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Aeromagnetic map of the Death Valley ground-water model area, Nevada and California

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INTRODUCTION

This aeromagnetic map of the Death Valley ground-water model area was prepared from numerous separate aeromagnetic surveys that were gridded, merged, and described by Hildenbrand and Kucks (1988) and by McCafferty and Grauch (1997). These data are available in grid format from the EROS Data Center, U.S. Geological Survey, Sioux Falls, South Dakota, 57198, and from the National Geophysical Data Center, 325 Broadway, E/GC4, Boulder, Colo., 80303. Magnetic investigations of the Death Valley ground-water basin are part of an interagency effort by the U.S. Geological Survey (USGS) and the Department of Energy (Interagency Agreement DE-AI08-96NV11967) to help characterize the geology and hydrology of southwest Nevada and adjacent parts of California (Blakely and others, 2000b). The Death Valley ground-water model is located between lat 35°00' and 38°15'N., and long 115° and 118°W.

AEROMAGNETIC DATA

Aeromagnetic data for the Death Valley ground-water model were collected at various flight-line spacings and altitudes (Hildenbrand and Kucks, 1988; Sikora and others, 1993; McCafferty and Grauch, 1997). Some parts of the map are covered by more recent and detailed aeromagnetic surveys flown at a flight-line spacing of 400 m (1/4 mi) and a nominal flight-line elevation of 122 m (400 ft) above the ground. Older surveys were flown at flight-line spacings of 800 to 1,600 m (1/2 to 1 mi) and at constant barometric elevations of about 2,440 m (8,000 ft). Magnetic anomalies were derived by subtracting an International Geomagnetic Reference Field (Langel, 1992) appropriate for the year of the survey. Aeromagnetic surveys were continued downward, if necessary, to a flight-line elevation of 122 m (400 ft) above the ground, adjusted to a common datum, and merged to produce a uniform map that allows interpretations across survey boundaries. Because of the poor quality of the older surveys, caution should be exercised when interpreting short-wavelength anomalies that cross the original survey boundaries. The digital data set was gridded at an interval of 1 km using a computer program (Webring, 1981) based on a minimum curvature algorithm by Briggs (1974). The resulting grid was then interpolated to a 200-m grid to minimize pixel size, and then it was color contoured.

DISCUSSION

Geologic features often produce small magnetic fields that perturb the main field of the earth and can be enhanced by the removal of a regional magnetic field. These measurements reflect lateral changes in rock magnetic properties and can be analyzed to gain insights into the three-dimensional nature of the causative source. In general, aeromagnetic anomalies within the Death Valley ground-water model reflect volcanic rocks, calderas, granitic intrusions, and linear geologic features such as faults. Many of these features play an important role as aquifers or confining units in the region, and their distribution is important to the understanding of the hydrogeologic framework of the area.

One of the most prominent magnetic anomalies in Nevada is a broad magnetic high over the Spring Mountains in the southeast part of the study area. Blank (1987) attributed this anomaly to a concealed upwarp of Precambrian basement. Most Paleozoic rocks are relatively non-magnetic with one notable exception: an unusually strongly magnetized member of the Eleana Formation (Baldwin and Jahren, 1982) that produces a conspicuous magnetic high over the southern part of Shoshone Mountain in the central part of the study area. Magnetic highs are associated with the Wahmonie (Ponce, 1984) and Climax stocks (Healey, 1983) at Lookout Peak, in the central part of the study area, and Belted Range, in the northern part of the study area, respectively. Tertiary volcanic rocks have variable magnetic properties and play a significant role in the extensional history of the area and in the formation of large collapse calderas in the southwest Nevada volcanic field. Thick accumulations of these volcanic rocks are present in the central and northern part of the Death Valley ground-water model (for example, Timber Mountain and vicinity). Volcanic units, vertically offset by faults in the central part of Yucca Mountain just south of Timber Mountain, produce conspicuous anomalies that can be used to infer the strike, dip, and vertical offset of the magnetic units (Ponce, 1996). Alluvial deposits within the study area are essentially nonmagnetic and most basins have subdued magnetic anomalies with the exception of those basins that may contain volcanic centers (for example, Amargosa Valley).

A number of geophysical studies were undertaken to aid in characterizing the geologic and hydrogeologic setting of the Death Valley ground-water model area. A summary of geophysical investigations at Yucca Mountain that includes gravity, magnetics, electrical methods, seismic methods, heat-flow, and stress data were provided by Oliver and others (1995). Recent studies characterized the geophysical framework of the southwestern Nevada volcanic field (Grauch and others, 1999; Mankinen and others, 1999) identifying a number of subsurface features that might control or influence ground-water flow. These features include resurgent calderas and prominent geophysical lineaments that probably reflect faults. Blakely and others (2000a, b) summarized geophysical investigations of the Death Valley regional ground-water model area.

In this region, geophysical methods are critical to the understanding of the geologic, tectonic, and hydrologic framework. The diverse physical properties of rock units that underlie this region are well suited to geophysical investigations. The contrast in magnetic properties between pre-Cenozoic rocks, volcanic rocks, and alluvium produces a distinctive pattern of anomalies that can be used to determine the sources of the anomalies and their subsurface extent.

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