

THE ACTIVITIES AT WORLD DATA CENTRE FOR GEOMAGNETISM MUMBAI, INDIA

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ABSTRACT

The World Data Centre for Geomagnetism, Mumbai has functioned as a division of the Indian Institute of Geomagnetism, Navi Mumbai since its full fledged activities commenced in 1991 in coordination with the International Council of Scientific Unions (ICSU) Panel on World Data Centres. Responsibility for the compilation of final hourly absolute values from nine of the Indian magnetic observatories and deposition of this data to the World Data Centres is undertaken at the centre. We have utilized the full advantage of technology advancement in upgrading our data preservation and conservation policy at various levels. In recent years, the centre has prioritized its activities related to digital preservation to ensure digital archiving of magnetic data from the traditional media and also digital conservation of very old hand written/printed data volumes and magnetograms. In view of the scientific importance of data from the Colaba-Alibag Magnetic Observatory, old magnetograms and data volumes are being converted to digital images for long term preservation. In the digital preservation process, the creation of metadata has become an important component in storing information related to old and current scientific records for future use. The centre also hosts a database driven website to make datasets available online to the global scientific community.

Keywords: ICSU, Digital preservation, Colaba-Alibag magnetic observatory, Geomagnetic data archives

1 INTRODUCTION

The main objective of this paper is to introduce the various data related activities at the World Data Centre (WDC) for Geomagnetism, Mumbai, which is located at the historic site of the COLABA-ALIBAG Magnetic Observatory at Mumbai (Geog. Long. 72°52'E, Lat. 18°53' N). This centre is operated by the Indian Institute of Geomagnetism (IIG), which is an autonomous research organization under the Department of Science and Technology, Government of India. The WDC for Geomagnetism, Mumbai is a part of the International Council of Scientific Unions (ICSU) world data centre system.

The Colaba Observatory located at Mumbai was built in 1826. Geomagnetic measurements were begun there in 1841, and it was in continuous operation until 1906. Geomagnetic observations continue today at the Alibag (Geog. Long. 72°52'E, Lat. 18°38'N) Magnetic Observatory. The Colaba-Alibag combined series of observations contributes geomagnetic data for a period of more than 160 years. This large geomagnetic data set has unique importance, as it provides the opportunity to relook at old geomagnetic storm events and understand the physical processes associated with them. For example, the most intense 1–2 September 1859 magnetic storm in recorded history was studied by Tsurutani et al. (2003) using geomagnetic field records from the Colaba Observatory. Also such a large time series of observatory data is useful in the study of long term change in geomagnetic activity, which has important implications for secular change in solar activity, global climate change, and the prediction of the likelihood of magnetic storm occurrences (Love, 2011).

The IIG presently operates a network of nine magnetic observatories in the Indian longitudes, which are shown in Figure 1. Geomagnetic field data is recorded continuously at these observatories, which extend from close to the equator to the northernmost latitude of India. The WDC for Geomagnetism, Mumbai is actively involved in the geomagnetic data depository in India. Geomagnetic data at all the stations operated by the IIG are collected at the WDC for Geomagnetism, Mumbai along with geomagnetic activity indices supplied by a worldwide network of magnetic observatories. Data Services at the WDC are available for scientific use at

<http://www.wdciig.res.in>. The activities of the WDC for Geomagnetism, Mumbai are elaborated in Section 2. Old magnetic field data preservation and digitization process is explained in Section 3. Early magnetic data recording at Colaba Observatory is briefed in Section 4, and the paper is summarized in Section 5.

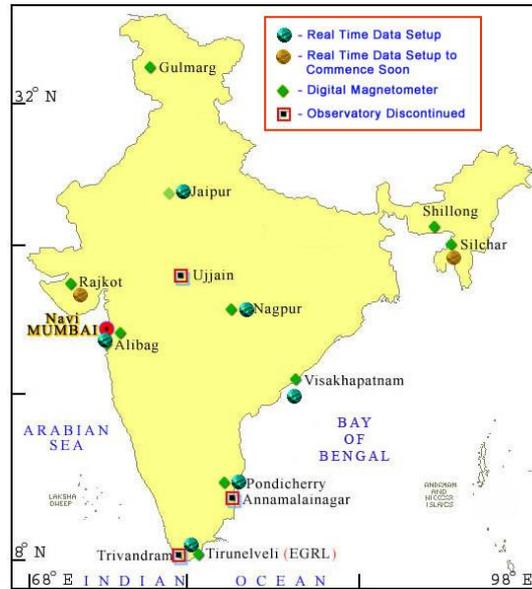


Figure 1. The network of magnetic observatories operated by the Indian Institute of Geomagnetism

2 ACTIVITES OF THE DATA CENTRE

The centre collects geomagnetic data from Indian geomagnetic observatories, other international research organizations, and world data centers. We take this opportunity to forward our thanks to all these institutes, centers, and organizations for their constant and valuable data supply and support. Figure 2 is the current data status of the centre, which has vast geomagnetic data set collections from Indian and international geomagnetic observatories in various data types.

