Exploration Geophysics (1986) **17**, 16

Magnetic Quiet Daily Variation

Variations in the magnetic declination on abnormal quiet days

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For stations on the poleward side of the Sq focus the minimum in H on quiet days occurs near 1100 LT. In fact, on about 80% of quiet days, the minimum occurs between 0830 and 1330 h local time (LT). Such days were termed 'normal quiet days' (NQD) by Brown and Williams (1969) whereas those days where the minimum occurs outside this time range were termed 'abnormal quiet days' (AQD). It has been shown that when AQD occur, the amplitude of the normal H variation is significantly reduced and the daily minimum is formed by a magnetospheric substorm event. The reduction in the H variation is caused by a current which flows in the ionosphere, in a west-east direction on both sides of the focus, and therefore causes an increase in the amplitude of H at stations on the equatorward side of the focus (see Fig. 1). The strength of this current has been found to be dependent on the polarity of the interplanetary magnetic field (IMF), it being larger on days when the IMF is away from the sun (A-days) that when it is toward the sun (T-days). This current also affects the position of the Sq focus, causing it to move poleward on AQD, the effect being greatest on A-days.

The source of this current is not known. Takeda (1982) has suggested that the source of this current is a field-aligned current at high latitudes which leaks equatorward and eastward before exiting as a field-aligned current. If this is the case, it should cause an equatorward current in the morning and a poleward current in the afternoon. Such currents should manifest themselves in the declination data. Declination data have been analysed and compared on NQD and AQD

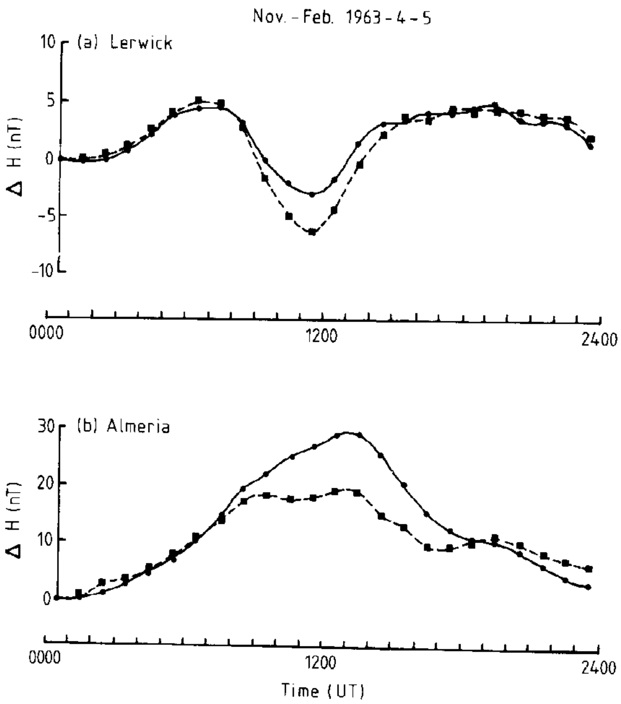

Fig 1 Variation with time in the magnetic element H for NQD (---) and AQD (—) for two stations, (a) Lerwick and (b) Almeria, which are on the poleward and equatorward sides respectively of the focus of the daily variation current system Sq.

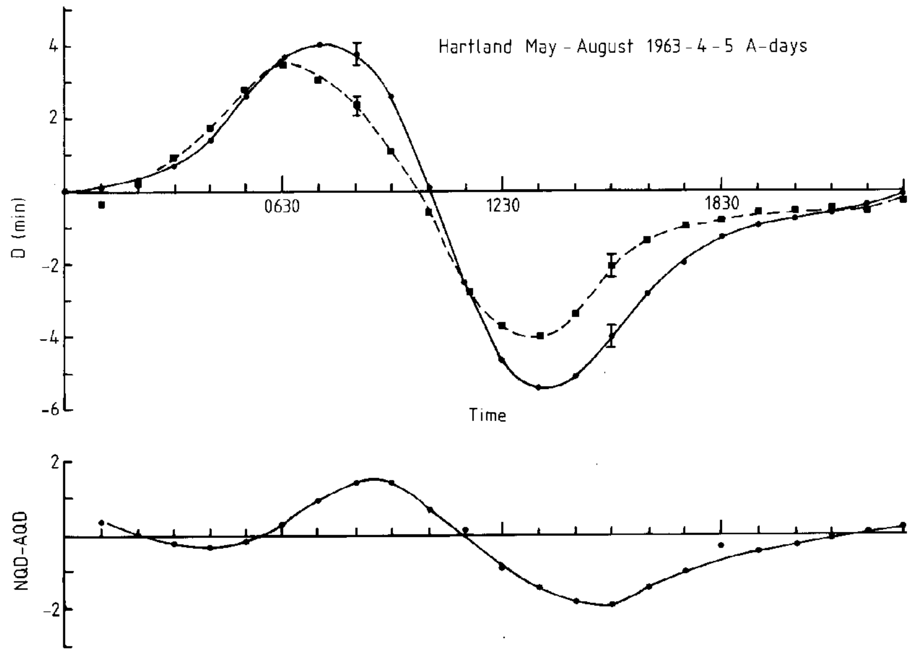

Fig 2 The variation throughout the day of the magnetic declination (*D*) at Hartland, for NQD (—) AQD (---), and (lower graph) their difference.

(Fig. 2). It is evident that on AQD on A-days there is a poleward current in the morning and an equatorward current in the afternoon, the opposite to that predicted by Takeda. The effect does not appear to be present on T-days. Possible sources for this current will be discussed.

References

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Takeda M. (1982), 'Three-dimensional structure of ionospheric currents produced by field aligned currents', *J. Atmos. Terr. Phys.* **44**, 695–701.

The geomagnetic field and Sq

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The process of conductivity modelling using results for internal and external components of daily magnetic variations and their seasonal changes gives consistently poor results from Sq at 1 c per day and from L at both 1 and 2 c per day. One possible way of proceeding is to assume that there are small terms of internal origin at these frequencies that are not part of the induction process, and to use conductivity models based on other daily variation terms to provide estimates of their amplitude and phase. Studies of local midnight values that extend the work of Malin (1977) on lunar magnetic variation midnight values should also help to determine the extent of magnetic variations of internal origin generated directly by the ocean dynamo. Work by Ashour and Price (1965) on night-time earth currents associated with the daily magnetic variations needs to be included in such studies.

Interpretation of the physics of the standard theory of induction as set down by Chapman and Whitehead (1922), and Lahiri and Price (1939) can also be improved, using, for example, the poloidal and toroidal vector field representation used so successfully by Bullard and Gellman (1954) in their studies of the main field. The induction equation can be written:

$$\nabla^2 \boldsymbol{B}_o + \mu_o \sigma \alpha \boldsymbol{B}_o = -\mu_o(\nabla\sigma) \times \boldsymbol{E}_o + \alpha \nabla \times \boldsymbol{P}_o$$