Equatorial electrojet at a close pair of stations

The regular tidal movements of the upper atmosphere across the vertical component of the earth's magnetic field generate a global system of electric field in the ionosphere. The electric field acting on the ionization in the *E*-region of the ionosphere generates a global system of ionospheric currents causing a regular diurnal variation of the horizontal component *H*, of the geomagnetic field at ground. Chapman[1] explained the abnormal enhancement of the daily range of *H* over the magnetic equator in Peru as due to strong eastward-flowing current within ± 3° latitude in the ionospheric E region and named it 'equatorial electrojet' (EEJ). The magnetic and electric fields are orthogonal to the upward electron and ion density gradients at equatorial latitudes generating vertical Hall polarization electric field, which causes additional abnormal electric conductivities within ± 3° over the magnetic equator.

During the International Geophysical Year (1957–58), geomagnetic observatories within the EEJ belt were operated at Addis-Ababa in Ethiopia, Thiruvananthapuram in India, Koror and Jarvis in the Pacific. Rastogi[2] showed a significant longitudinal variation in the strength of the electrojet current, being largest at Huancayo where $H = 0.28$ G and weakest at Thiruvananthapuram, where $H = 0.39$ G. He suggested that ionospheric conductivity may be inversely proportional to the strength of the background mean geomagnetic field. No correlation in the strength of EEJ between a pair of stations on day-to-day basis or even for longer periods has been detected due to the limited number of electrojet observatories. Later, Chandra *et al.*[3] showed that the average range of *H* at Thiruvananthapuram was slightly larger than the corresponding range at Addis-Ababa, where $H = 0.36$ G.

Kyushu University under K. Yumoto has established field stations with fluxgate digital magnetometers at a number of locations around the world and the daily variation charts are available in the university website. One of the stations close to Thiruvananthapuram has been recently established at Bac Lieu in Vietnam. The coordinates of the two stations are given in Table 1.

It is seen that Bac Lieu (BCL) is at 106°E long., whereas Tirunelveli (TIR) is at 78°E; thus the two stations are separated by less than 2 h local time. The strength of geomagnetic field is 0.41 G at BCL compared with 0.40 at TIR. The inclinations at both the places are less than 3°. Thus this pair seems to be ideal for the study of longitudinal and the day-to-day variations of the EEJ current strength.

Figure 1 shows the daily variations of *H* field at BCL and TIR during the period 1–15 January 1999. The BCL data are downloaded from the website of Kyushu University, and TIR data from the website of World Data Centre at Copenhagen. A cursory glance at the two sets of curves indicates a close correspondence in the variations at the two places during quiet as well as disturbed days.

Next, we computed the daily variations of *H* at the two stations on five international quiet days of January, April

Table 1. Coordinates of stations whose data have been used

Station	Tirunelveli	Bac Lieu
Geogr. lat. °N	8.7	9.3
Geogr. long. °E	77.8	105.7
Geogr. lat. °N	–0.3	–17.1
Geogr. long. °E	149.8	183.9
Geomagnetic field *X*, nT	39900	41200
Geomagnetic field *Y*, nT	1800	20
Geomagnetic field *Z*, nT	930	2080
Inclination °N	1.4	2.9
Declination °E	–2.8	0.0

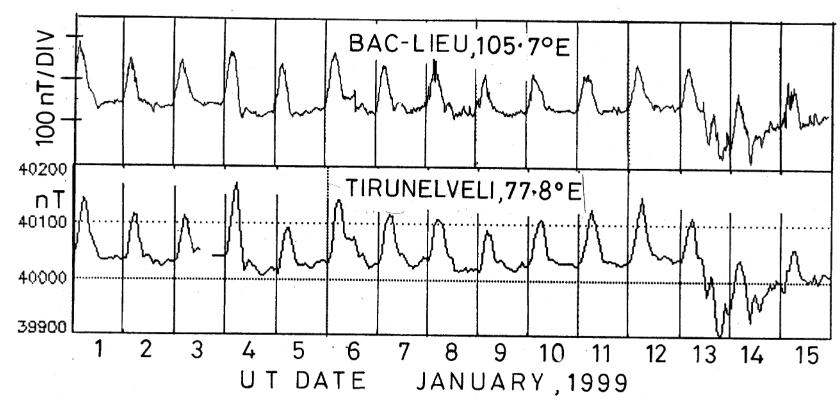

Figure 1. Daily variations of horizontal geomagnetic *H* field at Bac Lieu and Tirunelveli during 1–15 January 1999.

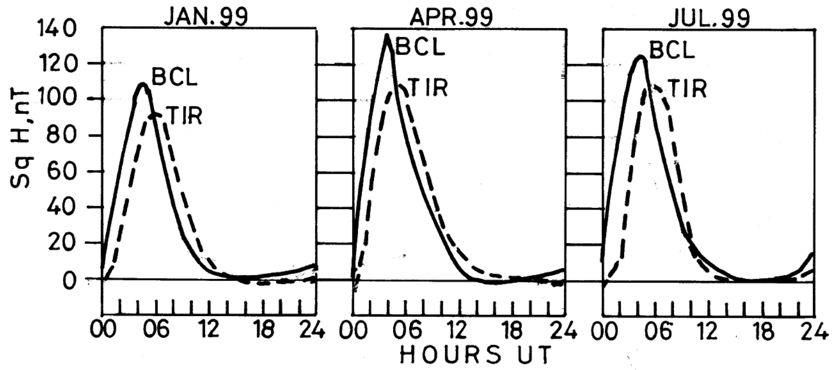

Figure 2. Diurnal variations of the *H* field at BCL and TIR averaged over five international quiet days of January, April and July 1999.

