# Preliminary Results of Airborne and Ground Resistivity Surveys for Subsurface Mapping in the Hunton Anticline South-Central Oklahoma

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## PANEL 1 Geology and Geophysics: Logistics

### INTRODUCTION

Airborne and ground electrical resistivity surveys were performed to map the subsurface geologic and hydrologic character of the Hunton Anticline area of the Arbuckle-Simpson aquifer in south-central Oklahoma. Four areas, with distinctly different geology, were flown with a helicopter electromagnetic system (HEM) in March, 2007, with U.S. Geological Survey (USGS) and National Park Service (NPS) funding. Apparent resistivity measurements were made at six different frequencies ranging from 400 Hz to 115,000 Hz. Total field magnetic and high precision (GPS and laser altimeter) location measurements were also made. A total area of about 1,700 square kilometers were flown in blocks A through D mostly with a line spacing of 400 m. The HEM electromagnetic data were processed to produce an electrical resistivity map of each area, and the data along each flight line was inverted to produce resistivity-depth sections.

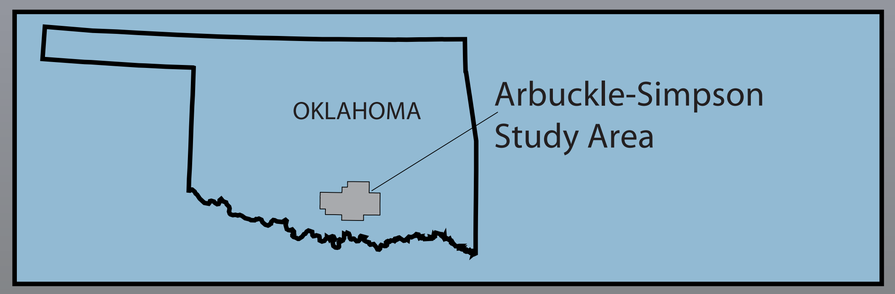
Block A extends from the Chickasaw National Recreational Area (CNRA) to Mill Creek on the west side of the anticline. Geology of this block consists of dolomitic limestone of the Arbuckle Group in fault contact with younger Paleozoic clastic rocks. The flight line spacing was 800 meters in the western half of the block and 400 meters in the eastern part. Airborne magnetic data indicate that the Sulphur fault bends south to merge with the Mill Creek fault, substantiating a hypothesis first made from interpretation of gravity data.

