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GEOPHYSICAL INVESTIGATIONS IN THE BI'R IDIMAH-WADI WASSAT AREA SAUDI ARABIA

Part One

by

R. V. Allen and W. E. Davis
U. S. Geological Survey

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PREFACE

In 1963, in response to a request from the Ministry of Petroleum and Mineral Resources, the Saudi Arabian Government and the U. S. Geological Survey, U. S. Department of the Interior, with the approval of the U. S. Department of State, undertook a joint and cooperative effort to map and evaluate the mineral potential of central and western Saudi Arabia. The results of this program are being released in USGS open files in the United States and are also available in the Library of the Ministry of Petroleum and Mineral Resources. Also on open file in that office is a large amount of material, in the form of unpublished manuscripts, maps, field notes, drill logs, annotated aerial photographs, etc., that has resulted from other previous geologic work by Saudi Arabian government agencies. The Government of Saudi Arabia makes this information available to interested persons, and has set up a liberal mining code which is included in "Mineral Resources of Saudi Arabia, a Guide for Investment and Development," published in 1965 as Bulletin 1 of the Ministry of Petroleum and Mineral Resources, Directorate General of Mineral Resources, Jiddah, Saudi Arabia.

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Introduction

A geophysical investigation was conducted over the northern part of a large gossan near Bi'r Idimah in the Asir quadrangle. The study was made primarily to determine the electromagnetic response of a deposit of massive sulphides found in exploratory drilling. Presumably the geophysical data could be used to trace the deposit and to locate the richest parts of the mineralized zone for additional test drilling. Field measurements were made by the authors during December 1965.

The area is near latitude 18°20'N., longitude 44°20'E., about 20 Km south of Bi'r Idimah (Fig. 1). Most of the area, lies in a wadi bounded by low hills that reach elevations near 1250 meters and rise as much as 50 meters above the wadi floor. The gossan is exposed in the wadi and near the crests of a few hills in the southern part of the surveyed area. It is underlain by andesite porphyry and greenstone intruded by granitic rocks, and appears to have been displaced laterally by faulting in the central part of the area. An inclined test hole north of the offset cut massive pyrite between depths 98 and 141 feet, 250 and 260 feet, and between depths 299 and 351 feet. This test and the character of the gossan suggest that the mineralized zone continues southward for a considerable distance.