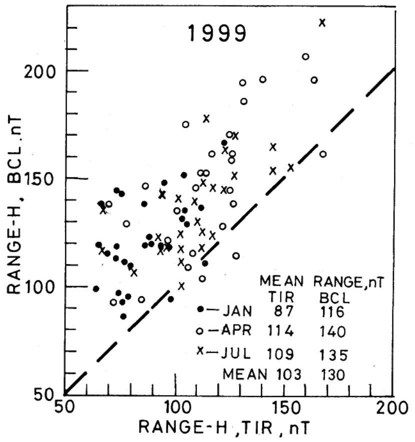

Figure 3. Mass plot of daily range of H field at BCL against the corresponding value at TIR during January, April and July 1999.

and July 1999. These SqH field variations are shown in Figure 2. The daily range of SqH is seen to be clearly larger at BCL than at TIR during any of the months considered. The daily peak occurring about 2 h earlier in universal time further at BCL compared to that at TIR is due to the difference in time at local noon in the two places.

Figure 3 shows the mass plots of the range of H at BCL against the corresponding value at TIR, during the three months of 1999. It is seen that the mean Sq range H values are significantly larger at BCL than at TIR during any of the months. The yearly value is 103 nT for TIR and 130 nT for BCL, indicating an increase of about 27% at BCL over the same at TIR.

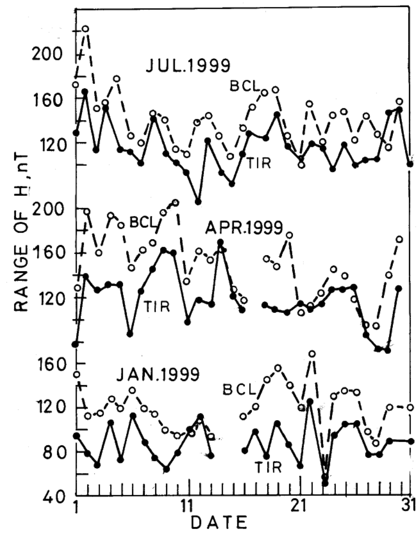

Figure 4. Day-to-day variations of the daily range of H field at BCL and TIR during January, April and July 1999.

Figure 4 is a plot of the individual day value of range of TIR and BCL during the three months of 1999. The value of range H at BCL on any day is larger than that at TIR.

These are descriptions of the variation of the strength of electrojet current at two nearby stations. The present results negate the theory that the ionospheric conductivity over the magnetic equator is inversely proportional to the mean magnetic field.

The day-to-day fluctuations in the range of H being coherent at two stations separated by only 28° in longitude, suggest a longer domain of the electrojet current variations. The source of the electrojet current variations has a much larger extent in space than assumed so far.

It is suggested that the observed variations of EEJ current at different longitudes or on different days are due to corresponding variations of the ionospheric electric fields generated by the local variations in the tidal movements of the upper atmosphere or due to transmission of magnetospheric electric fields.

It is recommended that a more detailed study of ΔH at stations organized by the Kyusha University together with those from permanent geomagnetic observatories could lead to new useful information on the strength, direction and sources of fluctuations of the EEJ current.

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Sulphur isotope composition of galena from Bandalamottu area, Guntur district, Andhra Pradesh

The Agnigundala base metal belt (16°05′–16°20′N lat. and 79°35′–79°50′N long.), traced over a cumulative strike length of about 6 km, is located near Vinukonda, Guntur district in the northeastern part of the Cuddapah Basin (Figure 1 *a*) and constitutes one of the prominent base metal deposits in India. About thirty copper–lead–zinc occurrences are localized within this belt, with Bandalamottu, Nallakonda and Dhukonda constituting the main deposits[1]. Though Cuddapah Basin contains vast resources of mineral wealth, isotopic studies on mineralization are scanty, except for the S-isotopic study of the Mangampeta baryte deposit[2] and Pb, Sr and Nd isotopic studies of uranium-mineralized stromatolitic Vempally dolomites[3]. Variation in isotopic composition of sulphides has an important bearing on type of mineralization. We present here S-isotopic data on carbonate-hosted lead mineralization of the Bandalamottu area, Guntur district, Andhra Pradesh and discuss the role of sulphur in the process of Pb-mineralization.

The Bandalamottu lead deposit (16°14′: 79°43′) is potentially the largest in the Agnigundala poly-sulphide deposit (Ziauddin Mohd. and R. K. Sharma, unpublished). The zones of mineralization are confined mainly to the upper dolostone and dolomitic limestone, which crop out