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Airborne Geophysical Surveys in the Boulder Watershed, Jefferson and Lewis and Clark Counties, Montana

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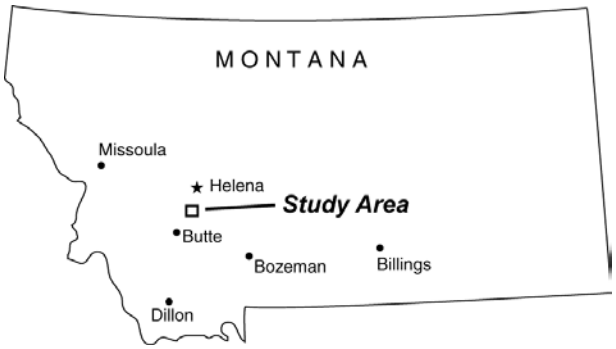
INTRODUCTION

Three airborne geophysical surveys have been made in the Boulder watershed and adjacent areas (fig. 1). The objectives of the geophysical studies in the watershed is to map subsurface lithologic, structural and hydrologic features important in controlling possible ground water contamination from mining activities and to design remediation efforts. These studies are part of an abandoned mine land study of the Boulder Basin mining district and watershed.



GEOLOGIC SETTING

The Boulder Basin mining district is located in the Northeast part of the Cretaceous Boulder Batholith. Geologic mapping in the area has been done by Becraft and others, 1963, and Ruppel, 1963. A more recent summary of the geologic setting is given by O'Neill and others (2000). The majority of the batholith is a muti-textured granitoid which include different plutons. In the Boulder watershed the batholith is overlain by cogenetic Elkhorn Mountains Volcanics which are predominantly quartz latite to andesite in composition.

The Boulder Batholith is extensively jointed particularly in this study area which is in the upper part of the Butte pluton. The batholithic rocks are cut by numerous faults which trend northeast or east. Mineralization follows the east-trending faults or shear zones.

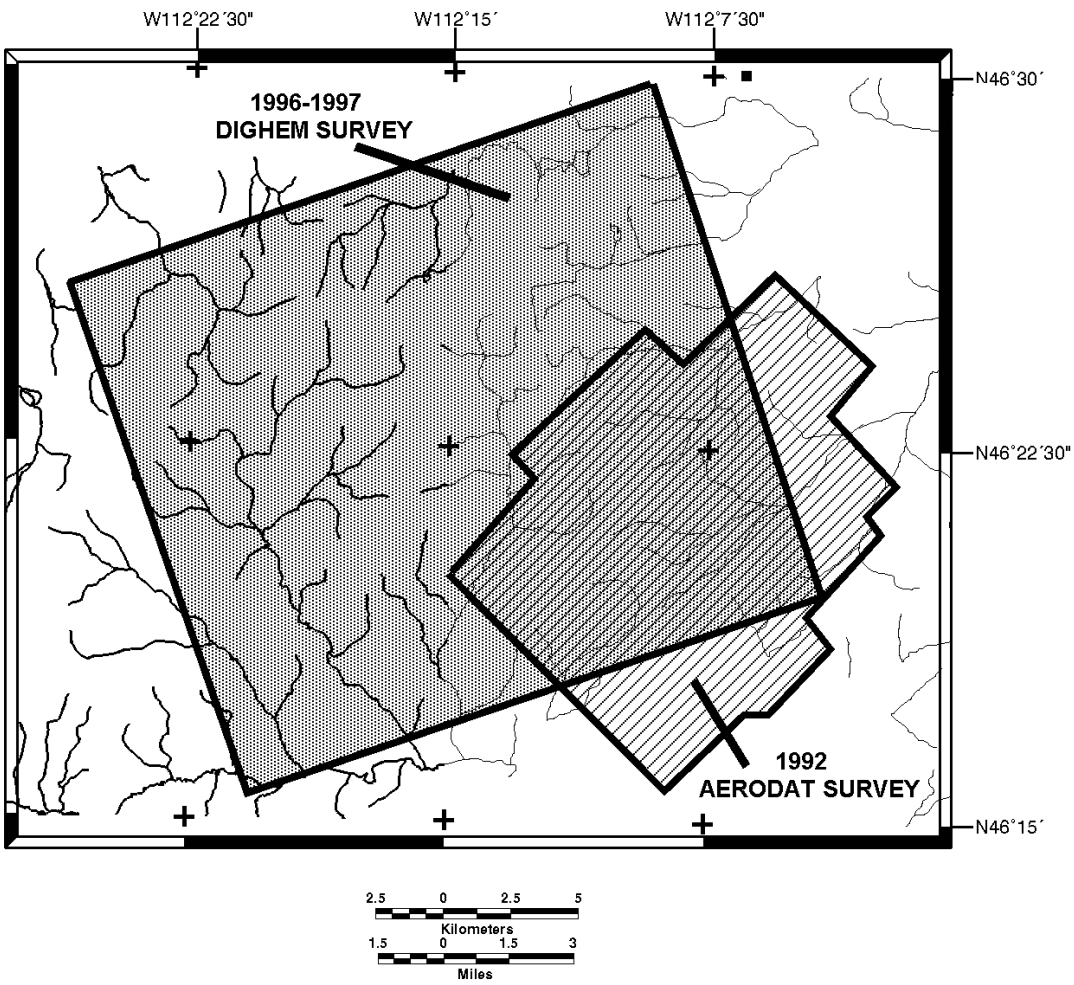
Several Tertiary volcanic sequences overlay the batholith. Of particular importance in the southeast part of the study area is the Eocene Lowland Creek volcanic sequence. This and other Tertiary volcanic units are described in detail by O'Neill and others (2000).