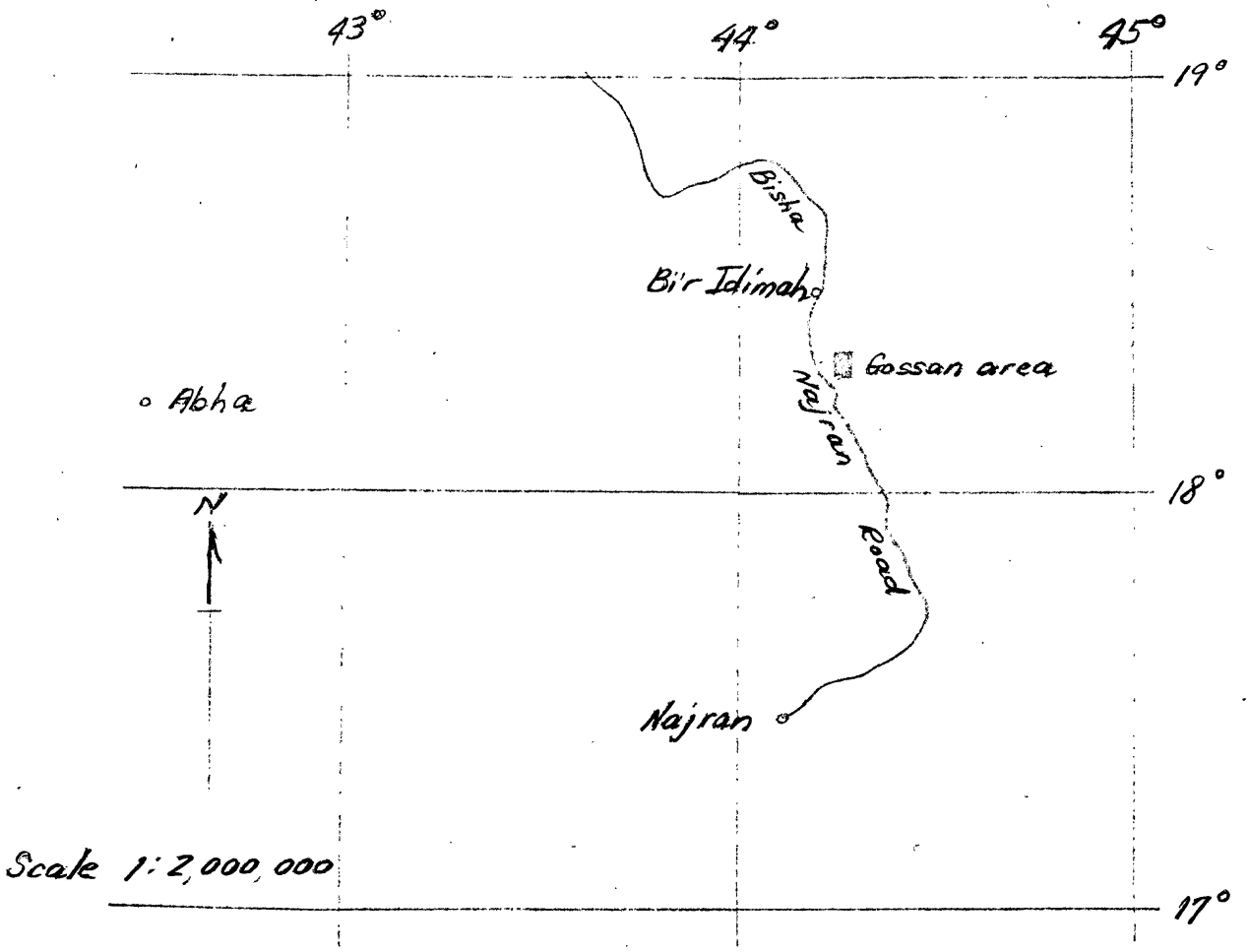

Figure 1. Location of area studied

Instruments and field technique

Vertical-coil electromagnetic dip-angle equipment with a 500 watt generator and operating frequency of 1100 cps (Sharpe, Model SE-100) was used in making field measurements. Dip-angle data were obtained at stations 10 or 12.5 meters apart along traverses spaced 50 and 100 meters, perpendicular to base lines along the gossan trend (Fig. 2). The measurements were made with the transmitting coil over the conductive zones and the receiving coil along traverses 100 to 300 meters from the transmitting source. This arrangement gave an effective depth of penetration about equal to half of the distance between the transmitting and receiving coils. The horizontal control was established by means of compass and tape; and stations were indicated by rock monuments.

Analysis of data

Prominent dip-angles occur over gossan exposures along base lines A and B (Figs. 3 and 5). Cross-over points and irregularities in the dip-angle profiles mark conductive zones that underlie the exposures. Analysis of the data indicates that the tops of the zones lie at shallow depths and that the zones contain material of moderate conductivity.

Along baseline A, two major zones are inferred to lie beneath traverses south of 300S (Fig.2). The western zone seems to terminate between traverses 700S and 800S. The eastern zone swings southeastward from traverse 800S and continues across base line B into a wadi along the granite front to the east. Near traverse 300S the zones join to form a single subsurface conductor that extends northward beyond traverse 0.

Drill hole 1 (inclined 45°E.) is near station 65W on traverse 450S. The bodies of massive sulphides cut in this hole are indicated as a single conductor in the west part of the dip-angle profile (Fig. 4). The hole bottomed in andesite at depth 500 feet and did not reach the eastern conductive zone, which is marked by the cross-over point near station 90E. A study of the data indicates that the sulphide-bearing zones dip steeply to the west and that their tops lie at depths less than 45 meters (148 feet).

