REPORT ON
THE INTERPRETATION OF
AN AIRBORNE MAGNETIC SURVEY,
CARRIED OUT IN SEPTEMBER 1959,
NEAR REYKJAVÍK
SOUTHWESTERN ICELAND

for

THE STATE ELECTRICITY AUGHORITY OF ICELAND

by

HUNTING SURVEY CORPORATION LIMITED

TORONTO, CANADA

DECEMBER 1963

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GENERAL

Between September 24th and 26th, 1959, Hunting Survey Corporation Limited carried out an airborne magnetic survey near Reykjavik in south-western Iceland.

The survey area extended, approximately, from Longitude 21°30' to 22°00' West and from Latitude 64°07' to 64°15' North.

The survey covered an area of approximately 290 square kilometres, and required a total of approximately 814 profile line kilometres at a line spacing of 1/2 kilometres at a terrain clearance of 150 metres. The crew and aircraft, a Canso, were based at Reykjavik. The interpretation was carried out in the Toronto office of Hunting Survey Corporation Limited in December 1963 for the State Electricity Authority of Iceland.

2. Positioning

Vertical control was provided by a modified APN-3 radio altimeter measuring the ground clearance, while the flight path of the aircraft was recorded by vertical photography using a 35 mm aerial camera.

3. Magnetic Control

Magnetic control was provided by four control lines almost six kilometres apart and flown perpendicular to the flight lines.

4. Airborne Magnetometer

The survey was carried out using a Gulf Research and Development Company Mark III flux gate magnetometer, recording variations in total intensity of the magnetic field. The magnetometer was housed in a bird, and towed by a 100-foot cable below and behind the aircraft.

The resolution and noise level of the instrument are such that variations of 1.5 gammas are readable. The magnetic data were recorded on 10-inch Leeds and Northrop rectilinear charts. The sensitivity of the magnetometer was set at 1,200 gammas full scale with a 1,000 gammas step interval. A tape speed of 10 inches per minute was used.

5. Airborne Radiation Detector

The radiometric survey was carried out using an airborne radiation detector. The output of this instrument was recorded on the same curvilinear chart as the signal from the radio altimeter. A full scale deflection on this chart represents 6,000 counts per minute over a 1-second integrating time.

6. Mapping

The base map was prepared from a 1:40,000 geological map by Hunting Survey Corporation Limited.

The magnetic data are presented in the form of contour lines of the variations of the total magnetic intensity referred to an arbitrary datum, at intervals of 25 gammas, on both the base map and on six maps at 1:10,000 scale.

The interpretation is presented on a 1:40,000 map overlay showing the location and apparent strikes of the dykes, and the general outline of the interpreted zones, along with low temperature thermal lines.

GENERAL GEOLOGY

The area in question is one of a flood basalt nature where volcanism has been primarily confined to the Tertiary and post-Tertiary periods. Thus its geology can be described as one of plateau basalts, overlain by soil and silt and cut by numerous dykes and small normal faults.

The volcanics are of the Tertiary and Quaternary age, the latter lying unconformably on the former. The Tertiary volcanics outcrop on the northwestern portion, while post-glacial lava flows are present in the southeastern part.

REMANENT MAGNETISM

Remanent magnetism is present in most of the basalts and a considerable number of reversals of the earth's field are known to have taken place during the solidification of the magma.

INTERPRETATION

GENERAL

The area is one of very strong magnetic relief with superimposed magnetic anomalies of positive and negative nature, as is expected of a flood basalt area.

However, this can be further broken down into four general zones based on magnetic character, i.e. three definite areas, plus the remainder. These three areas appear to coincide fairly closely with known areas of outcrop, and leads to the conclusion that the anomalies are caused by intrusives in the form of dykes, sill and other irregularities, and by different volcanic horizons of slightly different magnetic character in the main basalts themselves.

Furthermore, since in the Tertiary period there were known to be thirty or more reversals of the earth's field, and since it is the writer's belief that induced magnetization by the present field plays very little part in the magnetics obtained, these being most attributable to remanent magnetization, all calculation of dips and strikes of formations can be literally disregarded. This follows as the total magnetization is the vector sum of the induced and remanent magnetization.

