

# THE ACTIVITIES AT WORLD DATA CENTER FOR GEOMAGNETISM MUMBAI, INDIA

*M Doiphode\*, R Nimje and S Alex*

*\*Indian Institute of Geomagnetism, New Panvel, Navi Mumbai, 410218, INDIA*

*Email: mahendra\_d@yahoo.com*

*Email: rakesh\_nimje@yahoo.com*

*Email: salex@iigs.iigm.res.in*

## ABSTRACT

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

**Keywords:** ICSU, Digital Preservation, Colaba-Alibag Magnetic observatory, Geomagnetic data archival

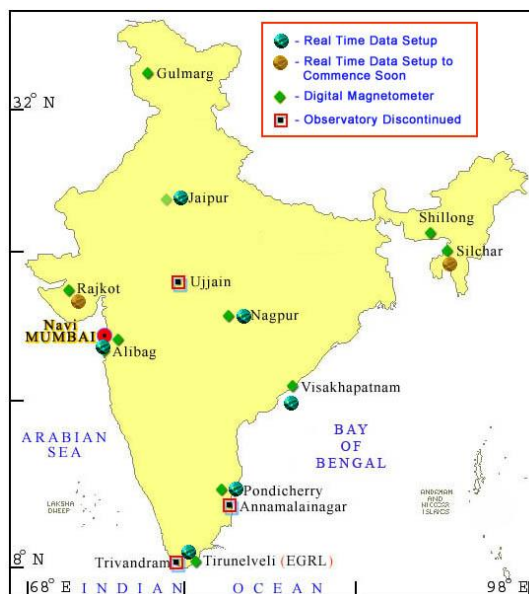
## 1 INTRODUCTION

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

The Colaba Observatory located at Mumbai was built in 1826, however the geomagnetic measurements were started in 1841 and it was continuously operational till 1906. Later geomagnetic observations are continued at Alibag (Geog. Long. 72°52'E, Lat. 18°38'N) magnetic observatory. Colaba-Alibag combined series makes the 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 in to old geomagnetic storm events and understand the physical processes associated with it. For example, the most intense 1–2 September 1859, magnetic storm in recorded history is studied by Tsurutani et al., (2003) using geomagnetic field records from Colaba observatory. Also such a large time series 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 magnetic storm occurrence likelihood [Love, 2011].

IIG presently operates a network of nine Magnetic Observatories in the Indian longitude, which are shown in Figure 1. Geomagnetic field data is recorded continuously at these observatories, which extend from dip equator to the northernmost latitude of India. WDC for geomagnetism, Mumbai is actively involved in geomagnetic data depositary in India. Geomagnetic data at all the stations operated from IIG is collected at WDC geomagnetism

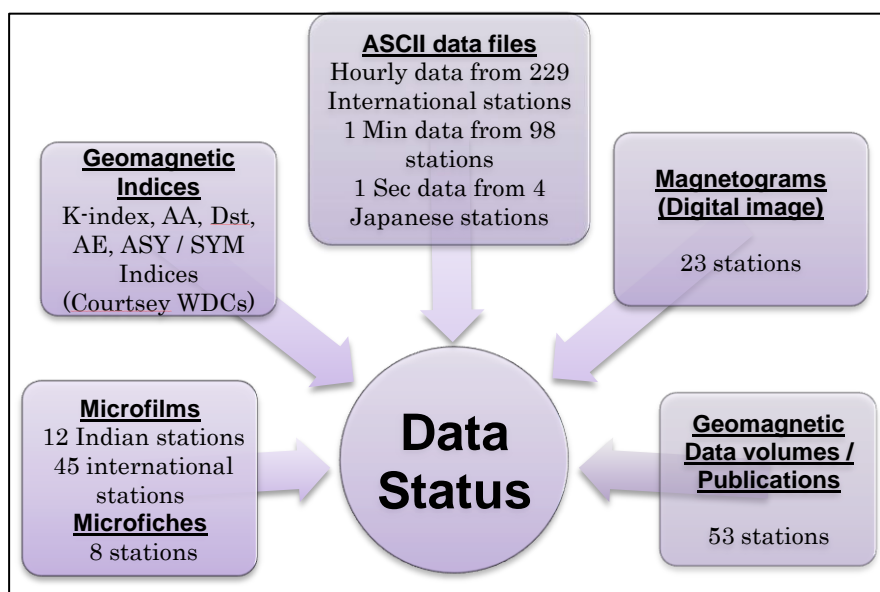
Mumbai along with geomagnetic activity indices supplied from a worldwide network of magnetic observatories. The Data Services at the WDC are available for scientific use at <http://www.wdciig.res.in>. Activities of WDC for geomagnetism Mumbai are elaborated in section 2. Old magnetic field data preservation 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.** Shows network of magnetic observatories operated by Indian Institute of Geomagnetism.

