UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Saudi Arabia Investigation Report
(IR) SA-54

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

Part Two

by

R. V. Allen and W. E. Davis

1969

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 Also on open file in that office is a large amount of material, in the form of unpublished manuscripts, maps, field notes, drill logs, annotated aerial photographs, etc., that has resulted from other previous geologic work by Saudi Arabian government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.

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Saudi Arabian Mineral
Exploration - 54

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

Part Two

by

R. V. Allen and W. E. Davis

INTRODUCTION

Geophysical studies were continued in the Bi'r Idimah-Wadi Wassat area during February 1966. Detailed electromagnetic measurements were made along selected traverses over the northern part of the gossan to supplement earlier dip-angle data; and reconnaissance surveys were made over the central and southern parts of the gossan. Gossan is exposed near the crests of prominent hills and is marked by a zone of alteration in the lowland. The geophysical exploratory work was done mostly in the lowland to determine the continuity of the gossan and to delineate associated deposits of massive sulphides.

INSTRUMENTS AND FIELD PROCEDURE

A horizontal-coil electromagnetic unit (ABEM Gun) with operating frequencies of 1760 and 440 cps and a coil separation of 200 feet was used in making the detailed measurements. Observations were made at intervals of 12.5 meters along traverses 50S, 100S, 450S and 500S of base line A; and along traverses 200S and 250S of base line B over the northern part of the gossan (Fig. 2, Allen and Davis, 1969). The effective depth of penetration of the measurements was between 100 and 150 feet. The equipment was calibrated in the lowland southeast of the drill camp.

Vertical-coil dip-angle equipment (Sharpe, Model SE 100) operated at a frequency of 1100 cps was used in the reconnaissance surveys. The transmitter was placed over conductive zones and inclinations of the resulting electromagnetic field were measured at intervals of 12.5 meters along traverses spaced 100 meters apart across the gossan trend. Distances between the transmitter and receiver were selected to give depths of penetration ranging from 150 to 500 feet. Data were obtained in localities C, D, E and F shown in figure 1.

ANALYSIS OF DATA

Horizontal-coil measurements.

Prominent horizontal-coil anomalies occur over the gossan outcrops and coincide with the traces of conductors inferred from the dip-angle data. Along traverses 50S and 100S of base line A (Fig. 2, Allen and Davis, 1969) the horizontal-coil data (Fig. 2) suggest that the mineralized zone is about 35 to 50 meters wide and is nearly vertical. It is centered beneath the dip-angle "crossover" and seems to contain two enriched parts that lie east and west of the base line. The massive sulphide (pyrite) bodies cut in drill hole 1 near traverse 450S are marked by small anomalies close to station 0 on the horizontal-coil profile (Fig. 2). The eastern pyrite-bearing zone is indicated by a pronounced anomaly centered near station 90E. It is inferred to be the richer zone and is about 25 meters wide. To the south along traverse 500S the east and west zones are dominantly expressed in the profile. The east zone is about 50 meters wide and the west is approximately 10 meters in width. Both zones are nearly vertical.

Horizontal-coil anomalies over the conductor trace on traverses 200S and 250S of base line B (Fig. 2, Allen and Davis, 1969) are characteristic of a broad gently-dipping mass, though they are probably caused by steeply-dipping enriched parts of the mineralized zone. The data suggest that the zone in this part of the area may be as much as 100 meters wide.

Dip-angle surveys.