Throughout the area of base line A, tops of the mineralized zones probably lie at depths less than 65 meters (213 feet). The zones dip steeply westward and doubtlessly contain pods and lenses of massive sulphides (pyrite) as found in drill hole 1.

Width of null-point data indicates that the conductivity of material in the zones is fairly uniform. The greatest change seems to occur between traverses 300S and 350S and probably corresponds to less massive parts of the pyrite-bearing zones.

The dip-angle data along base line B (Fig.5) indicate that a continuous mineralized zone extends south from traverse 100S (Fig.2). The zone dips steeply westward and the maximum depth to the top of the sulphide mass is generally less than 60 meters. Hole No. 2 (inclined 45°W) is being drilled near station 45E, traverse 1150S, on the east slope of a large gossan-capped hill. Comparison of dip-angle profiles suggests that a smaller amount of massive sulphides will be found in this hole than was cut in drill hole 1. A very strong electromagnetic response was observed between traverses 150S and 300S. This occurs near the intersection of inferred mineralized trends from base line A and along base line B. The strong response probably represents a richer part of the pyrite-bearing zone or may be caused by more conductive material, such as chalcopyrite. Elsewhere the data suggest that only minor changes in the amount of sulphides occur within the zone.

Recommendation

Results of the investigation indicate that a major change in character of the mineralized zones occurs along the northern part of base line B. Therefore, we recommend that this anomalous part of the area be tested by drilling at least one hole near the following location:

Position - Near traverse 200S of base line B; 37 meters (121 feet) west of base line; inclined 45°, bearing N.87°E.

Comment - Top of the conductive zone is inferred to lie beneath the traverse about 20 meters east of the base line at an estimated maximum depth of 55 meters (180 feet). Hole should be drilled to a slant depth of about 152 meters or 500 feet.

