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Contact

Niedersächsische Staats- und Universitätsbibliothek Göttingen
Georg-August-Universität Göttingen
Platz der Göttinger Sieben 1
37073 Göttingen
Germany
Email: gdz@sub.uni-goettingen.de

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Study of the Spatial Variation of the Magnetic Field Intensity on North-South Profiles in Iran in Comparison with the IGRF Model of 1970

N.H. Guya

Institute of Geophysics, Tehran University, Tehran, Iran

Key words: Magnetic anomalies – International Geomagnetic Reference Field (IGRF) – Proton magnetometer.

The purpose of this work is to compare the International Geomagnetic Reference Field (IGRF) of 1970 with the data obtained for magnetic elements from the Tehran observatory, as well as the data from two north-south profiles in Iran. Such a comparison, firstly reveals the difference of the IGRF model and the observed data at the observatory, and secondly acts as a guide to determine the accuracy and the cause of spatial irregularities of magnetic elements. An attempt has been made to interpret the existing differences in terms of local magnetic anomalies.

A computer program, originally developed by the U.S. Coast and Geodetic Survey, was modified and adopted for use the IBM computer available in Tehran. Using this program values of the geomagnetic components are derived from spherical harmonic models for given geographic positions and recording intervals, concerning measurements at local sites. The method involved uses models of degree and order up to twelve and the first time derivatives of the coefficients (Hurwitz et al., 1966). A similar method of comparison of field data and the IGRF model was applied by Bleil (1974) for a profile in the Alps.

In Figure 1, the yearly mean values of geomagnetic elements D (declination), I (inclination) and F (total intensity) from the Tehran observatory are compared with the corresponding values, calculated from the IGRF model for the period 1960–1973. The existing differences could be caused by local magnetic anomalies near Tehran or by the occurrence of secular variation which is not adequately included in the IGRF model.

For further studies of this question, the same method of comparison was applied to the data obtained from field observations, measuring the total intensity with a proton magnetometer at intervals of 6–10 km on two profiles (No. 1 and No. 2) both running north and south of the Tehran station from the Caspian

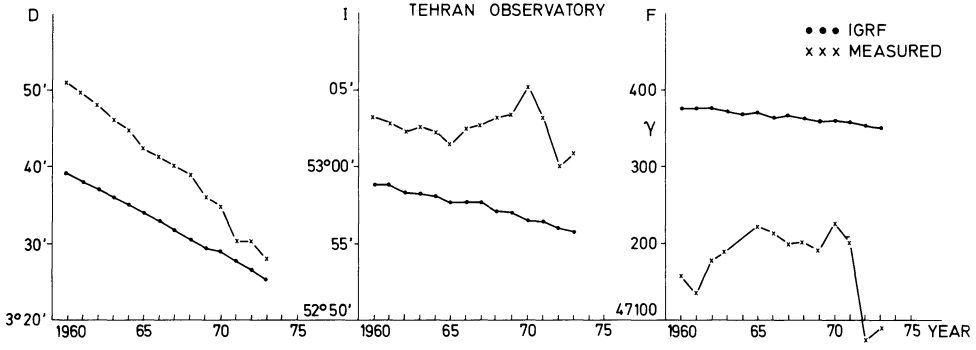

Fig. 1. Comparison between the IGRF model and the yearly mean values of the magnetic elements D, I and F, measured at the Tehran observatory for the period 1960–1973. The occurring differences suggest the presumption of a local magnetic anomaly near Tehran

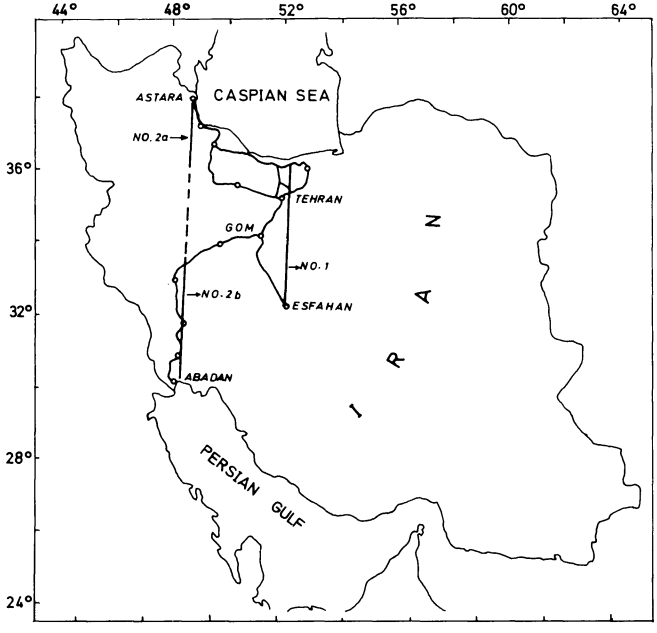

Fig. 2. Geographical map of Iran showing the roads along which the total intensity has been measured. The straight lines are the two north-south profiles to which the data of neighbored sites have been related

Sea to the Persian Gulf (Fig. 2). In the course of this survey a total of 310 points was obtained. Since the field sites are located near big roads by reason of transportation, the profiles represent the general direction to which the data of neighbored single sites or groups of sites is related. The part of profile No. 2, for which the stations are too far, is left out, dividing it into two sections.