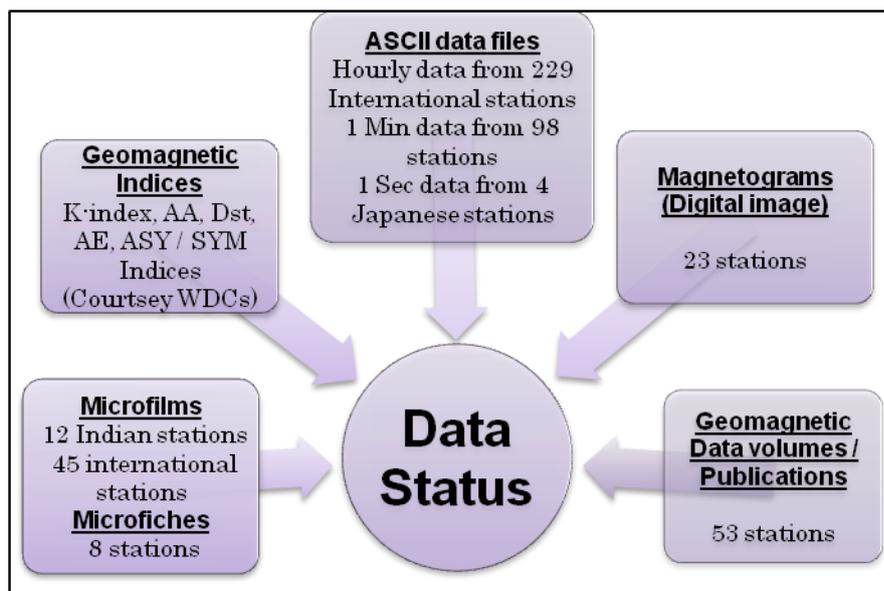


Figure 2. WDC for Geomagnetism, Mumbai current data status and types

The centre contains datasets from traditional media, such as punch cards, magnetic data tapes, microfilms/microfiches, printed data volumes, and analog records such as magnetograms. Most of these

traditional old magnetic records are also in current data forms, such as ASCII data files on compact disks and DVDs, digital images of magnetograms, online data sets and images, and real time digital data and plots. Earlier, the centre prepared an html data catalogue to submit to the WDC system. However, with the advancement of information technology and the use of the Internet for scientific data exchange and communication, the centre has implemented various IT technologies for its day to day data handling tasks. For example, the centre has hosted its own webportal since 2007 to provide geomagnetic data from Indian observatories online to the scientific community. The website contains hourly magnetic data (H, D, Z components), diurnal variation of plots of 1min resolution, and data from a few international observatories. Figure 3a shows an example of the diurnal variation of H, D, and Z components of the geomagnetic field recorded at Alibag on 1 January 2003 with a 1min sampling interval. The content is upgraded regularly, and presently the high resolution magnetogram images are ready for online data users to upload. Currently more than 500 scientific users are registered and regular use data exchange facilities on this website. The average website uptime is 67%. Online data access to this webportal is by a onetime simple registration without restrictions and free of charge as a part of WDS data exchange policies.

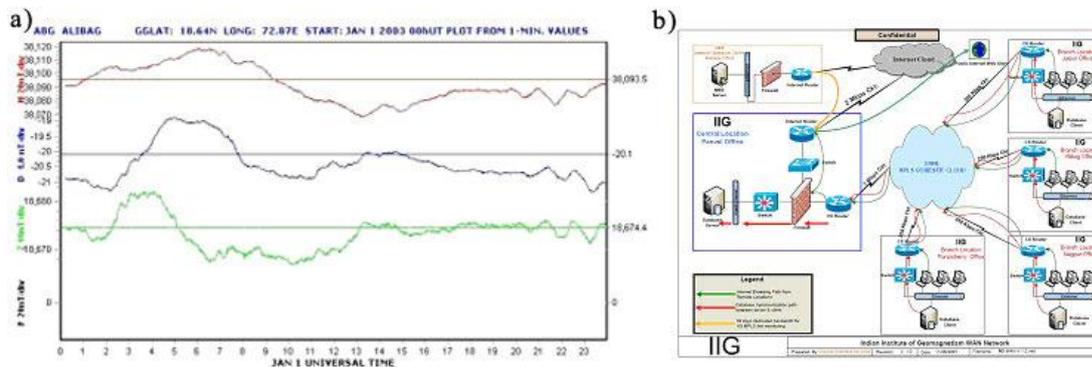


Figure 3. (a) Variation of H, D, and Z components recorded at Alibag on 1 January 2003 at 1min sampling interval, shown as a function of universal time (UT). (b) Pictorial representation of the realtime data transmission network diagram of the initial four Indian magnetic observatories

As a part of the technology advancement in science, most Indian observatories are equipped with digital fluxgate magnetometers (DFM). The institute has implemented a central REAL TIME DATA ACQUISITION SYSTEM at headquarters in Panvel for real time magnetic data collection from 6 remote observatories using MPLS VPN data transmission technology. Figure 3b shows a pictorial diagram of realtime data transfer from the observatories. Also the centre is planning to put these realtime magnetic field data plots online through our WDC webportal.