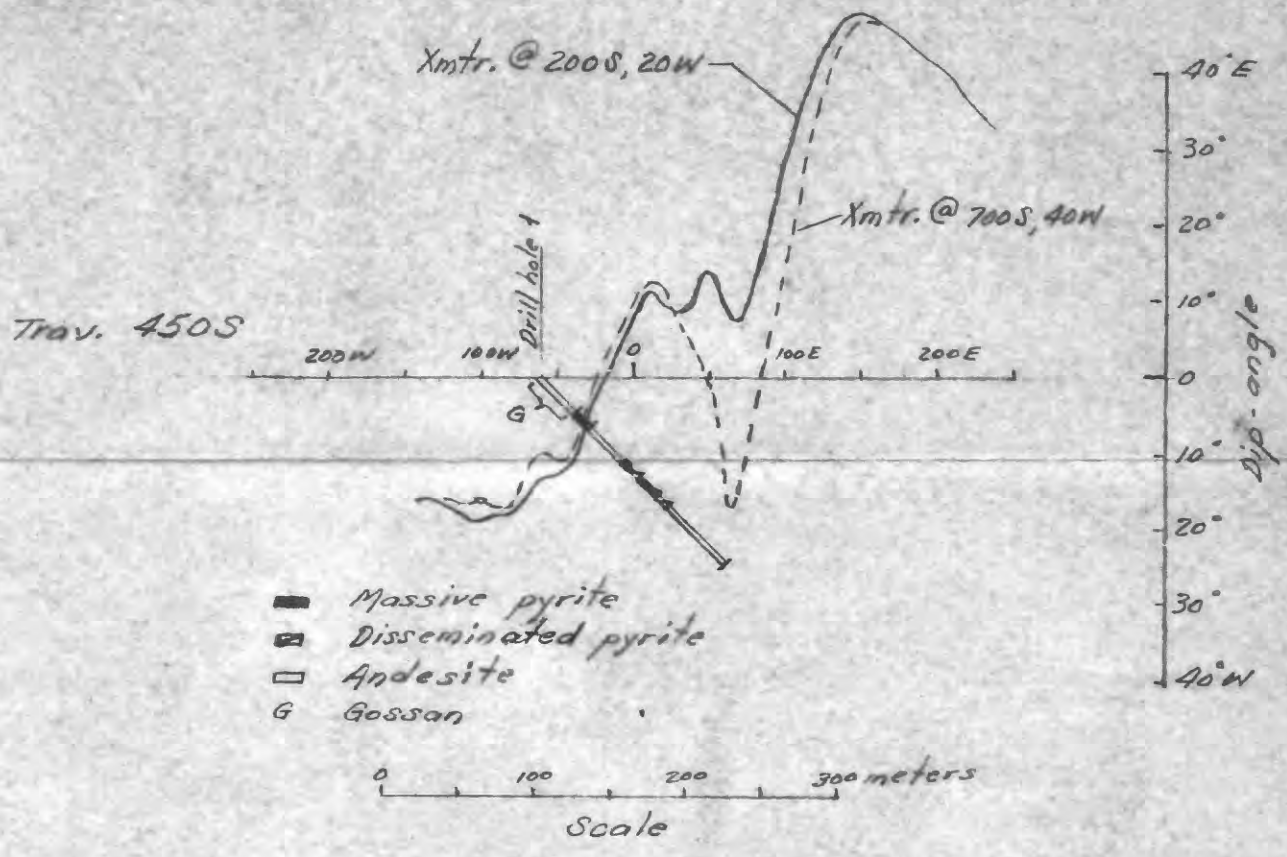

Figure 4. Dip-angle profiles over drill hole 1

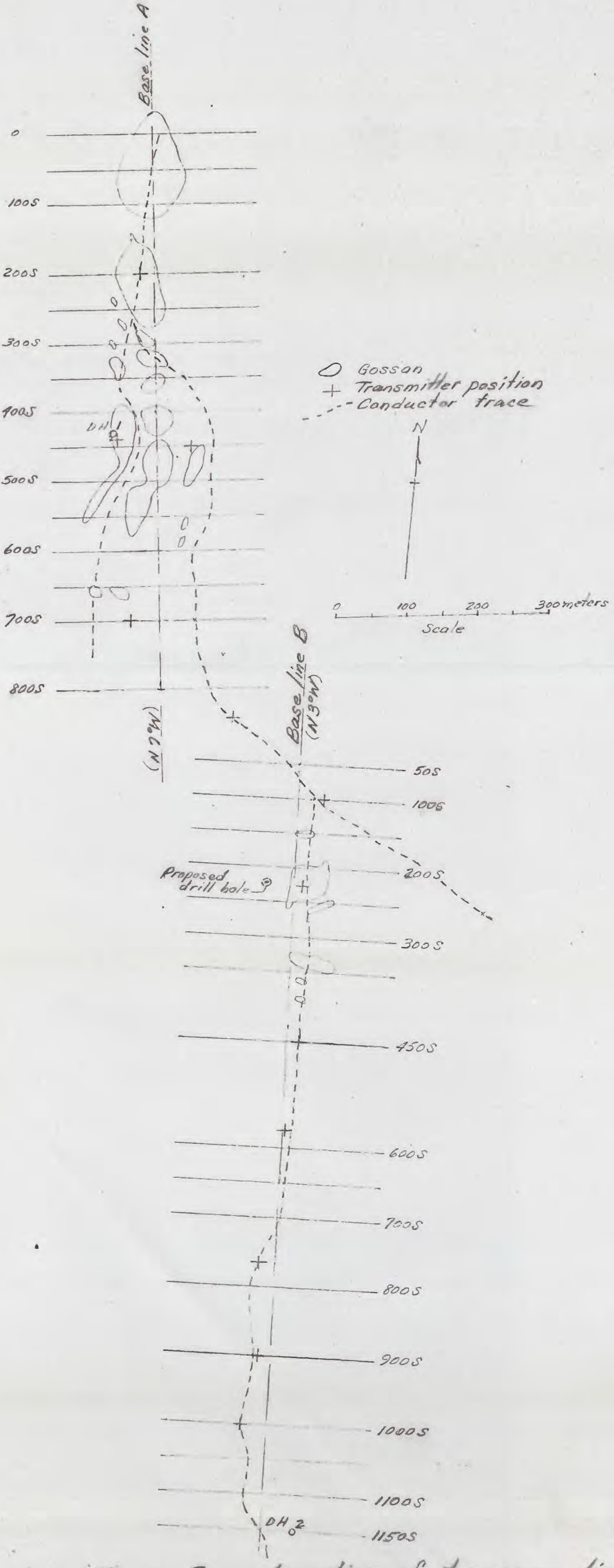

Figure 2. Location of traverse lines

