

Reply

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We thank E. Belenkaya [Belenkaya, this issue] for her interest in our recent paper [Gosling *et al.*, 1991]. However, in contrast to her comment, we do not believe that the observations we reported in that paper lend any particular support to the model she outlines.

The observations we reported were obtained by the fast plasma experiment on ISEE 2 within the northern high-latitude magnetopause, adjacent to the near-tail lobe, at a time when the local magnetosheath and tail lobe magnetic fields were nearly oppositely directed. Solar wind plasma from the magnetosheath entering the magnetopause current layer alternately was observed accelerated either tailward or sunward by approximately twice the magnetosheath Alfvén speed. Such accelerations are in agreement with predictions of the reconnection process at the magnetopause [e.g., Cowley, 1982; Sonnerup *et al.*, 1990]; accordingly, we interpreted these observations in terms of the reconnection, or re-reconnection, of interplanetary and (open) lobe magnetic field lines at the high-latitude magnetopause. The large field shear observed at the magnetopause and the multiple ion populations observed both within the magnetopause and upstream in the magnetosheath were consistent with this interpretation. We suggested that the sense of the observed accelerations, either tailward or sunward, depended upon whether the spacecraft was tailward or sunward of the magnetopause reconnection site.

Belenkaya [this issue] suggests an alternate interpretation of these observations in terms of a model developed by Alexeev and Belenkaya [1989]. As outlined in her comment, this model suggests a completely different magnetic topology for the observations. In particular, she suggests (1) that the reconnection occurred inside the magnetosphere and (2) that the accelerations were produced by reconnection between open magnetospheric field lines emanating from the opposite polar caps. We fail to understand the physical basis for either the model or the particular magnetic field topology that she advocates for our observations. We believe that it is clear from the location of the observations (at the high-latitude magnetopause), the identification of the accelerated plasma (solar wind plasma from the magnetosheath entering the magnetopause current layer), and the magnitude of the accelerations observed (twice the local magnetosheath Alfvén speed) that (1) reconnection in this event occurred at the magnetopause and (2) the field lines being reconnected were interplanetary and lobe field lines. There is no reason to believe either that the reconnection occurred entirely internal

to the magnetosphere or that it occurred between open field lines emanating from the opposite polar caps. We are aware of no evidence to suggest that field lines from the southern polar cap were even present in the northern polar cap at this time. Further, although it is clear that a large field shear conducive for reconnection existed across the magnetopause at this time, there is no evidence that a large local field shear existed between adjacent lobe field lines irrespective of their origins.

Finally, we feel Belenkaya's criticism of our use of Tsyganenko's model [Tsyganenko, 1987] is misdirected. We used the model in conjunction with certain assumptions only to illustrate the plausibility of ISEE 2 being at the high-latitude magnetopause for the event in question. The observations themselves, which show the presence of mantle plasma within the magnetosphere adjacent to the magnetopause and the complete absence of hot plasma from the plasma sheet and/or ring current there, demonstrate conclusively that the magnetopause crossing in question was from the open field lines of the tail lobe to the magnetosheath rather than from the closed field lines of the plasma sheet or ring current.

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REFERENCES

- Alexeev, I. I., and E. S. Belenkaya, Convection structure in the magnetosphere for southward and northward IMF, *Geomagn. and Aeron.* (Engl. Transl.), 29, 725, 1989.
- Belenkaya, E., Comment on "Observations of reconnection of interplanetary and lobe magnetic field lines at the high-latitude magnetopause" by J. T. Gosling, M. F. Thomsen, S. J. Bame, R. C. Elphic, and C. T. Russell, *J. Geophys. Res.*, this issue.
- Cowley, S. W. H., The causes of convection in the Earth's magnetosphere: A review of developments during the IMS, *Rev. Geophys.*, 20, 531, 1982.
- Gosling, J. T., M. F. Thomsen, S. J. Bame, R. C. Elphic, and C. T. Russell, Observations of reconnection of interplanetary and lobe magnetic field lines at the high-latitude magnetopause, *J. Geophys. Res.*, 96, 14,097, 1991.
- Sonnerup, B. U. Ö., I. Papamastorakis, G. Paschmann, and H. Lühr, The magnetopause for large magnetic shear: Analysis of convection electric fields from AMPTE/IRM, *J. Geophys. Res.*, 95, 10,541, 1990.
- Tsyganenko, N. A., Global quantitative models of the geomagnetic field in the cislunar magnetosphere for different disturbance levels, *Planet. Space Sci.*, 35, 1347, 1987.

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