VERTICAL COMPONENTS OF MAGNETIC FIELD GRADIENT AND CURRENT DENSITY IN THE ACTIVE REGION BBR 18474 IN JULY 1982

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ABSTRACT. Four vector magnetograms of 15 and 16 July are used to derive the vertical components of magnetic field gradient and current density. The two parameters attained maxima of respective 0.30 G/km and 19.10^{-3} A/m^2 within the central delta area. They coincide with maxima of the longitudinal magnetic field or are located in their neighbourhood. At the same side of the neutral line current density maxima with opposite sign are observed close together. In the case of some short compact filaments agreement of their foot points with a positive and a negative current density maximum was found, pointing on currents flowing along the filament.

ВЕРТИКАЛЬНЫЕ СОСТАВЛЯЮЩИЕ ГРАДИЕНТА МАГНИТНОГО ПОЛЯ И ПЛОТНОСТИ ЕЛЕКТРИЧЕСКОГО ШОКА В АКТИВНОЙ ОБЛАСТИ ББР 18474 В ИЮЛЕ 1982 : Четыре вектор-магнитограммы, полученные 15 и 16 июля, использовались для вычисления вертикальных составляющих градиента магнитного поля и плотности электрического тока. В центральной дельта - области были получены значения меньше чем 0.30 Г/км и меньше чем 19.10^{-3} $А/м^2$. Эти максимумы совпадали с максимумами продольного магнитного поля или лежали недалеко от них. На той же стороне нейтральной линии наблюдались близко друг к другу лежащие максимумы и минимумы. В случае нескольких коротких компактных волокон найдено соответствие между их ногами и максимумами и минимумами плотности тока.

VERTIKÁLNE ZLOŽKY GRADIENTU MAGNETICKÉHO POĽA A HUSTOTA ELEKTRICKÉHO PRÚDU V AKTÍVNEJ OBLASTI BBR 18474 (JÚL 1982): Štyri vektorové magnetogramy z 15. a 16 júla 1982 boli použité na výpočet vertikálnych zložiek gradientu magnetického poľa a hustoty elektrického prúdu. V centrálnej oblasti, ktorá obsahovala delta konfiguráciu, boli zistené maximálne hodnoty počítaných veličín a to 0.30 G/km a 19 x 10^{-3} A/m^2. Tieto maximá priestorove súhlasili s maximami pozdĺžnej zložky magnetického poľa, alebo sa nachádzali v ich bezprostrednej

blízkosti. Tesne vedľa seba, na tej istej strane neutrálnej čiary, sa vyskytovali maximálne hodnoty hustoty elektrického prúdu opačných znamienok t.j. prúdy opačných smerov. Kladné a záporné maximá hustoty elektrického prúdu boli pre prípad krátkych filamentov stotožnené s koncovými bodmi filamentu, čo svedčí o existencii prúdov tečúcich pozdĺž filamentu.

In order to understand the flare phenomenon, knowledge of the magnetic field in chromosphere and the lower corona is necessary. Because of the difficulties in direct measurements in these layers the method of extrapolation of the photospheric magnetic field is often used. A potential field or a force-free field with a uniform field line twisting (α = const) frequently is assumed.

By means of vector magnetograms it is now possible to check such methods. This can be carried out by calculating the current density from the measured vector components or the parameter α . If it is unequal to zero the magnetic field is no potential field.

Our vector magnetograms from July 1982 we will use to give a contribution to answer the questions yet open.

On the procedure of measurement and first results a short report was given by Bachmann et al. (1983) at the XI. Consultation on Solar Physics in Debrecen.