3 OLD GEOMAGNETIC DATA PRESERVATION AND DIGITIZATION

The center is equipped with infrastructure for preserving valuable geomagnetic records in analog formats, such as hand written/printed data volumes and magnetograms. In 2005 IAGA gave funds for archiving and retrieval of old Indian magnetic records; technical support was provided by the World Data Centre for Geomagnetism, Kyoto, Japan. Under this project, the centre has converted old magnetograms from the Colaba Observatory into high resolutions digital images, with the help of a high resolution digital camera setup. Some of these records were digitized in 1 hour and 1 minute resolutions. The centre has taken steps to preserve the oldest geomagnetic paper records and data volumes by using preventive and curative conservation technologies. Through this activity, the centre succeeded in curating a large set of deteriorated data volumes. These processed data volumes can last another 50 years for use by future generations. A preventative process is also being used on recent good condition volumes to increase their durability, which will help the centre in the long term storage of geomagnetic records.

4 MAGNETIC DATA RECORDING AT COLABA OBSERVATORY

As mentioned earlier, the Colaba-Alibag Observatory is a very old observatory and has been measuring geomagnetic data measurements for more than 160 years. Geomagnetic data was recorded very systematically during the initial stage using visual observations prior to photographic recording. Figure 5(a) shows an image of a sample visual observation sheet of 8-10 July 1859 at Colaba. Figure 5(b) shows two days of magnetogram image recording at Colaba during 03-04 August 1882 with header details. During 1847-1872 hourly visual observations were made every day but Sundays and holidays. Whenever a disturbance was observed in the

movement of magnets, visual observations were made at 15 min intervals. For severe disturbances, observations were done at 5 min intervals. Also during this period, corrections to geomagnetic data were incorporated time to time to get better quality magnetic data. Allowances for temperature correction were made by reducing each scale reading to a uniform temperature of 80°F. No allowance was made for correction for moisture on the suspension wire because the silver suspension wire of the magnet is supposed to be unaffected by moisture. (Moos, 1910)

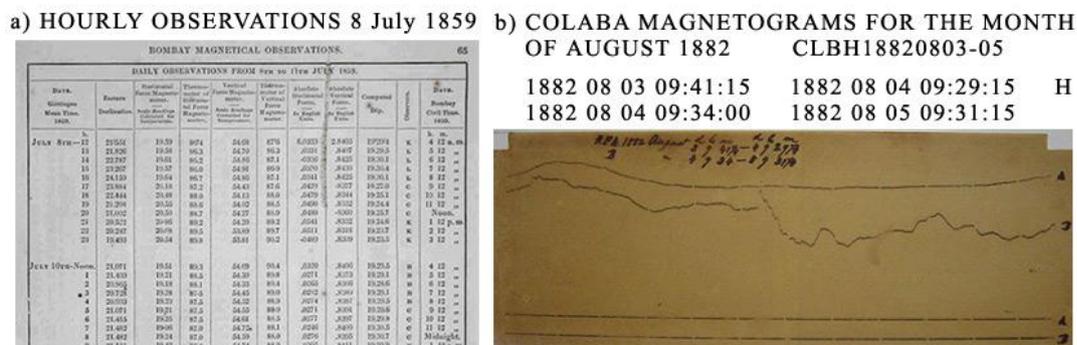


Figure 5. (a) Sample final geomagnetic data sheet (b) Sample two day magnetogram image with header

5 FUTURE PLANS AND SUMMARY

The WDC for Geomagnetism, Mumbai was established in 1991 with the coordination of the International Council of Scientific Unions (ICSU). This centre provides geomagnetic data from a network of magnetic observatories operated by IIG, India, together with geomagnetic data from a few international observatories. Geomagnetic data and its information can be archived from our WDC web portal <http://www.wdciig.res.in/>. For any data set used for scientific purposes, the quality of the data is foremost. The main aim of our centre is to provide the best quality geomagnetic field data online from a network of observatories to the scientific community. The centre has the following plans for the future:

1. To enhance magnetic data quality and consistency
2. To extract and organize metadata information for magnetic data in internationally acceptable metadata format
3. To preserve and conserve old magnetic records for future reference
4. To implement IT technologies for data handling and global availability
5. To upgrade our web portal to add more online data services, such as real time variation plots of Indian stations

6 ACKNOWLEDGEMENTS

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7 REFERENCES

Love, J.J. (2011) Secular trends in storm-level geomagnetic activity. *Ann. Geophys.* 29, pp 251–262, doi:10.5194/angeo-29-251-2011

Moos, N.A.F. (1910) *Magnetic Observations made at the Government Observatories, Bombay 1846-1907, Parts I and Part II*. Government Central Press Bombay, India.

Nimje, R., Doiphode, M., & Alex, S. (2008) Archival of Geomagnetic Data Management in Digital Form and its Retrieval. *DESIDOC*, pp 279-284.

Tsurutani, B.T., Gonzalez, W.D., Lakhina, G.S., & Alex, S. (2003) The extreme magnetic storm of 1–2 September 1859. *J. Geophys. Res.* 108(A7), p 1268, doi:10.1029/2002JA009504