No attempt was made to interpret the structure, as it was felt that the very nature of the magnetics would only lead to great ambiguity in the location of faults.

SPECIFIC

ZONE 1

This zone possesses the strongest magnetic response of all, and consists of a high magnetic level with strong magnetic relief.

Unfortunately, the greater part of the zone is located over the sea making geological correlation extremely difficult. However, using the remainder of the zone, it would appear as though this unit coincides with the grey basalts of the type that are exposed on the shoreline around Reykjavik.

The individual magnetic anomalies are probably caused by basaltic dyke swarms with the help of different volcanic horizons of slightly different magnetic properties. All the anomalies correspond to an origin of shallow source, i.e. mostly surface or near surface effect, indicating that those beneath the sea may be caused by submerged peaks and valleys.

The magnetic susceptibility in this area is very high and with an average range of 0.004 to 0.1 c.g.s. units, i.e. having a maximum percentage magnetite content of 1.6 to 40%.

ZONE 2

This zone is so characterized by a high magnetic level with strong magnetic relief. On correlation with known geology, it is again found that this must coincide, approximately, with known outcrops of grey basalts.

Again, the individual anomalies can be attributed to intrusives such as dykes, sills, etc., and to different volcanic horizons. However, the anomalies in this area are not nearly as strong as those in Zone 1, possibly indicating a property difference in the solidified magma. This is supported by the decrease in value of the susceptibility, it being in the average range of 0.002 to 0.01 c.g.s. units, i.e. a maximum magnetite content of 0.8 to 4%.

ZONE 3

This zone can be classified as one of high magnetic level with superimposed anomalies. On correlation with known geology, the unit appears to be associated with existing outcrops of the old basalts of the type found around Ulfarsfell.

The individual anomalies are again attributed to dyke swarms etc., and to different volcanic horizons. The anomalies themselves are weaker than in Zone 1, with susceptibilities in the same range as those in Zone 2, i.e. 0.002 to 0.01 c.g.s. units.

ZONE 4

This is better classified as the remainder. Here again, a high magnetic level is obtained with fewer superimposed anomalies. On correlation with known geology, this unit seemingly corresponds to areas of loess, sill and with post-glacial lava flows in the southern portion where slightly more magnetic relief is apparent.

The causative sources of the anomalies appear to be deeper than those of the previous three zones, suggesting that they be attributed to intrusive dykes and to various volcanic horizons of different property which are covered by accumulations of loess, silt and peat with added effects from the tephra layers within the depositions themselves.

The magnetic susceptibility is in general less than 0.004 c.g.s. units, i.e. maximum magnetite content less than 1.6%, with possible exceptions in the areas of post-glacial lava flows.

Thus in an examination of the Zones 1 and 2, it would appear that Zone 1 is indicative of more rugged topography and more intrusives than Zone 2, the intrusives being also more basic as indicated by the difference in susceptibilities.

Also, the first three zones appear to have more evidence of intrusives than the fourth and so are considered representative of swarms of dykes, sills and other intrusive irregularities. These swarms, as a unit, appear to strike in a general northeasterly direction.

SUMMARY

1. The causative sources of the anomalies are shallow.

2. The anomalies are attributable to basic intrusives and different volcanic horizons of different magnetic character in the rock itself.

3. The area can roughly be divided into four zones, three of which are representative of narrow swarms of basic intrusions of considerable extent.

4. These swarms as a unit appear to trend in a northeasterly direction.

5. That two low temperature thermal lines as located by Bodvarsson seem to line up with two of these units.

RECOMMENDATIONS

It is the writer's recommendation that the data be re-interpreted by an authority in Iceland who is decidedly more familiar with the magnetic and geologic properties of the rocks in the area.

HUNTING SURVEY CORPORATION LIMITED,

Peter E. Walcott,
Geophysicist.

Toronto, Canada,

December, 1963.

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