Locality C: This locality is about six kilometers south of the gossan's northern end. The gossan is not well-exposed; therefore, suitable transmitter positions were determined initially by means of a brief reconnaissance survey. Dip-angle

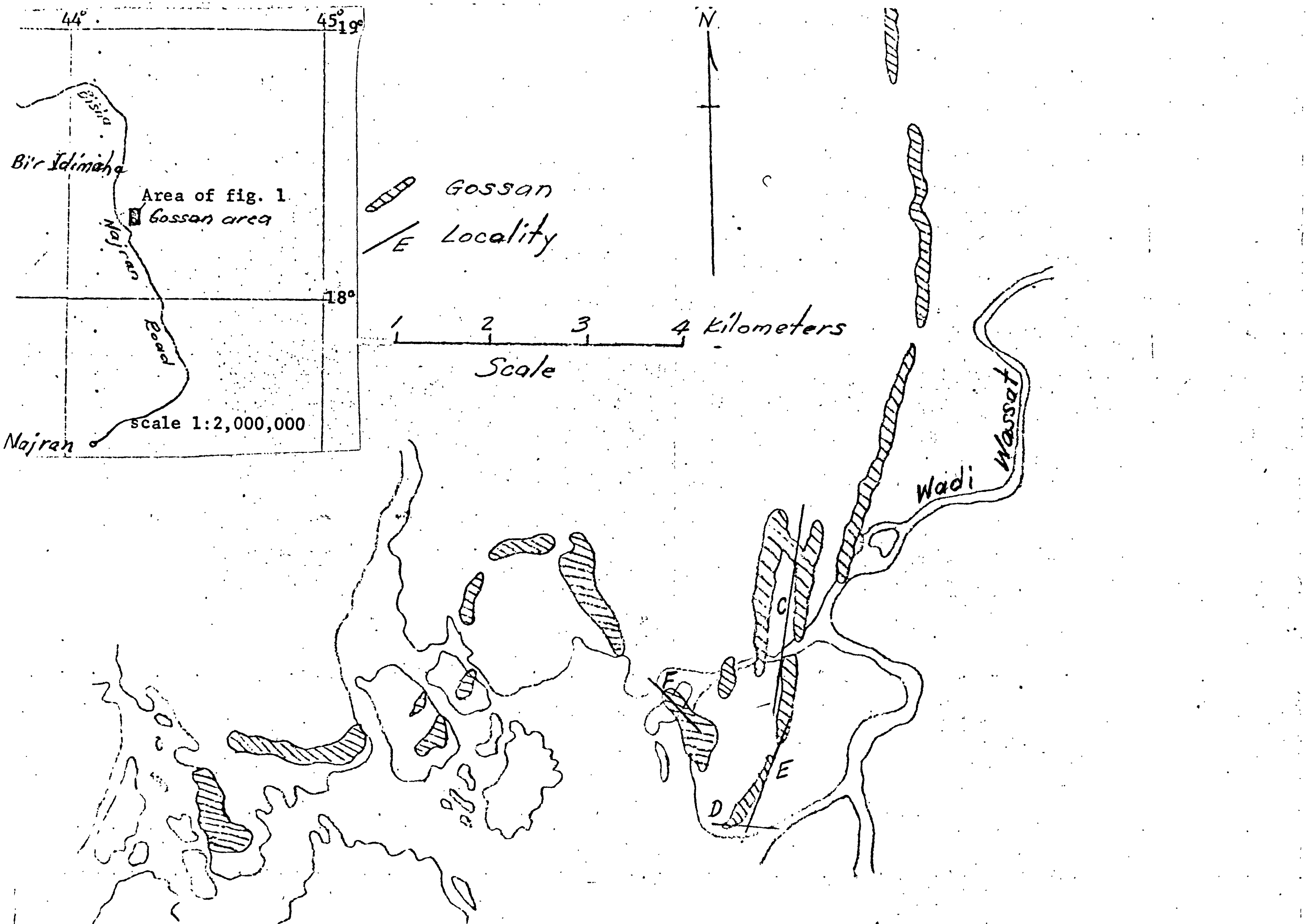

Figure 1. Localities investigated

measurements were then made along 18 traverses (Fig. 3, Base Line C). Gossan outcrops in hills along the west side of the area were not included in the survey.