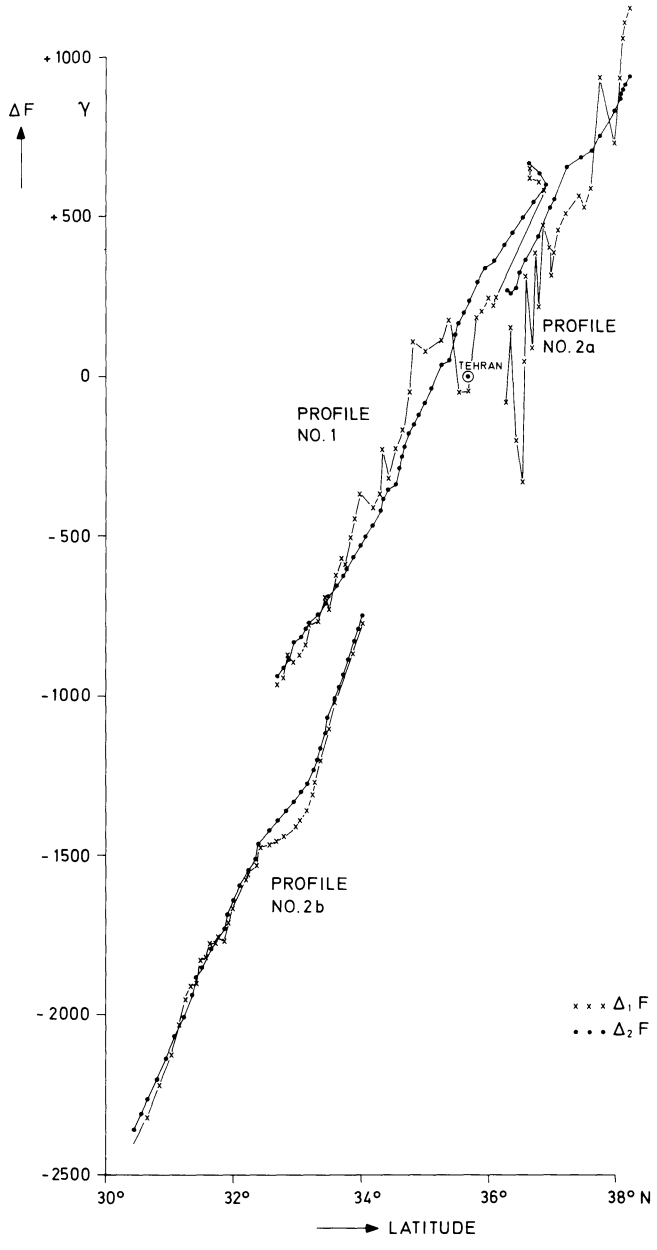

Fig. 3. Difference $\Delta_1 F$ between the total intensity, measured at field sites and at the Tehran observatory and difference $\Delta_2 F$ between the total intensity, evaluated from the IGRF model for field sites and from the monthly mean values of the Tehran observatory as functions of the station's latitude. Notice the prominent anomaly in the surroundings of Tehran

In order to evaluate the magnetic anomaly with respect to the reference field, the following procedure was applied:

$\Delta_1 F = F(St) - F(TP_1)$,

$\Delta_2 F = F(RF) - F(TP_2)$,

$\Delta_3 F = \Delta_2 F - \Delta_2 F$.

The used symbols have the following meaning:

$F(St)$ = Total intensity at each field site,

$F(TP_1)$ = Total intensity measured at Tehran observatory at the time of field measurement,

$F(RF)$ = Total intensity from the IGRF model for the field sites,

$F(TP_2)$ = The monthly mean value of the total intensity at Tehran observatory with regard to the period of field measurement.

Assuming that secular, daily, and irregular variations show parallel traces at both the field stations and the observatory of Tehran, the influence of these transient variations is eliminated with the above formulae. Hence, $\Delta_3 F$ represents the anomalous magnetic intensities with respect to the IGRF model.

In Figure 3 $\Delta_1 F$ and $\Delta_2 F$ are plotted for the profiles No. 1, 2a and 2b. On profile No. 2b, the curves for $\Delta_1 F$ and $\Delta_2 F$ are very close and no major anomaly can be recognized except between the latitudes 32°40′ N and 33°30′ N, but larger anomalies can be seen on profiles No. 1 and 2a. We conclude that these anomalies are mainly restricted to the surroundings of Tehran. The anomaly $\Delta_3 F$ itself is to be distinguished from the vertical difference of both the curves.

