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WHAT WAS KNOWN ABOUT THE MARTIAN MAGNETOSPHERE BEFORE PHOBOS-2 MISSION

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Abstract. The only source of experimental data on martian magnetosphere before 1989 was the results of plasma and magnetic field measurements from Mars orbiters Mars 2, 3 and 5. The features of martian magnetosphere similar to proper features of magnetospheres of Earth and Venus were revealed; some evidences in favour of the existence of martian intrinsic magnetic field are mentioned.

Prior to the Phobos-2 mission the only sources of knowledge concerning the areomagnetosphere were data obtained from plasma and magnetic field instruments aboard the soviet Mars orbiters Mars-2, 3 and 5 (1971-1974). After 1975 the results from these spacecraft were summarized by soviet authors in several reviews (i.e. Dolginov et al., 1976, Gringauz, 1976, Vaisberg et al., 1976, Dolginov, 1978, Smirnov et al., 1978, Gringauz, 1981. See also references in these papers). The same experimental data were considered by American authors in a number of papers (i.e. Russel, 1978, Intriligator and Smith, 1978, Ness, 1979, Russel, 1979, Slavin and Holzer, 1982).

The comparisons of data from Mars 2, 3 and 5 orbiters with the results of plasma and magnetic field studies near Venus from orbiters Venera 9, 10 (1974-75) and Pioneer-Venus (1978) were very useful for current understanding and interpretation of data on martian magnetosphere (Gringauz, 1981, Slavin and Holzer, 1982).

The aim of this paper is to summarize very briefly the main results of areomagnetosphere prior to 1989 (without detailed references). It can help to distinguish really new Phobos-2 plasma and magnetic experimental results on areomagnetosphere from results and conclusions obtained earlier.

Analysis of Mars 2, 3 and 5 data and comparisons with data from mentioned above Venus orbiters led to the following conclusions :
A bow-shock located close to Mars does permanently exist. There is a transition region (magnetosheath) between the bow-shock and the magnetosphere, stretched in the antisolar direction. There is the magnetic tail (the antisolar part of the magnetosphere) within which the plasma fluxes and turbulence are lower than in the magnetosheath, while the magnetic field is correspondingly higher. The magnetic tail of Mars is compressible i.e. its lateral thickness decreases when ram pressure of the solar wind increases.

The boundary between the magnetosheath and the magnetosphere (magnetopause) sometimes is sharp enough. In cases when the transition from magnetosheath to magnetosphere is more or less gradual, the comparatively thin region of gradual change of plasma and magnetic field had been called "boundary layer" (i.e. Dolginov et al., 1976). These features resembled very much the well known features of geomagnetosphere (that is why the similar terminology was used) and produced at first an impression of evidence of existence of intrinsic field of Mars. But similar phenomena were revealed near Venus, which has no intrinsic magnetic field. So after study of plasma and magnetic fields near Venus it was necessary to look for other possible signatures of an intrinsic magnetic field of Mars.

As one of such signatures the results of ionospheric observations at Mars compared with results of similar observations of Venus can be regarded. Soviet and american observations had revealed the existence of "dayside ionopause" in the ionosphere of Venus where the ionospheric pressure is balanced by the solar wind ram pressure. At Venus the dayside ionopause exists in about 90% of cases of observations but it was never observed at Mars. This difference between dayside ionospheres at Mars and Venus can be explained by some intrinsic magnetic field of Mars (Gringauz, 1981, Slavin and Holzer, 1982).

There is an other difference between magnetospheres of Mars and of Venus : the thickness of the magnetic tail of Mars (measured in planetary radii) is substantially

larger than that of Venus (Gringauz, 1981, Vaizberg and Smirnov, 1976). It also can be explained by some intrinsic magnetic field of the planet.

So these two features provided some evidence of small intrinsic magnetic field of Mars.

The comparatively small dimensions of areomagnetosphere mean that external current system which defines the topology of magnetospheric magnetic field is close to the planet. Mars 2, 3 and 5 orbiters had the closest approaches to martian surface Hmtn > 1000 km. That is why, taking into account obviously small possible intrinsic magnetic field of Mars, all previous estimations of magnetic moment of Mars can not be regarded as reliable.

None of the Mars orbiters before Phobos-2 had a possibility to carry out measurements in the optical shadow of the planet. Thus before 1989 no observations were made close to the axis of the magnetic tail. Also there was no ion mass-spectrometry in the areomagnetosphere.

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