From the data (Fig. 4) we infer that conductive zones occur between traverses 0 and 1050N and between traverses 350S and 650S (Fig.3). The zones dip eastward and their tops lie at depths less than 65 meters. The dip-angles are not large compared to those observed near drill hole 1 in the northern part of the gossan. This weaker electromagnetic response suggests that the conductive zones contain less massive sulphides than found in the northern zones. The sulphide content is inferred to be quite variable throughout the area. The richest parts seem to be near traverse 750N and between traverses 350S and 650S.

Localities D and E: Localities D and E (Fig.3, Base lines D and E) overlap and include the southern part of the gossan's main northerly trend. They are southeast of baseline C from which the gossan seems to have been displaced laterally by faulting. Dip-angle measurements were made along 15 traverses across the gossan outcrops.

The data (Fig.5) reveal that subsurface conductive zones follow the general trend of the gossan. Along base line D, a conductor occurs between traverses 0 and 200E (Fig.3). This conductive zone seems to be associated with a northeasterly-trending fault that forms the southern contact of the gossan. Near traverse 0 the zone is nearly vertical and it is concealed by less than 40 meters of overburden. Near traverse 200E the conductive zone joins another that trends northward along gossan exposures in locality E (Fig.3). This zone is well-expressed in the dip-angle profiles (Fig.6) between traverses 250S and 450N of base line E, but it appears to die out to the north. In all probability it has been terminated by a south-easterly-trending fault that cuts across baselines C and E. The data are affected by conductivity of the gossan material or by underlying sulphide mineralization and suggest that another conductive zone occurs along the western side of the outcrops. We infer from the data that the amount of mineralization within the conductive zones varies considerably. The richest parts probably lie between traverses 250N and 450N and south of traverse 50S. Elsewhere, we suspect that sulphides occur in multiple zones beneath the gossan west of the main conductor. Between traverses 250N and 450N the conductive zone dips steeply to the west and its top is less than 25 meters beneath the ground surface. Along traverse 250S the zone probably dips eastward, is much thicker, and lies at a shallower depth.

Locality F: Locality F is about one kilometer west of locality E. It is near the mouth of Wadi Wassat where the trend of the gossan swings northwestward (Fig.1). This locality is of particular interest because the gossan is in contact with a large granitic intrusion that underlies much of the area to the west. Dip-angle data were obtained along six traverses across the gossan-granite contact.

The data (Fig.7) indicate that several conductive zones occur in this locality. The main zone underlies the large gossan outcrop and continues east along the south side of the smaller exposure (Fig.3). It seems to be offset between traverses 100W and 200W, though the western segment may be a part of another zone that lies beneath the northern portion of the outcrop. Unfortunately, data were not obtained over this part of the gossan. The electromagnetic response is sufficient to indicate that these zones probably contain massive sulphides. Near traverse 100E the zone dips steeply to the south and its top lies at depths less than 50 meters. Irregularities in the profiles suggest that a conductive zone occurs along the gossan-granite contact and that another lies in the granite to the south. The transmitter was not placed over these zones, therefore, we are not able to determine if they are as highly mineralized as the conductors beneath the gossan.

CONCLUSIONS

Results of the geophysical studies indicate that deposits of massive sulphides occur intermittently along the gossan. The deposits vary in width and depth of burial, and can be detected by means of close - spaced electromagnetic measurments. We believe that the gossan should be investigated completely; and recommend that detailed geologic mapping be done in conjunction with additional geophysical exploratory surveys in order to obtain sufficient information for planning and undertaking a systematic exploratory drilling program.

REFERENCE

Allen, R. V., and Davis, W. E., 1969, Geophysical investigations in the Bi'r Idimah - Wadi Wassat area, Saudi Arabia, part 1: U. S. Geol. Survey open-file rept. SA-53, 3 p., 5 figs.