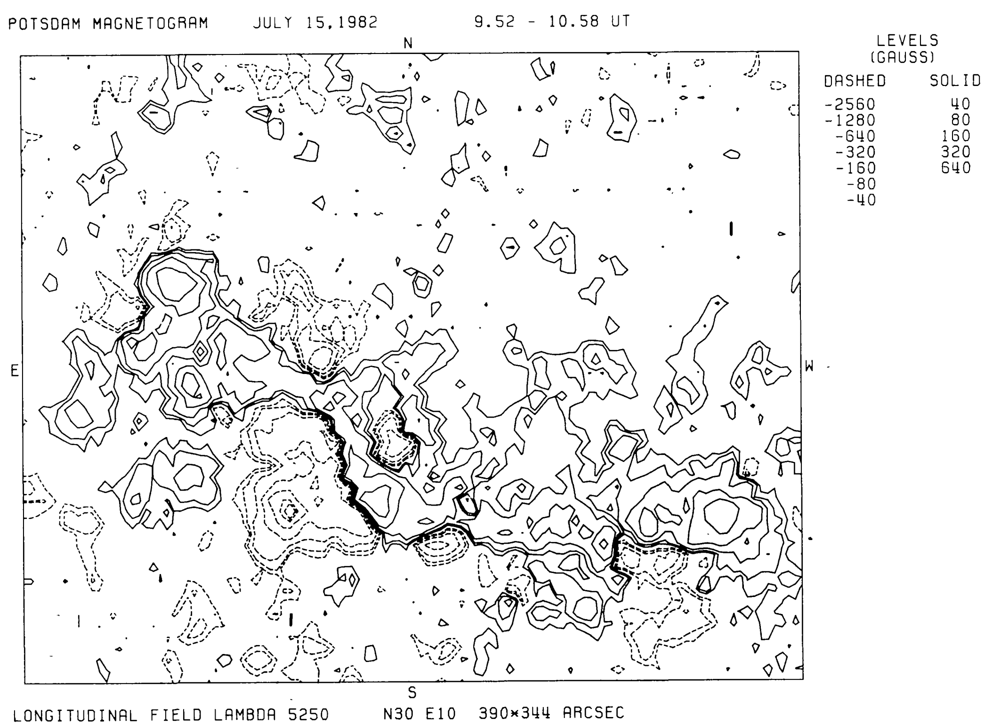

Fig. 1: Isolines of the longitudinal magnetic field on 15 July, 09:52 - 10:58 UT and neutral lines.

