[2] Warren, R. G., Osborn, T. W., and Schmitt, R. A., *Meteoritics*, **6**, 321 (1971).
[3] Müller, O., Baedecker, P. A., and Wasson, J. T., *Geochim. Cosmochim. Acta*, **35**, 1121 (1971).
[4] Loveland, W., and Schmitt, R. A., *Geochim. Cosmochim. Acta*, **33**, 375 (1969).
[5] Wiik, H. B., *Comment. Phys. Math.*, **34**, 135 (1969).
[6] Larimer, J. W., *Geochim. Cosmochim. Acta*, **31**, 1215 (1967).
[7] Arrhenius, G., and Alfvén, H., *Earth Planet. Sci. Lett.*, **10**, 253 (1971).
[8] Larimer, J. W., and Anders, E., *Geochim. Cosmochim. Acta*, **34**, 367 (1970).

Relative Movements of Mid-Latitude Trough and Scintillation Boundary

THE ionospheric mid-latitude trough has been investigated by means of satellite *in situ* probes[1] and topside sounders[2,3]. Its behaviour has also been studied by measurements of total electron content[4] which show it to exhibit a diurnal variation reaching its lowest latitude shortly after local midnight. Rycroft and Thomas[3], however, after removing variations due to changes in magnetic activity, have shown a movement towards lower latitudes as dawn progresses. Studies of the motion towards the equator of the trough with increasing magnetic activity have led Rycroft and Thomas to infer that the ionospheric trough and the magnetospheric plasmapause are basically related phenomena. Liszka and Turunen[5] have shown that the polewards boundary of the trough follows the movement of the equatorwards boundary of the precipitation of 1 KeV auroral electrons and they propose a mechanism for the production of the trough in terms of the increase in temperature resulting from the influx of precipitating particles.

Another boundary between the high and mid-latitude ionospheres is the scintillation boundary, the edge nearest the equator of the small-scale F-region irregularity structure that manifests itself in scintillations of beacon satellite and radio star signals[6]. This boundary exhibits a diurnal movement, reaching its lowest latitude in the early hours[7], and movement towards the equator with increasing magnetic activity dependent on local time[6].

It has been postulated by Aarons and Allen[6] that the energy responsible for the high-latitude irregularity structure may come from low energy electrons, of about a few hundred electron volts, or from waves originating in the plasmapause. It is thus indicated that links could exist between the origins of the mid-latitude trough and the scintillation boundary. Similarities between the mean diurnal variations of the boundary and the edge of the trough nearer to the equator have been noted[7], as has the movement of both phenomena towards lower latitudes with increasing magnetic activity. Aarons and Allen, however, note apparent discrepancies between the mean position of the scintillation boundary and the mean position of the trough as given by Muldrew[2].

We have carried out simultaneous observations of the relative positions of the trough and the scintillation boundary. Some 220 recordings of passes of the ionospheric beacon satellite BE–B (1964–64A) taken at Aberystwyth (52.42° N, 4.05° W) were selected from the available records for the year 1967. The basis of the selection procedure was that either a sharp scintillation boundary was observed or variations in the Faraday rotation rate towards the northern end of the record were present indicating strong gradients in total electron content to the north of the station. The recordings of the 40 and 41 MHz signals were analysed by the differential Faraday technique to give the variation of total electron content along the pass in terms of invariant latitude for an assumed ionospheric height of 350 km. The invariant latitude (at 350 km) of the scintillation boundary (Λ_s), defined in terms of the mean between zero and 100% modulation of the 40 MHz signal, was also found. Plots of total electron content were used to identify the trough, and the invariant latitude of the minimum in electron content was taken as the trough position (Λ_T).

In the present study the mean difference in the invariant latitudes of simultaneously observed positions of the trough and the scintillation boundary ($\overline{\Lambda_T - \Lambda_s}$) has been studied as a function of local time. The results presented in Fig. 1 for local time groupings of one hour show that the relative position of the two phenomena is not constant. Between 1500 and 0200 h the scintillation boundary is to be found on average 1.5 degrees invariant latitude equatorwards of the trough. After 0400 h, however, a reversal of the relative positions is observed with the scintillation boundary polewards of the trough, and the mean difference in invariant latitude increasing with local time.

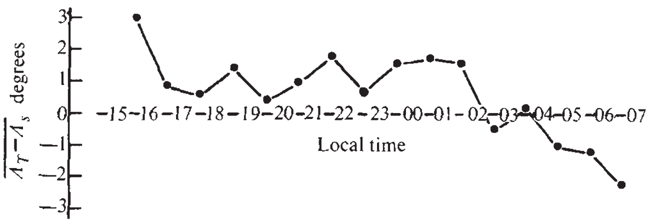

Fig. 1 Mean difference of the invariant latitudes of the trough and the scintillation boundary as a function of local time.

While no account was taken in this analysis of variations associated with magnetic activity, it was found that for every pass before 1900 h $\Lambda_T - \Lambda_s \geq 0$ whereas for all passes after 0600 h $\Lambda_T - \Lambda_s < 0$ regardless of the level of magnetic activity. A further analysis eliminated the possibility of the observed reversal in the positions of trough and scintillation boundary around 0300 h being associated with any decrease in the height of the scintillation producing irregularities as dawn advanced.

It is thus concluded that while the mid-latitude trough and the scintillation boundary may individually exhibit behaviour which can be related to particle precipitation or plasmapause movements, simultaneous observations of the two phenomena show that there is a local time variation of their average relative positions.

L. KERSLEY
D. B. JENKINS
K. J. EDWARDS

Department of Physics,
University College of Wales,
Aberystwyth

Received July 14, 1972.

[1] Sharp, G. W., *J. Geophys. Res.*, **71**, 1345 (1966).
[2] Muldrew, D. B., *J. Geophys. Res.*, **70**, 2635 (1965).
[3] Rycroft, M. J., and Thomas, J. O., *Planet. Space Sci.*, **18**, 65 (1970).
[4] Liszka, L., *J. Atmos. Terr. Phys.*, **29**, 1243 (1967).
[5] Liszka, L., and Turunen, T., *Kiruna Geophysical Observatory Preprint No. 71*, 306 (1971).
[6] Aarons, J., and Allen, R. S., *J. Geophys. Res.*, **76**, 170 (1971).
[7] Oksman, J., and Tauriainen, A., *J. Atmos. Terr. Phys.*, **33**, 1727 (1971).

Experimental High-pressure Hydration of Cordierite

WE have successfully studied the hydration of cordierite ($Al_3(Mg, Fe^{2+})_2(Si_5AlO_{18})$) using crystalline reactants extracted from natural rocks. Our experiments are concerned with several reactions in the system $MgO\text{-}Al_2O_3\text{-}SiO_2\text{-}H_2O$