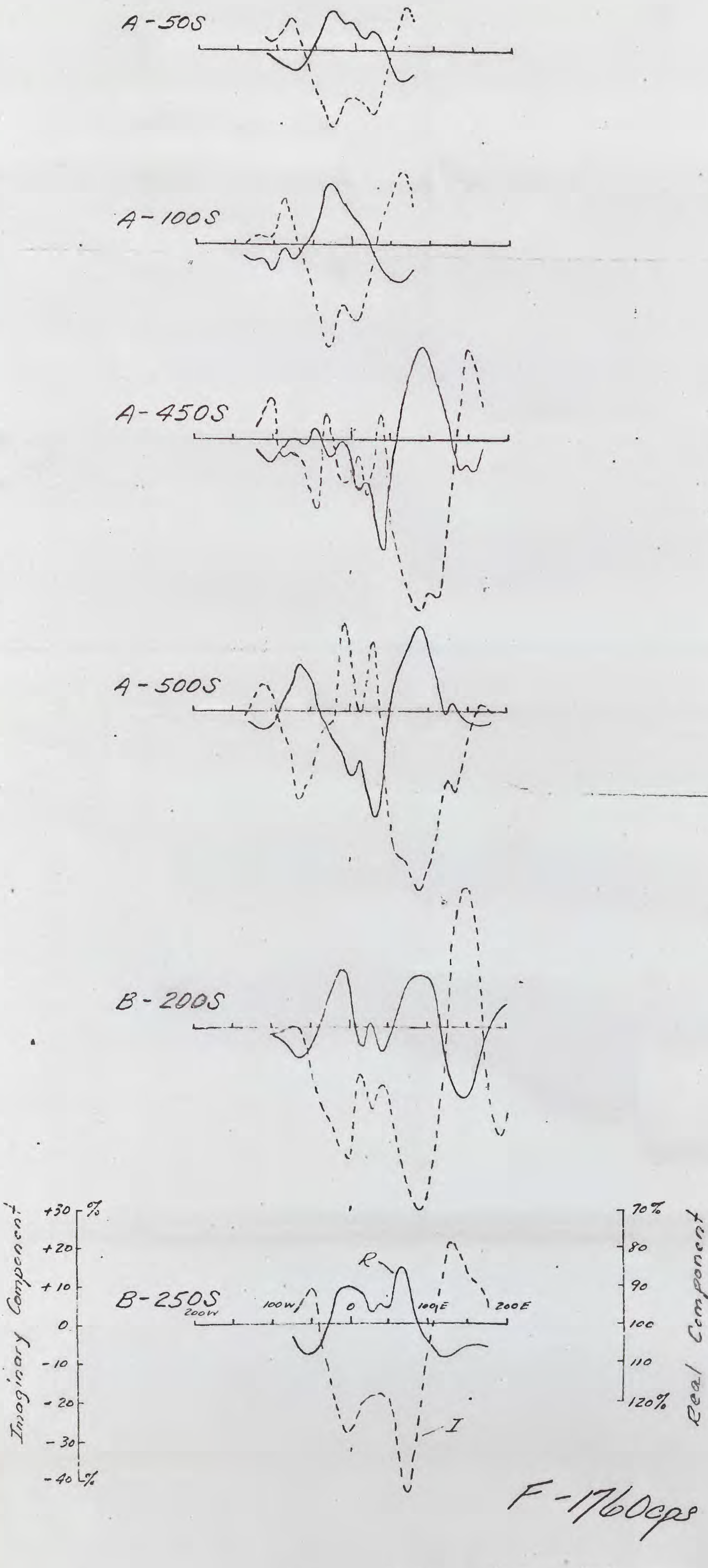

Figure 2. Horizontal-coil profiles

Figure 3. Location of dip-angle traverses