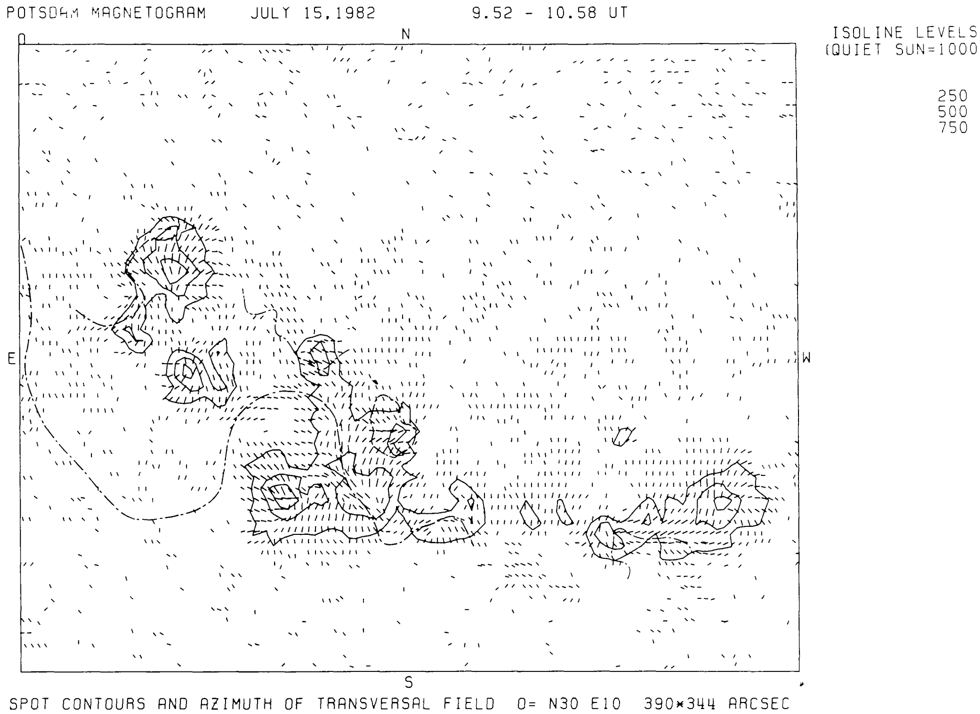

Fig. 2: Azimuth of the transverse magnetic field, some contours of the main sunspot and neutral line of the longitudinal field.

The calculation of the vertical magnetic field gradient was carried out using spline functions for smoothing the tranverse field components and by determining $\partial Bx/\partial x$ and $\partial By/\partial y$. Presuming div B = 0 it is then possible to derive the gradient $\partial B_z/\partial_z$ of the magnetic field. That was carried out for four measurements on 15 and 16 July. The results are presented by isoline charts, where the neutral lines are also shown for better intercomparison of different charts. In Figures 1 to 4 charts of the longitudinal field, the transverse field azimuth, the vertical gradient and the vertical current density on 15 July are shown.

Intercomparing the longitudinal magnetogram in Figure 1 and the maxima of the vertical gradient in Figure 3 one can see that maxima of the two parameters coincide. That was also the case on 16 July.

Only at some places the vertical gradient was stronger than 0.29 G/km; frequently we observed 0.16 G/km with a mean error of 0.1 G/km. This is in agreement to results by Hagyard et al. (1983) calculated from a potential field. The relative small vertical gradients have shown that in the chromosphere of large sunspots strong magnetic fields dominate.

From the same smoothed transverse field components like before rot_z B was

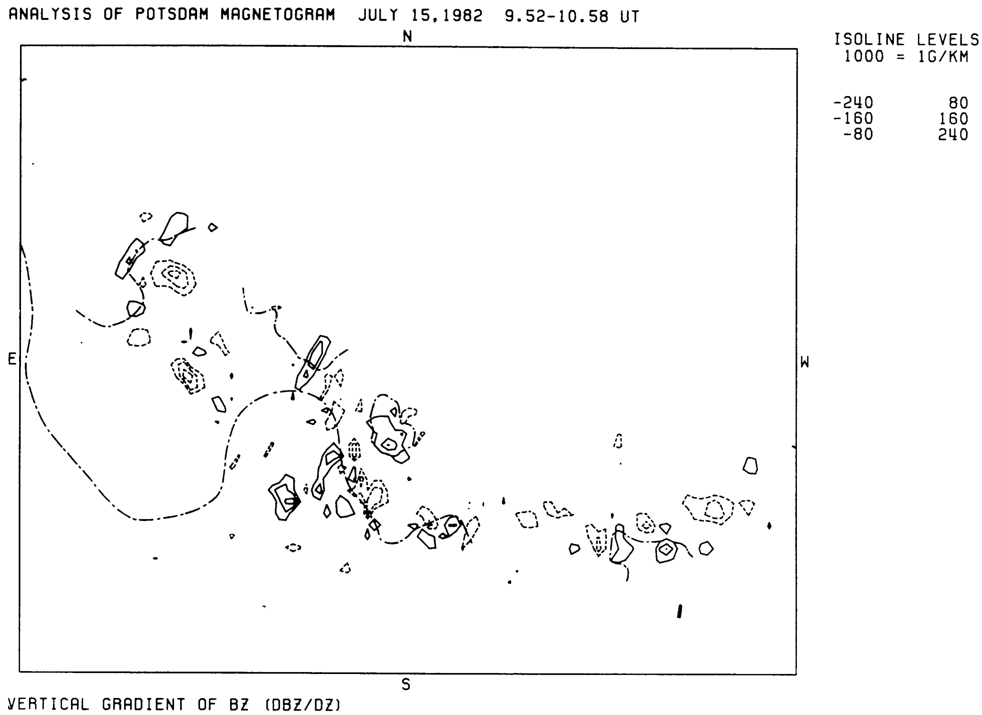

Fig. 3: Isolines of the vertical gradient of the magnetic field and neutral lines of the longitudinal field.

