Equivalent $S_q$ Current Systems at Occasions of the Equatorial Counter Electrojet

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The abnormal depression in $H$ component in the equatorial zone on magnetically quiet days was first found out by Barrels and Johnston (1940) at Huancayo. After that this event has been observed at many equatorial stations; Addis Ababa (Gouin, 1962), Ibadan (Onwumechilli, 1963) and in the Indian zone (Rastogi et al., 1971). In this event the horizontal intensity often decreases below the nighttime level. And as it is associated with the temporary disappearance of the equatorial $E_z$ (Cohen et al., 1962) and recently with reversal of the horizontal east-west electric fields in the $F$ region (Woodman et al., 1977), this event is attributed to the counter electrojet (Gouin and Mayaud, 1967). On the counter electrojet Rastogi (1973) pointed out the following features; (1) the afternoon depressions in $H$ are found to occur on isolated days, but in some cases the depression could be seen successively on every day for a week or so; (2) the geomagnetic activity tends to decrease or destroy the occurrence of the phenomenon; (3) the afternoon depression in $H$ seems to be much more frequent during the low than the high solar activity years; (4) it is a phenomenon fairly localized in longitude and on some occasions may not occur on the same day at two stations separated by even 2 or 3 hr in longitude; (5) amplitude distribution of this event is analogous to that of the equatorial electrojet and the currents causing the decrease of $H$ are confined to a narrow latitude zone near the magnetic equator; (6) though the occurrence of the phenomenon is not due to the effect of the moon, the phase of the moon has a fairly important effect in modulating the occurrence of the counter electrojet phenomenon. Bhargava and Sastri (1977) analysed the data on magnetically quiet days with a distinct counter electrojet afternoon event between the years 1958 and 1975 and mentioned that in the Indian region, on days when the counter electrojet afternoon events occur, a weak counter electrojet of large latitudinal extent, presents on most days in the early morning hours, narrows and intensifies, under favorable conditions, resulting in a depression of the horizontal field in the early afternoon at stations under the equatorial electrojet. The purpose of this note is to depict the equivalent current systems at occasions of the counter electrojet and

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to reveal the return current of counter electrojet.

The data used here are hourly values of the international quiet days in the year of 1973. Base lines are determined as the mean value of the day for $D$ component and as the mean of six values during the nighttime (2100-0300LT) for $H$ component. The "counter" day is defined here, for convenience, as the day when at least one of hourly values of $H$ component in the afternoon (1200-1800LT) is below the baseline value. At Kodaikanal there are eighteen days satisfying this condition in the year of 1973. We have examined four days when the depression is especially large and shown the horizontal variations at Kodaikanal and other stations by means of

![Fig. 1. Variance vectors of horizontal magnetic field at the dayside stations and equivalent current systems at 0900-1000UT on February 4, 1973. ⊗ represents the mean position of the sun.](image1)

![Fig. 2. Same as in Fig. 1, but at 0900-1000 UT on February 14, 1973.](image2)
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arrows when the depression is nearly maximum at Kodaikanal, drawing the equivalent current systems (Figs. 1 to 4). Figures 5 and 6 show appearances before and after 3 hr from that of Fig. 4 respectively.

Figures 1 to 4 suggest that equivalent current systems of counter electrojet appear as vortexes centered at about 20° and seem to be bulges from evening side. Figure 6 suggests that this vortex is conveyed with \textit{Sq} current system, though in Fig. 5 it cannot be so clearly seen. If a wind component contributing to the generation of \textit{Sq} currents is enhanced, this abnormal vortex may appear in the afternoon region. On the other hand, RASTOGI (1975) states that the depression in the \textit{H} field is due to superimposition over the \textit{Sq} current system (at about 107 km) of a separate westward cur-
rent systems at a lower level (about 100 km). Of course this idea cannot be rejected by our result. But, considering that global Sq current pattern has much fluctuation even during geomagnetically quiet days (Suzuki and Maeda, 1978), it would be more natural to think that the counter electrojet is caused by a change of wind system producing Sq current. Anyway, to reveal this event, a dense network observation of geomagnetism in the equatorial zone and measurements of electric field at the various height in the ionosphere would be necessary.

The data used here were obtained from the World Data Center C2 for Geomagnetism.
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