Figure 4. Dip-angle profiles, Locality C

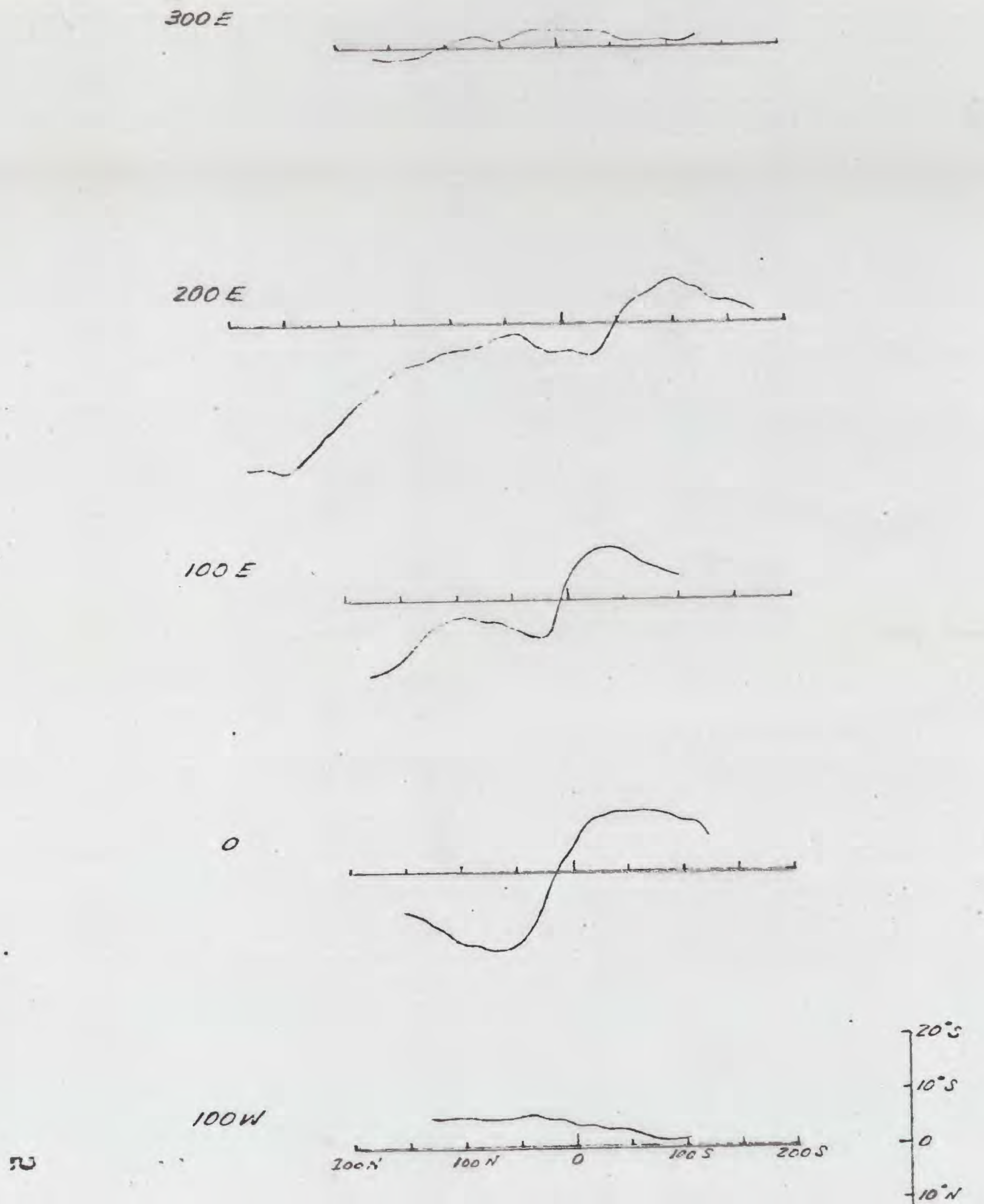

Figure 5. Dip-angle profiles,
Locality D