Pleistocene glacial till is present on some of the upland surfaces. Till is present in many of the flat areas in the valleys and lateral moraines are present along some of the larger valleys. Tertiary unconsolidated gravels mantle the uplands. Holocene fluvial-alluvial and minor pond and bog deposits have accumulated along some parts of the drainages.

AIRBORNE GEOPHYSICAL SURVEYS

In 1996 a helicopter airborne geophysical survey using electromagnetic (EM) and magnetic survey systems was contracted by the USGS to DIGHEM LTD. An additional helicopter survey was done in 1997 also by DIGHEM LTD to fill out the survey coverage of the watershed. Figure 2 shows an index map for these surveys described by Smith and others (2000).

HELICOPTER GEOPHYSICAL SURVEYS
LOCATION MAP



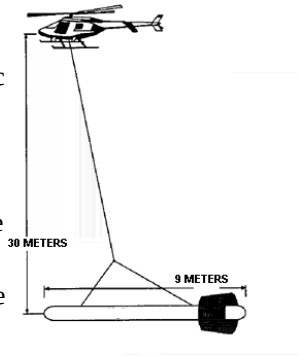
Details of the survey are given in the contractor's reports included in this CD ROM data release. The survey flight line spacing is 1/4 mile (220 meters) flown in a NW and SE direction. The geophysical EM sensor was flown about 100 feet (30 meters) above terrain.

In 1999, as part of a U.S. Environmental Protection Agency funded study (Smith et al, 1999), the USGS acquired digital data from a previous helicopter magnetic, EM and radiometric survey . This survey was conducted for Pegasus Gold (a mining company) by AERODAT Geophysics as part of a 1992 mineral exploration project. The survey is located in the southeast part of the main USGS survey area (fig 2). The magnetic and EM instrumentation used in this survey are similar to that used for the USGS contracted DIGHEM survey and are documented in the AERODAT report included on this CD ROM. Radiometric instrumentation made measurements of the decay spectrum in counts per second. Data processing included Compton striping but not reduction to parts per million since calibrations were not called for in the contract.

After the surveys were made, HighSense Geophysics (http://www.highsense.ca/) bought AERODAT. Subsequently both HighSense and DIGHEM were bought by FUGRO (http://www.geoterrex.com/)

METHOD

Principles of airborne geophysical methods can be found in several geophysical text books including Telford and others (1990). One current web site which gives an excellent description of airborne geophysical methods is http://www.geoterrex.com/.



The Boulder Basin watershed helicopter surveys utilized total field magnetic and electromagnetic (EM) sensors. The following is a description of the EM method for the DIGHEM system adapted from their web site (see above). "The DIGHEM^{V} system is mounted in a 9 metre cylindrical "bird", which is carried beneath a helicopter (fig. 3). The altitude of the bird above ground is kept at about 30m, and the airspeed is about 120 km/h. The system records the five EM frequencies at 10 samples per second, resulting in about 1 sample for each 3m along the flight line. The separation between survey lines varies, depending on the size of the target, and the detail desired in the resistivity mapping." For the surveys done for this study, the line spacing was 1/8 mile or 220 meters. The survey done by AEORDAT used a similar EM system. Both EM systems are described in more detail in the contractor reports included with this data release.

The total field magnetometer sensor used in airborne surveys for this study were positioned approximately 10m above the EM bird. The magnetometer system and measurements are more completely described in the contractor reports included in this data release.

The AERODAT survey used electromagnetic and total field magnetic measurement systems similar to the DIGHEM system described above. In addition the survey used a spectral radiometric system to map possible near surface alteration. Results of the radiometric survey are given as counts per second for uranium, thorium, and potassium. A more detailed discussion of the geophysical systems used in the survey is given in the contractor's report included as part of the digital open-file report.

The AERODAT survey report mentions paper map products which are not included in this open-file. Most of the map products can be generated from the flight line data or the digital grids included with this report.

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