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Corrigendum to "Substorm activity in Venus's magnetotail" published in Ann. Geophys., 27, 2321–2330, doi:10.5194/angeo-27-2321-2009, 2009

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Abstract. A re-evaluation of the reconnection event reported by Volwerk et al. (2009) shows that the original interpretation of the magnetic field data as quadrupolar Hall-current signatures around a reconnection site was mistaken. It could be interpreted as the signature of reconnection in the presence of a guide field. The path of VEX through the active region in Venus's magnetotail is re-evaluated and the strongly energized ions associated to this event are now in agreement with the magnetic field data.

Keywords. Magnetospheric physics (Magnetotail)

Correction

Volwerk et al. (2009) discussed a reconnection event in Venus's magnetotail on 22 August 2006. In that paper it was stated that the magnetic field showed the characteristic quadrupolar magnetic signature of the Hall and field-aligned current systems near a reconnection region (see e.g., Runov et al., 2003). Regrettably, this was a misinterpretation of the data. The intermediate magnetic field component ($B_{\rm INT}$, in minimum variance coordinates) does not display such a structure, but only shows the presence of a rather strong guide field near the presumed reconnection region.

The magnetic field data in minimum variance coordinates are shown in Fig. 1. The miminum variance coordinate system corresponds to the orientation of the plasma sheet, where $B_{\rm MIN}$ is normal to the plasma sheet, $B_{\rm MAX}$ is mainly in the $X_{\rm VSO}$ direction and $B_{\rm INT}$ is mainly along the current direction. The intermediate direction, which is basically along the Z-direction, shows that the field is varying around $B_{\rm INT} \approx -5$ nT during the interval of 02:00–02:09 UT. This indicates the existence of a guide field along the cross tail current, which is not unusual in e.g. the Earth's magnetotail (see, e.g., Petrukovich et al., 2005; Nakamura et al., 2006, 2008). After the initial increase in $B_{\rm MIN}$ (first vertical dashed line in Fig. 1) there is an increase in $B_{\rm INT}$ from -5 to -12 nT. VEX starts crossing the current sheet near 02:03:30 UT.

Initially, the increased $B_{\rm INT}$ was interpreted as the quadrupolar Hall magnetic field created by reconnection in the tail. However, from the current sheet crossing near 02:03:30 UT it is clear that this does not exhibit a quadrupolar signature as in Runov et al. (2003), $B_{\rm INT}$ does not change sign, as would be expected. There is only the meausured increase in $B_{\rm INT}$ over the period 02:02:30–02:04:30 UT (between the two vertical dashed lines). The also means that the bottom panel of Fig. 4 in the original paper is incorrect.

This, however, does not argue against the existence of reconnection. Numerical results obtained by Pritchett and Coroniti (2004) show that in the presence of a strong guide field an increase of this guide field is generated by the Hall currents, instead of a quadrupolar Hall signature. This is exactly what is seen in the magnetic field data of Volwerk et al. (2009), reproduced in Fig. 1. Between the two dashed lines one can identify 6 different regions based on $B_{\rm MIN}$ and $B_{\rm MAX}$, labeled 1 through 6 in Fig. 1, which are characterized by changed magntic field directions:

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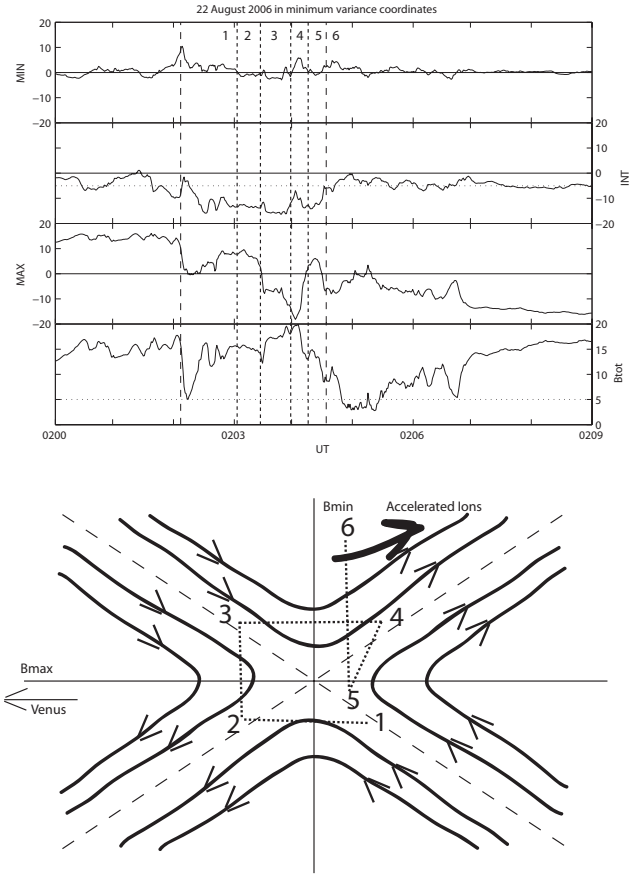

Fig. 1. Top panel: the magnetic field data in minimum variance coordinates. the vertical dashed lines show the interval of interest of this paper. Bottom panel: a sketch of the reconnection region with the path of VEX drawn in a dotted line and the highly accelerated ions drawn as a thick arrow.

1. $B_{\mathrm{MIN}} > 0$ and $B_{\mathrm{MAX}} > 0$
2. $B_{\mathrm{MIN}} < 0$ and $B_{\mathrm{MAX}} > 0$
3. $B_{\mathrm{MIN}} < 0$ and $B_{\mathrm{MAX}} < 0$
4. $B_{\mathrm{MIN}} > 0$ and $B_{\mathrm{MAX}} < 0$
5. $B_{\mathrm{MIN}} \sim 0$ and $B_{\mathrm{MAX}} > 0$
6. $B_{\mathrm{MIN}} > 0$ and $B_{\mathrm{MAX}} < 0$

These signatures are compatible with the spacecraft moving around an X-line in Venus's magnetotail as shown in the bottom panel of Fig. 1. This by itself would not be proof that reconnection was truly operating during the event described. Also, the plasma data from VEX do not have sufficient temporal resolution to investigate the plasma flows in great detail. Indeed, the largest signal found in the data are tailward streaming ions that are also found before the event takes place. However, the newly interpreted path of VEX through the active region in Venus's tail, in combination with the heated ions that are observed around 02:06 UT, which have energies well above the magnetotail or solar wind temperature strengthens the reconnection interpretation of this event as for several minutes VEX remains near "region 6" (i.e. in the top right quadrant), which explains the tailward direction of the highly energized ions at 02:06 UT as coming from the reconnection region.

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