We hope in the future, with more measurements along some east-west profiles and with the help of geological and tectonic information of the area, to locate these anomalies more accurately and to be able to say more about their nature.

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Plate Tectonics and Geomagnetic Reversals. Reading with Introductions by Allan Cox (Editor). 702 S., 360 Abb., 45 Tab. W.H. Freeman and Compagny, San Francisco, Reading (G.B.) 1973, £8,20 clothbound, £4,30 paperbound.

Dieses Buch enthält vierzig der wichtigsten Originalarbeiten über die Plattentektonik, darunter vier ältere Arbeiten, auf denen dieses Konzept aufbaut. Allein schon für diese in neun Sachabschnitte gegliederte Sammlung der über viele Zeitschriften verstreuten und teilweise schwer zugänglichen Artikel muß man dem Herausgeber Allan Cox dankbar sein; ist doch das Studium der Originalarbeiten durch kein noch so gut geschriebenes Buch über die Plattentektonik ersetzbar. Dies ist auch eines der Argumente, das Cox zur Herausgabe des Buches führte, weil das Erregende des Entdeckungsprozesses durch die Schilderungen der Forscher selbst besser miterlebt werden könne. Doch er verfolgt noch ein weiteres Ziel und geht damit über eine einfache Sammlung hinaus: Wenn wir unsere Wissenschaft darstellen, sagt er dem Sinne nach, dann ziele dies im allgemeinen auf eine Wissenschaft ohne ihre Urheber ab. "The effect is that we inadvertently may leave students with the impression that science is a routine, matter-of-fact business, which it surely isn't". Deshalb hat Cox jedem der neun Abschnitte Einführungen vorangestellt, die eine Kombination darstellen aus einer Einführung in das betreffende Sachgebiet, einer Schilderung der historischen Entwicklung und nicht zuletzt der die Forschung initiierenden und tragenden Persönlichkeiten, von denen viele Photos, größtenteils Schnappschüsse während der Arbeit, beigefügt sind. Diese auf der wohltuenden Grundlage einer umfassenden Sachkenntnis und kritischen Beurteilung geschriebenen Einführungen zusammen mit den abgedruckten Originalarbeiten und weiteren Literaturempfehlungen (Reading lists) stellen dem Leser ein ausgezeichnetes Material zur Verfügung für eine gründliche und anregende Beschäftigung mit der Plattentektonik, ihrer historischen Entwicklung und ihrer Tragweite bzw. Weiterentwicklung. Hierfür wenigstens ein Beispiel aus der Einführung zum 2. Abschnitt, wo Cox schreibt, daß Belege für die sogenannte Tiefenstruktur der Kontinente wie etwa die seismische Zone unter der Westküste von Südamerika tatsächlich mehr auf einen *Prozeß* als auf eine Struktur hindeuten würden. Hier ist gewissermaßen die Lösungsmöglichkeit für ein Problem vorweggenommen, das erst kürzlich bezüglich der den Erdmantel durchfurchenden „Kiele" der Kontinente aufgeworfen wurde.

Das Buch ist in die folgenden Sachabschnitte gegliedert:

I. Paradigm of Plate Tectonics; II. The Beginning: Marine Geology; III. Geometry of Plate Tectonics; IV. Geomagnetic Reversals: The Story on Land; V. Reversals at Sea: The Magnetic Stripes; VI. Earthquakes at the Edges of Plates; VII. Second-Generation Plate Tectonics; VIII. Heat Flow, Gravity, and Driving Mechanism; IX. Plate Tectonics and Geology.

Die Literaturzitate der Originalarbeiten sind am Ende in einem Gesamt-Literaturverzeichnis zusammengestellt, das rd. 1300 Titel umfaßt. Ein Autoren- und Sachregister schließen das Buch ab, an dem alle ihre Freude haben werden, für die Wissenschaft mehr ist als ein „nüchternes Geschäft".

K. Strobach, Stuttgart

M. Schulz, L.J. Lanzerotti: Particle Diffusion in the Radiation Belts, 215 p. Berlin-Heidelberg-New York: Springer 1974.

The book which is considered in this review gives a rather special account of the field of particle diffusion in the radiation belts. Since both authors are active workers in the field of magnetospheric and particularly radiation belt physics the book is up to date (1974). After some introductury remarks it starts with a presentation of the theoretical framework of particle diffusion using a didactically somewhat novel approach based on Hamiltonian mechanics. The theory is compared with selected observations.

This comparison is by no means complete but relatively well balanced. The final chapter deals with techniques to compare observational data with the appropriate theories.

The book is useful for workers in and newcomers to the field of diffusion in the radiation belts but also in other fields where diffusion by the violation of the adiabatic invariants plays a role. It is valuable not only by giving a logical development of the theory but also as a source book for the various formulas resulting from the theory.

F.M. Neubauer, Braunschweig