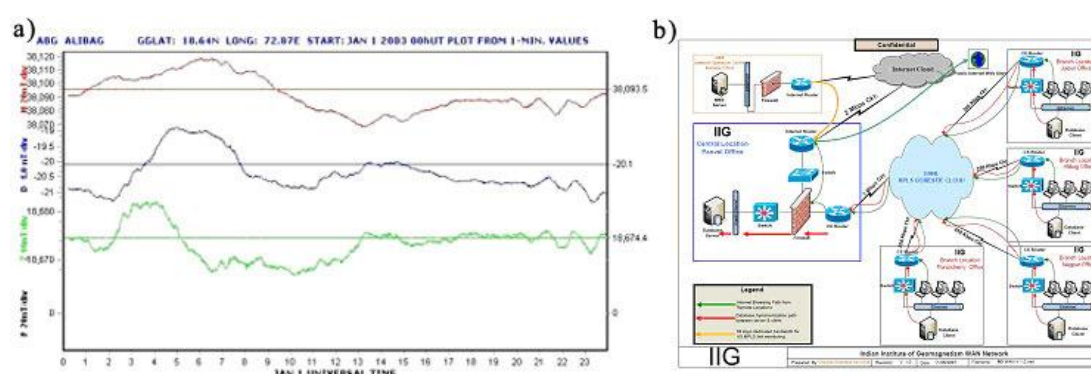
## 2 ACTIVITIES OF THE DATA CENTRE

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



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

Centre is having datasets from traditional media like punch cards, magnetic data tapes, microfilms/microfiches, printed data volumes, analog records like magnetograms. Most of these traditional old magnetic records are in current data forms also like ASCII data files on compact disks and DVDs, digital images of magnetograms, online data sets and images, real time digital data and plots. Earlier the centre was preparing html data catalogue to submit it to WDC system. However with the advancement of information technology and common media of internet for scientific data exchange and communication, the centre implemented various IT technologies for its day to day data handling purposes like now centre has hosted its own webportal in 2007 to provide geomagnetic data from Indian observatories online to the scientific community. The website contains hourly magnetic data (H, D, Z component), diurnal variation of plots of 1min resolution and data from few international observatories. Figure 3a shows an example of diurnal variation of H, D and Z component of geomagnetic field recorded at Alibag on 1 January 2003 with 1min sampling interval. The content is upgraded regularly and presently the high resolution magnetogram images are also ready to upload for online data users. Currently more than 500 scientific users are registered and regularly using data exchange facilities on this website. The average website uptime is 67%. This webportal is having online data access by onetime simple registration formalities without any restrictions and free of charge as a part of wdc data exchange policies.