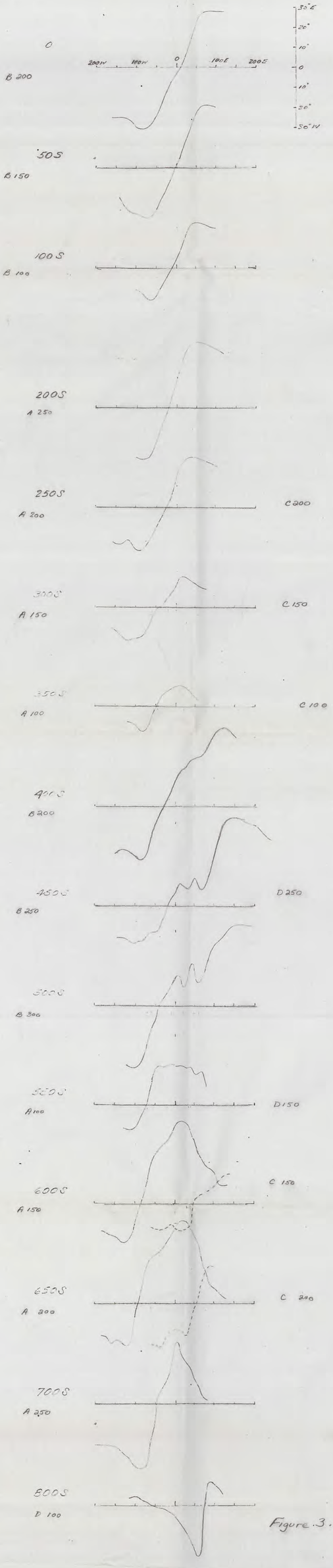

Figure 3. Dip angle profiles. Base line A.

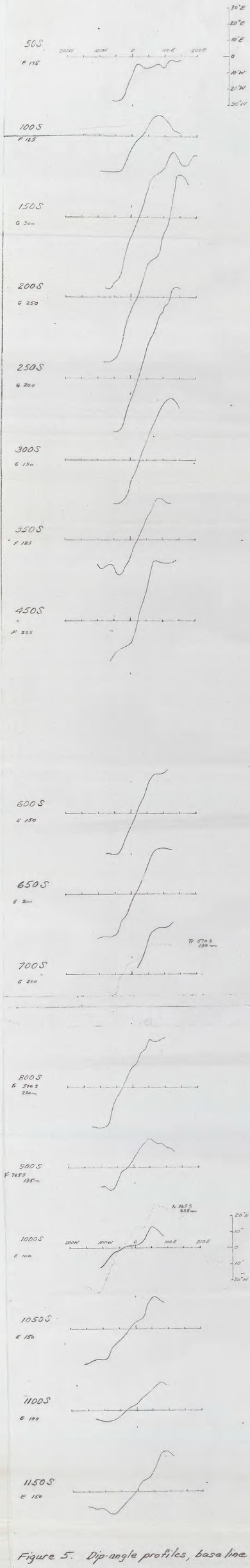

Figure 5. Dip-angle profiles, baseline B