IN-SITU MEASUREMENT OF THE SURFACE COMPOSITION OF THE MARS MOON PHOBOS: THE ALPHA-X EXPERIMENT ON THE PHOBOS MISSION; D. Hovestadt[1], B. Andreichikov[2], J. Brückner[3], T. Economou[4], B. Klecker[1], E. Künneth[1], P. Laeverenz[1], L. Mukhin[2], A. Prilutskii[2], V. Radchenko[5], C. Reppin[1], R. Rieder[3], R. Sagdeev[2], C. S. Sastri[3], A. Turkevich[4], V. Vasiliev[5], and H. Wänke[3]. [1]Max-Planck-Institut für Physik und Astrophysik, München, FRG; [2]Space Research Institute (IKI), Moscow, USSR; [3] Max-Planck-Institut für Chemie, Mainz, FRG; [4]University of Chicago, Chicago, USA; [5]Nuclear Reactor Institute, USSR.

In July 1988 two Soviet spacecrafts will be launched towards Mars to investigate the planet and its environments. One of the investigation phases of the mission provides for a close flyby to martian moon Phobos and subsequent deployment of a LANDER to the Phobos surface.

The low albedo of the martian satellite Phobos suggests that it is different in the origin from that of Mars. Unlike Mars, Phobos is very dark in color suggesting a composition alike carbonaceous chondrites. The ALPHA-X experiment on the LANDER is designed to provide the chemical composition of the material of the Phobos surface. The experiment is performed in a collaborative effort of the above mentioned institutions.

The ALPHA-X instrument makes use of two different techniques for analyses: a) measurement of energy spectra of elastically backscattered alpha particles from a monochromatic radioactive source, and b) measurement of characteristic x-ray energy lines resulting from the excitation of the atomic structure of the analyzed material by the alpha particles and the x-rays from radioactive sources. These techniques complement nicely each other: the ALPHA will provide better results on the light elements while the X-RAY will be more effective for higher Z elements. The former method was successfully used by Turkevich et al. (1) in the late 1960's to provide the "in situ" chemical analysis of the Moon.

The Phobos ALPHA-X instrument consists of ALPHA sensor head, X-RAY sensor head located on the two booms of the LANDER that are lowered to the surface of Phobos, and an electronic compartment in the LANDER. The two sensor heads (80 x 60 x 80 mm each) are schematically shown in Figs. 1a and 1b. The total weight of the flight instrument is 2.5 kg and the power consumption is less than 2.0 watts. The instrument uses silicon solid state detectors for the alpha mode and cooled Si(Li) detector for the x-ray mode. The cooling of the x-ray detector on Phobos is provided during the night time passively through a cooling plate radiating into free space. During that time, the temperature of the detector is expected to be below -120°C and the resolution below 300 eV FWHM at 5.9 keV. The intensity of Cm-244 alpha sources for the ALPHA is 18 mCi and their resolution is about 2.7% FWHM. For the X-RAY two excitation sources are used: 30 mCi Cm-244 alpha source and 70 mCi (at the time of Phobos landing) of Cd-109 x-ray source. The Cm-244 alpha sources are in the form of a platinum alloy resulting in high stability, but less specific activity. More information about the experiment can be found in the report at the Phobos workshop by Hovestadt (2).

The flight instruments are currently undergoing final calibration and integration with the LANDER of the Phobos spacecraft. Figs. 2a and 2b show a Fe_2O_3 alpha backscattering spectrum and an x-ray spectrum from Allende meteorite taken recently with a flight instrument.

It is expected that from the chemical composition of the Phobos material, obtained from the ALPHA-X experiment, the basic question regarding Phobos origin can be inferred.

Hovestadt, D. et al.

Ref.: (1) Turkevich A et al. (1968) JPL Techn. Report 32-1265. (2) Hovestadt D, Rep. Workshop Scientific and Methodological Aspects on the Phobos Study, Nov. 1986, Moscow (in press).

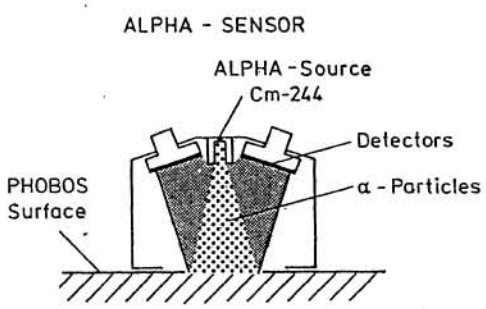

Fig. 1a: ALPHA Sensor

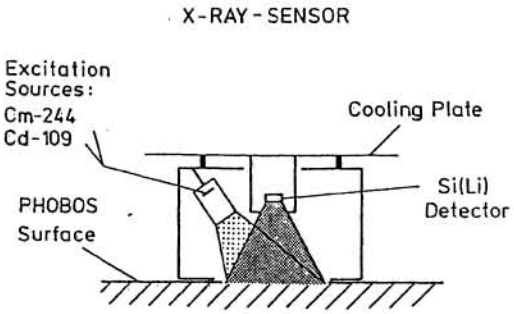

Fig. 1b: X-RAY Sensor

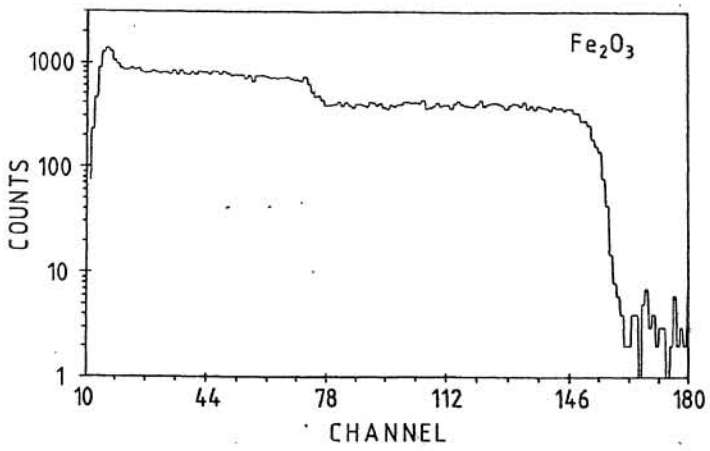

Fig. 2a: Alpha backscattering spectrum from Fe_2O_3 sample taken with a flight instrument.

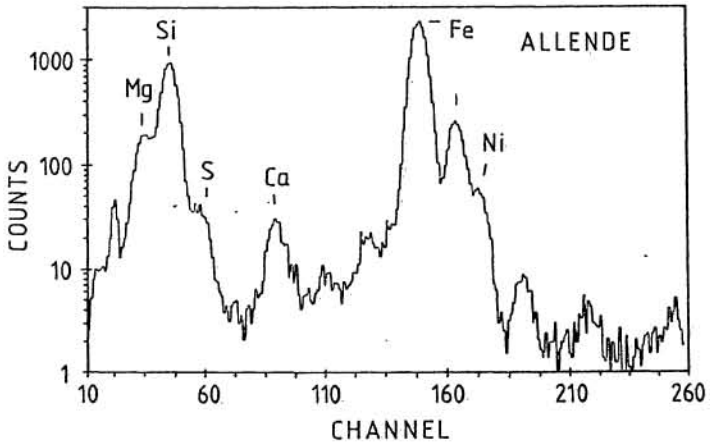

Fig. 2b: X-ray spectrum of Allende meteorite excited by a Cm-244 source and obtained with a flight instrument at detector temperature -110°C.