Figure 6 Dip-angle profiles, Locality E

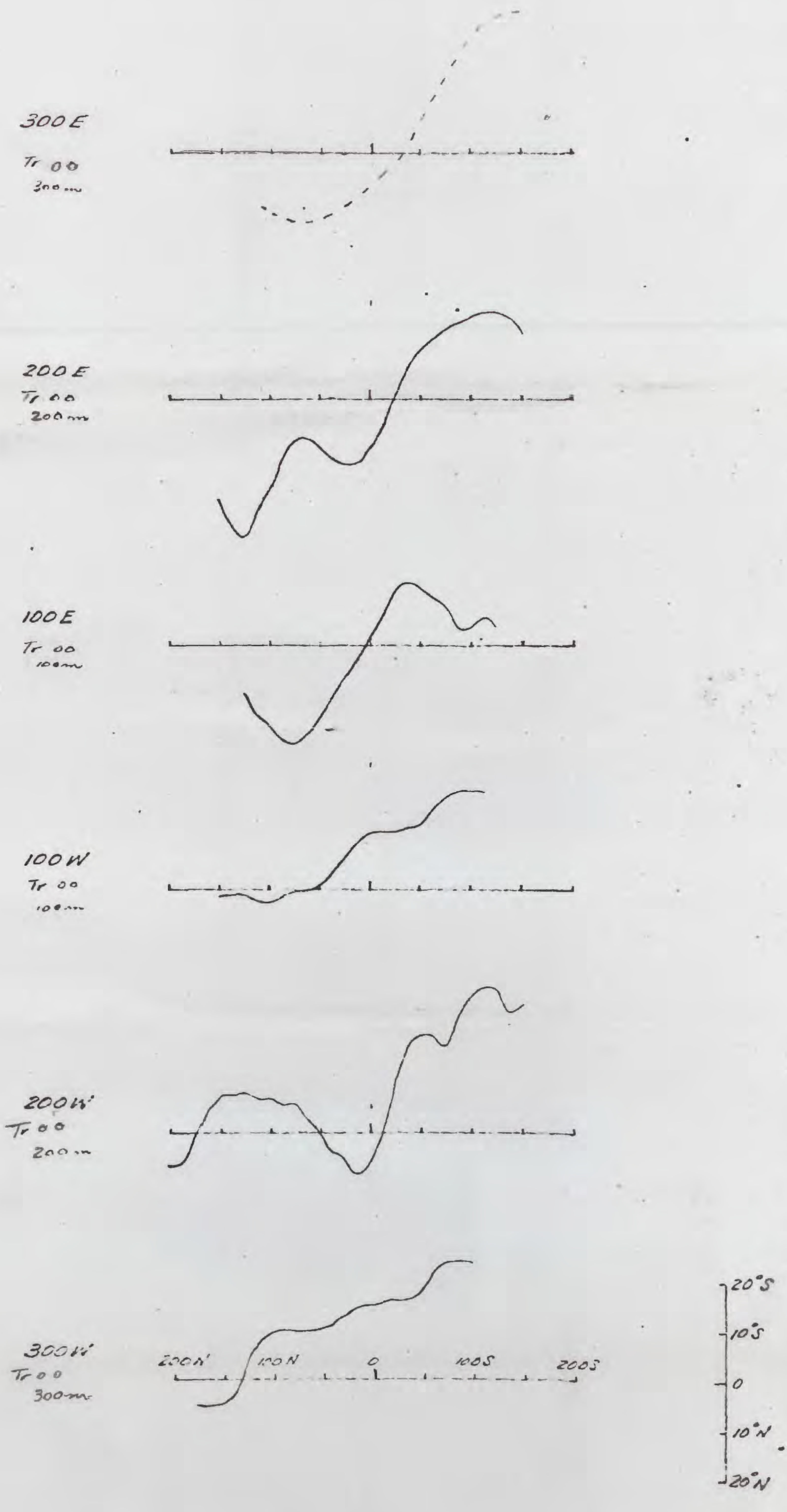

Figure 7. Dip-angle profiles, Locality F