GEOLOGICAL INTERPRETATION OF AEROMAGNETIC SURVEYS

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JAMES AFFLECK[1]

Abstract

EDITOR'S NOTE: Because of the lack of permission from the Gulf's publication committee which has jurisdiction Mr. Affleck was unable to supply us with a full manuscript or any illustrations from his numerous slides. Hence this short abstract of an important paper.)

Introduction

The purpose of this address is to develop the geological significance of magnetic anomalies and to demonstrate the part which magnetics can play in an integrated geological and geophysical exploration program.

The sedimentary rocks are usually so nearly non-magnetic that they contribute little or nothing to the magnetic anomalies. Therefore, the magnetic method deals with the igneous and sometimes the metamorphic rocks. Magnetics must therefore be considered a reconnaissance method, and its utility is limited to the degree that knowledge of the depth and configuration of the igneous rocks can contribute to knowledge of the overlying sedimentary section. Magnetic anomalies are of two types, those associated with basement uplift and those caused by changes of rock magnetization within the basement. The problem of the interpreter is to attempt to select between the two types. Usually the anomalies due to intra-basement contrasts are stronger than those due to basement relief.

The Gulf airborne magnetometer, survey procedures and data reduction processes were described briefly. The fundamentals of interpretation techniques were demonstrated. These included demonstrations of anomaly types, derivative techniques, and basement depth calculations.

Utilization of Results

The role of magnetics in an integrated exploration program was described. Through basement depth calculations, it is almost always possible to answer the following questions:

1. Is there a sedimentary basin within the area?
2. If so, what is its configuration?
3. Can any portions of the area be eliminated from further consideration?

Examples of magnetic surveys and assemblies of magnetic anomalies were used to demonstrate this part of the problem. Generalized magnetic profiles were shown. These included a profile across the Delaware Basin, Central Basin Platform, Midland Basin, Eastern Platform, and the Llano Uplift; a profile across the Wichita Mountains and the Anadarko Basin; and a profile across the Arbuckle Mountains and the McAlester Basin. The basin areas were defined by magnetics, as were the asymmetrical axes, the mobile, and the stabile belts within the basins.

The selection of dominant magnetic trend patterns was demonstrated,

1. Gulf Research & Development Company. Pittsburgh, Pennsylvania, A.A.P.G. Distinguished Lecturer.

and the relationships of these trends to basement zones of weakness was emphasized. Rejuvenation of these zones of weakness during deposition may have formed structures.

Selection of basement relief by means of the derivative technique was demonstrated. Examples used were in Wilbarger County, Texas, on the Red River Uplift, in the Sayre area of Oklahoma, and in Crane County, Texas. In areas of fairly uniform basement or in which igneous activity has taken place after sedimentary deposition, the method works well. In areas of complex basement with numerous magnetization contrasts, the difficulties of separation are great.

Comparisons between magnetic and gravity surveys can yield results not obtainable from either one alone. An example was shown in which the magnetics showed an area of shallow basement and an area of deep basement, the latter with little evidence of local structure. Strong, shallow-source gravity anomalies were present in both parts. In the area of deep basement, the gravity anomalies certainly represent sedimentary structure, while in the area of shallow basement they are associated with density contrasts within the basement.

Two examples of magnetic data along the California coast were shown. One showed the relationship to the San Andreas Fault and the other suggests the offshore position of that fault. Another slide showed the existence of an anomaly in association with the Medocino Escarpment.

Comparative costs of magnetics, gravity, and detailed seismograph were given as 1:3:100.