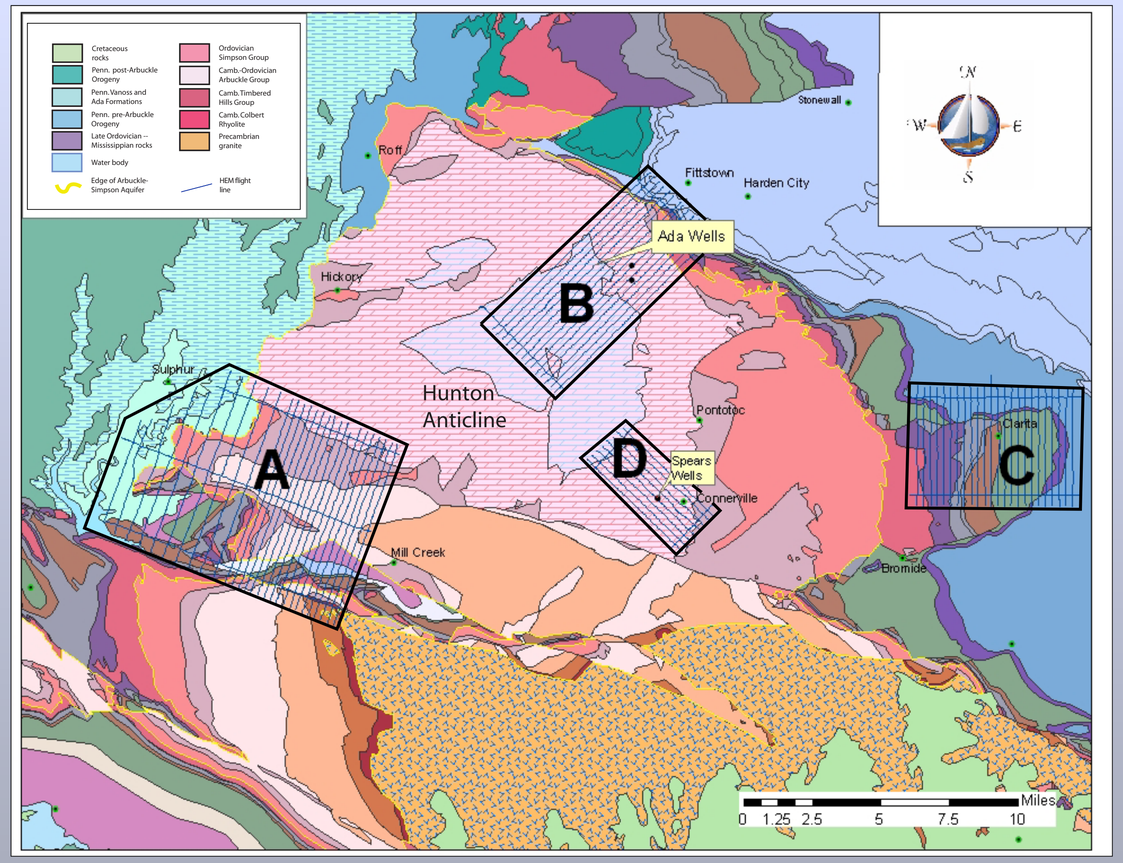
Block B, which encompasses Byrds Mill Spring and the city of Ada's water supply wells, is located on the north side of the anticline. Geology in this block consists of mostly of Arbuckle and Simpson Group rocks.

Block C, covering most of the Clarita horst on the east side of the anticline, consists of the Upper Ordovician Sylvan Shale to the Lower Pennsylvanian Springer and Wapanucka Formations.

Block D, which was flown to include the Spears deep test well site, consisted of eight lines. This well is entirely within the Arbuckle Group.

The airborne resistivity survey has helped greatly to map major faults between dolomitic limestone and clastic rocks and within the dolomitic limestone. Ground resistivity surveys suggest that, in places, the faults within limestone are zones of lower resistivity and map low resistivity surfical epikarst a few meters thick. Airborne data will be analyzed in more detail to correlate with ground resistivity surveys.



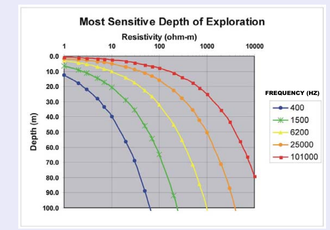


Helicopter and geophysical system on take-off. The bird is nearly 10 meter long. Boxes on the geologic map show HEM survey areas A-D. Flight lines in each area were spaced 800 m apart, except for the east half of Block A, which had infill lines at 400 meters. The direction of the flight lines were aligned to be roughly perpendicular to mapped major structural features, such as major faults and bedding.

**Helicopter Electromagnetic System Parameters**

| COIL CONFIGURATION | NOMINAL FREQUENCY (Hz) | ACTUAL FREQUENCY (Hz) | SENSITIVITY (ppm) |
|---|---|---|---|
| Coplanar | 400 | 389 | 0.12 |
| Coplanar | 1,500 | 1,574 | 0.12 |
| Coaxial | 3,300 | 3,245 | 0.12 |
| Coplanar | 6,200 | 6,075 | 0.24 |
| Coplanar | 26,000 | 25,300 | 0.60 |
| Coplanar | 115,000 | 114,940 | 0.60 |

Six coils inside the bird operate at six different frequencies.




Each frequency penetrates to a different depth, depending on the bulk electrical resistivity of the earth. For high resistivity rocks, there is a good spread of penetration depths, making it possible to invert the data to obtain resistivity-depth profiles along the flight lines.