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

As a part of technology advancement in science most of the Indian observatories are equipped with digital fluxgate magnetometer (DFM). The Institute has implemented Central REAL TIME DATA ACQUISITION SYSTEM at head quarter Panvel for real time magnetic data collection from 6 remote observatories using MPLS VPN data transmission technology. Figure 3b shows pictorial diagram of realtime data transfer from observatories. Also center is planning to make 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 the valuable geomagnetic records in analog formats like hand written/printed data volumes and magnetograms. In 2005 IAGA has funded for archival and retrieval of old Indian magnetic records and technical support was provided by World data centre for geomagnetism, Kyoto, Japan. Under this project the centre has converted old magnetograms of Colaba observatory into high resolutions digital images with the help of high resolution digital camera setup. Some of these records were digitized in 1 hour and 1 minute resolutions. The Center has taken steps to preserve the oldest geomagnetic paper records and data volumes by using preventive and curative conservation technologies. Through this activity centre succeed to curate large set of deteriorated data volumes and these processed data volumes can withstand for another 50 years for future generations. Preventative process is also done on recent good condition volumes to increase their durability, which will help centre in long term storage of geomagnetic records.

### 4 MAGNETIC DATA RECORDING AT COLABA OBSERVATORY

As mentioned earlier Colaba-Alibag observatory is a very old observatory and has geomagnetic data measurements for more than 160years. Geomagnetic data was recorded very systematically during the initial stage using eye observations prior to photographic recording. Figure 5(a) shows image of sample eye observation sheet of 8-10 July 1859 at Colaba and Figure 5(b) shows two days magnetogram image recorded

during 03-04 August 1882 at Colaba with header details. During 1847-1872 the hourly eye observations of the instrument were made on all days in the week except on Sundays and holidays. Whenever disturbance observed in the movement of magnets, eye observations were made at every 15 min and for severe disturbance at 5 min resolution. Figure 5(b) shows the geomagnetic data sheet of August 1882. Also during these period corrections to geomagnetic data is incorporated time to time to get the good quality magnetic data. Allowance for the temperature correction is made by reducing every scale readings to a uniform temperature of 80°F. No allowance is made for any correction for the effect of Moisture on the suspension wire, as the silver suspension wire of the magnet is supposed to be unaffected by moisture. [Moos, 1910]

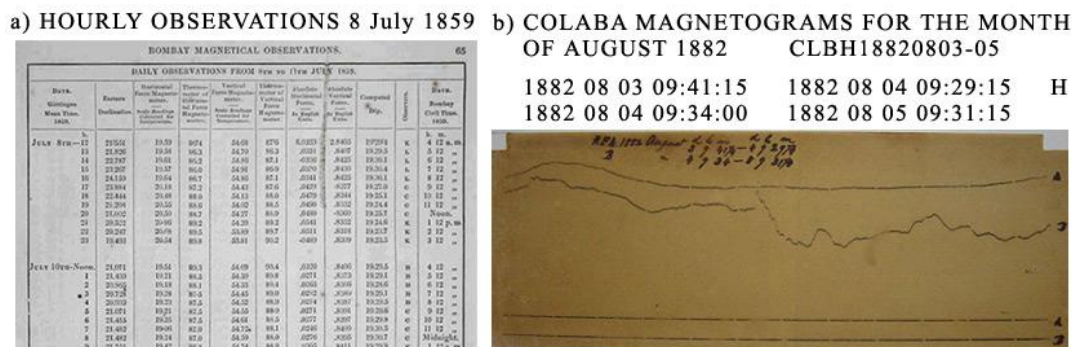


Figure 5. (a) Sample final geomagnetic data sheet . (b) Sample two days magnetogram image with header

## 5 FUTURE PLANS AND SUMMARY

WDC for geomagnetism Mumbai is established in 1991 with coordination of International Council of Scientific Union. This centre provides geomagnetic data from network of magnetic observatories operated by IIG, India together with geomagnetic data from 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 the quality of the data is foremost before it is used for scientific purpose. The main aim of our center is to provide best quality geomagnetic field data online from network of observatories to scientific community. Center has following future plans:

1. To enhance Magnetic Data quality and consistency.
2. To extract and organize the metadata information in internationally acceptable metadata format for Magnetic Data.
3. Long term preservation and conservation of the old magnetic records for future reference.
4. The Implementation of IT technologies for Data Handling and global availability.
5. Up gradation of the web portal to add more online data services like real time variation plots of Indian stations.

## 6 ACKNOWLEDGEMENTS

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