calculated and from it the vertical component of the current density. Also this parameter was presented in form of isoline charts. Same maxima exceed 19×10^{-3} A/m^2, more often we observed 6.4×10^{-3} A/m^2, where strong magnetic fields existed. That was the case near the large umbrae, in some cases also within the umbrae. In the central delta area many of the highest maxima are found on both sides of the neutral line. In some cases positive and negative maxima are located on the same side of the neutral line close together. Because of the strong shearing at the neutral line strong currents apparently flow along threads through the neutral-line filament.

Intercomparison of Hα filtergrams and current density charts has shown that the footpoints of some short and compact filaments agree with positive and negative maxima of the current density. At footpoints of long loop filaments the transverse field was so weak that the current density was below the noise level.

In relation to the maximum current density of 5×10^{-3} A/m^2 found by Krall et al. (1982) and of 20×10^{-3} A/m^2 found by Gopasyuk et al. (1983) our result of about 19×10^{-3} A/m^2 is in good agreement. The existence of many current density maxima especially concentrated in the central delta region of

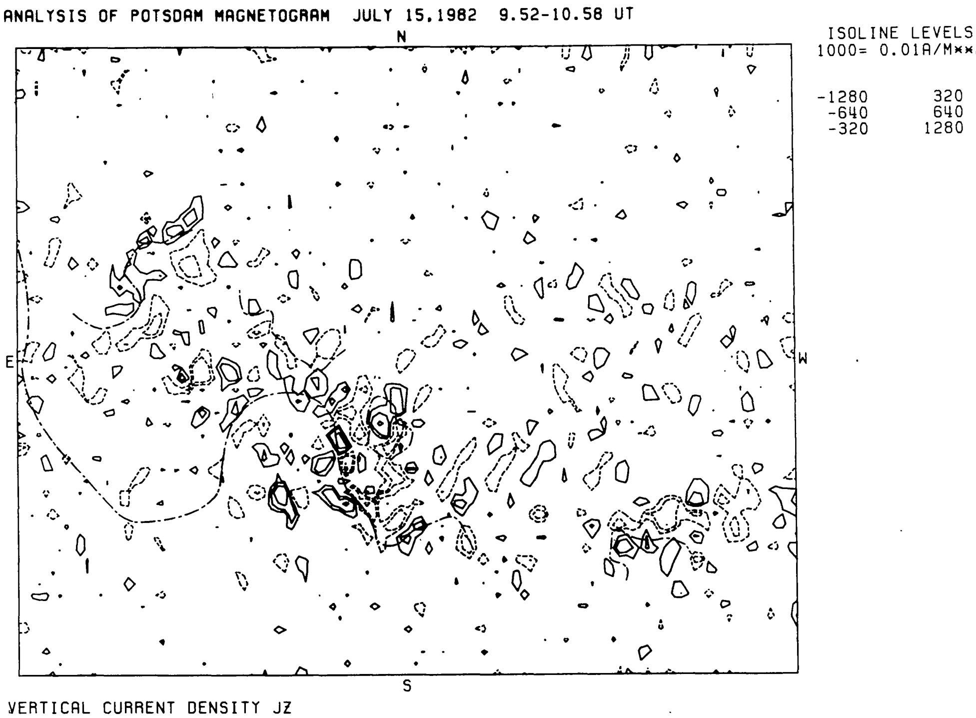

Fig. 4: Izolines of the vertical current density and neutral lines of the longitudinal field.

the active region demands in extrapolation calculations to take into account the variation of the parameter within the active region.

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