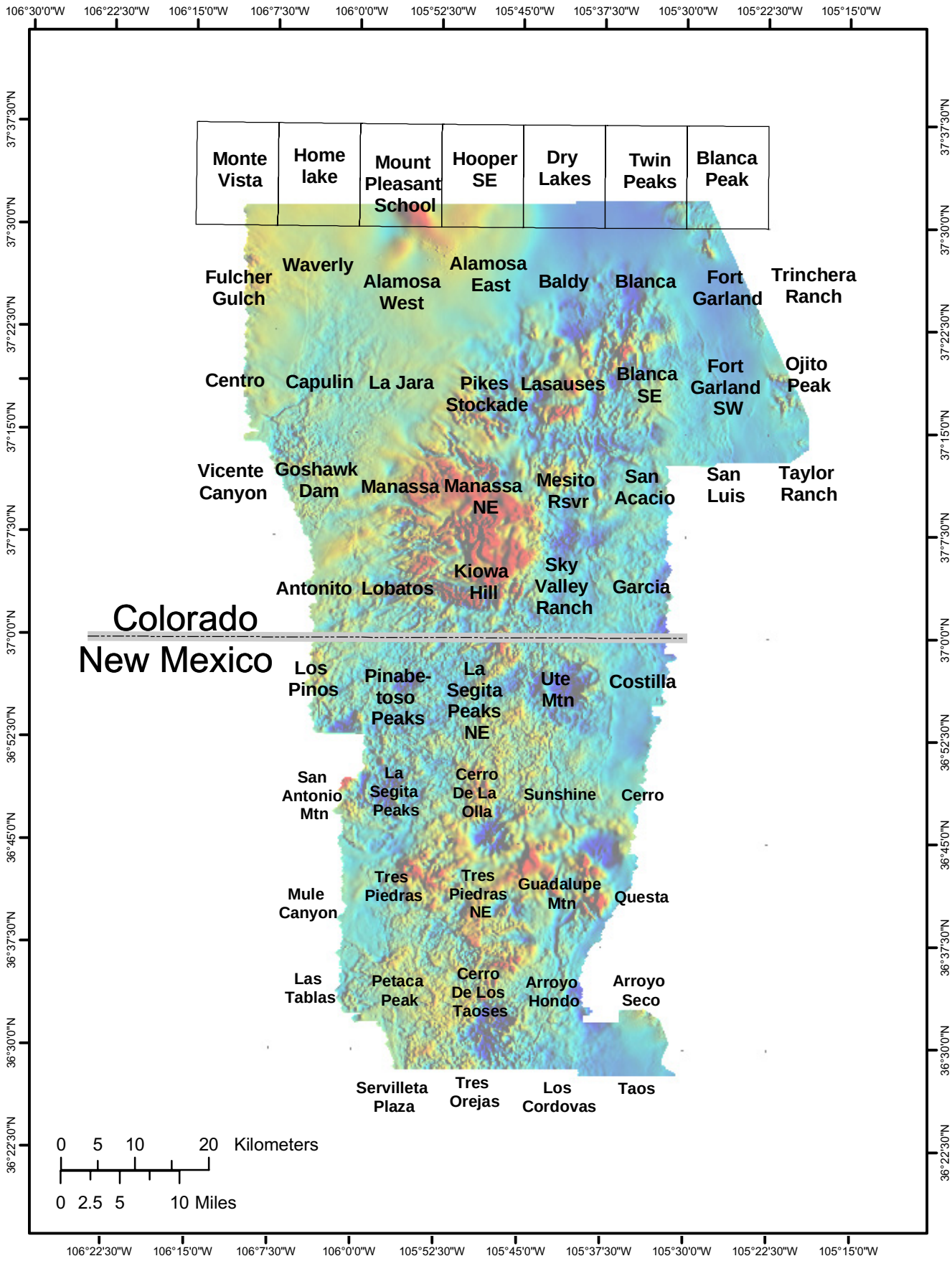

Figure 2. Index map of 1:24,000 scale quadrangle areas.