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GEOMAGNETIC MEASUREMENTS IN REMOTE REGIONS

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edited by

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Preface

Earth is a complex dynamic system and study of the geomagnetic field can provide insight to the dynamic processes operative in the outer core where the main field is produced by a geo-dynamo mechanism. By contrast the study of transient geomagnetic variations is an important tool for studying the complex solar wind-magnetosphere-ionosphere coupling. In addition the currents induced by the time varying external current system allow us to image the crust and the upper mantle in terms of electric conductivity. Lack of measurements and collection of geomagnetic data from certain strategic locations restricts the development of high quality models of main geomagnetic field as well as the current systems responsible for transient geomagnetic variations. Division V of the International Association of Geomagnetic Aeronomy (IAGA) jointly with the Interdivisional Commission for Developing Countries organized a special symposium «Geomagnetic Measurements in Remote Regions» at General Assembly of IUGG held at Perugia (Italy) during July 2-12, 2007. Papers were presented on data base numerical simulations identifying strategic gaps in the existing observatory network where new measurements of geomagnetic field could improve upon existing geomagnetic reference models. Special focus was on describing the novel design of equipment, modes of data collection and dissemination from remote regions. During the symposium, 21 presentations were presented and this issue of Annals of Geophysics *compiles a selection of papers.*

It is significant that each paper in this special issue is multi-authored by several institutions and countries. This emphasizes the importance of worldwide collaboration when obtaining and analyzing data from geophysical observations in remote regions.

With current technology magnetic observatories still require people to take measurements at least once per week to enable baselines to be established and must be away from power sources and transmission lines. This restricts the location of magnetic observatories used for deep Earth investigations. However, presented here are papers describing ways to overcome harsh conditions and obtain magnetic data in remote locations. The need for long term ground based geomagnetic observatories for reference models is well established and discussed. Also discussed, is the study of magnetic field variations for determining transient phenomena. The measuring stations can exist unmanned as highlighted during the session by the Japanese group

(not included in this volume) and Chambodut et al.

Five papers (Cafarella et al.*, Chambodut* et al.*, De Lauretis* et al., *Maksymchuk* et al.*, and Torta* et al.*) describe magnetic observations in Antarctica. Most of this continent is covered by ice so it is almost impossible to sample the continental surface directly: magnetic exploration allows us to overcome much of this problem, providing important information on the geological and tectonic settings of this continent. Antarctica is also an interesting magnetic region because it is in darkness for half of the year, so production of the ionospheric plasma that creates the daily Solar quiet variation is reduced for this period in this region (Chambodut* et al.*). In addition, it contains the southern polar cap current system – a window to the solar wind and the magnetospheric-ionospheric energy transfer processes (De Lauretis* et al.*).*

Torta et al. *and Chambodut* et al. *describe the exceptional means necessary for a magnetic observatory in Antarctica attempting to attain INTERMAGNET status. Torta* et al. *use Livingston Island (LIV), in the South Shetland Islands archipelago (in operation for ten years), and Chambodut* et al. *describe Concordia Base (in operation for just over 3 years). Both have not yet achieved INTERMAGNET* status.

De Lauretis et al. *use two stations Concordia at Dome C and Mario Zucchelli at Terra Nova Bay to show that the geomagnetic signals, measured by the two stations, have very different signatures that depend upon the position of the stations with respect to the sources.*

The paper by Cafarella et al.*, describes long-term trends in geomagnetic measurements which have non-absolute baselines for six months of the year at Mario Zucchelli station (TNB). These authors compare TNB data with the models from satellite measurements and find them to be in good agreement. They exhibit the different long-term trend in source currents for example, daily variation, pulsations and internal Earth sources such as jerks.*

Maksymchuk et al. *also describe the results of long-term (1998-2005 yrs.) magnetic investigations but use tectonomagnetic techniques in the Western Antarctic near the location of Ukrainian Antarctic Station «Academic Vernadsky». This new type of research is described.*

A novel approach to remote data acquisition is given in Torta et al. *They describe the development of data transmission facilities for real time access between Antarctica and Spain using METEOSAT and GOES satellites and recently the move to a high frequency (HF) digital radio-link, using ionospheric propagation.*

Geomagnetic measurements from the deep sea are discussed in Vitale et al. *From 2000 to 2005 two exploring geophysical missions were undertaken in the Tyrrhenian deep seafloor at depths between around -2000 and -3000 m in the framework of*

the European-funded GEOSTAR Projects. During the two GEOSTAR deep seafloor missions, scalar and vector magnetometer measurements were used to improve global and regional geomagnetic reference models and to infer specific geoelectric information about the two sites.

Three papers (Korte et al.*, Macmillan* et al.*, Matzka* et al.*) describe magnetic observations in the region of the South Atlantic anomaly. This is the region between Africa and South America where Earth's main magnetic field is depressed causing localized space weather hazards (some described in Macmillan* et al.*), especially satellite outages. Korte* et al. *describes the installation of new magnetic observatories in Bolivia, Namibia and St Helena, and Macmillan* et al. *describe two older magnetic observatories located on Ascension Island and Port Stanely.*

Repeat station surveys are a way of measuring the secular variation of main field. Matzka et al. *contains a detailed report of a repeat station survey in this region at Tristan da Cunha Island. They also describe the drawbacks of repeat station surveys and prefer a magnetic observatory in the region which will be established for the* SWARM *satellite mission. However, Korte* et al. *show that when nothing else exists repeat stations are still a good way of obtaining secular variation data. They describe the addition of several repeat stations in the South Atlantic anomaly area in Africa.*

Torta et al. *and Korte* et al. *also describe efforts being made to create an unmanned magnetic observatory, which would have* INTERMAGNET *standards.*

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