isotopic abundance. The ^{129}Xe to ^{132}Xe ratio was measured with an uncertainty of 70%, but none of the other isotope ratios for these species were obtained. Accurate measurement of the Xe and Kr isotopic abundance in this atmosphere provides a important data point in testing theories of planetary formation and atmospheric evolution. The measurement is also essential for a stringent test for the martian origin of the SNC meteorites, since the Kr and Xe fractionation pattern seen in gas trapped in glassy nodules of an SNC (EETA 79001) is unlike any other known solar system resevoir. Current flight mass spectrometer designs combined with the new technology of a high-performance vacuum pumping system show promise for a substantial increase in gas throughput and the dynamic range required to accurately measure these trace species.

The wide dynamic range of present space flight mass spectrometer analyzer/detector systems allows ionization pressures to be pushed toward the point where the gas mean free path in the ion source is limiting. However, the fixed capacity of miniaturized high-vacuum pumping systems has put significant constraints on several previous mass spectrometer experiments, including the Viking mass spectrometer. The noble gases are not pumped by chemical pumps and with a very limited capacity by miniaturized ion pumps. In addition, an ion-pumped system can release previously pumped material with a corresponding loss of accuracy.

A recent commercial development in high-vacuum pumping technology is that of wide-range turbomolecular/molecular drag pump hybrids where both stages are attached to the same rotating shaft. The natural exhaust pressure of the molecular drag stage is approximately 10 mbar. Compression ratios of 10^7 or higher for N are achieved with very small pumping systems. It is expected that with continued development toward a ruggidized flight pump a mass of less than 1 kg for a system with a pumping speed of 10 to 30 liters/s can readily be achieved. The pump capacity is only limited by power constraints and eventual failure of the bearings after several thousand hours of operation. With reference to the payload described by the MESUR Science Definition Team, a mass spectrometer experiment incorporating such a pump together with a recently developed thermal analyzer [1] could provide information on the volatile composition of martian near-surface solid-phase material in addition to carrying out the isotope measurements described.

References: Mauersberger K. et al. (1992) *LPI Tech. Rpt. 92-07.*

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VISIBLE IMAGING ON THE PLUTO FAST FLYBY MISSION. M. C. Malin, Malin Space Science Systems, 3535 General Atomics Court, Suite 250, San Diego CA 92121, USA.

Objectives for visible imaging of the Pluto-Charon system, as prescribed by the Outer Planets Science Working Group, are to acquire (1) global observations (FOV of ~5000 IFOVs) at 1 km/line-pair for the purpose of characterizing surface morphology and geology, (2) global observations in 3–5 broadband colors at 5–10 km/line-pair for studies of surface properties and composition as it relates to morphology, and (3) selected observations at higher spatial resolution for study of surface processes.

Several factors of the Pluto Fast Flyby mission make these difficult objectives to achieve: At Pluto's distance from the Sun, there is nearly 1/1000 the amount of light as at the Earth, the flyby velocity is high (~15 km/s), and the science requirements dictate a large data volume (1 km/line-pair implies between 20 and 50 MBytes for the panchromatic global image, and a comparable amount for the multispectral dataset).

The low light levels can be addressed through a large aperture, image intensification, long exposures with precision pointing and image motion compensation (scan mirror or spacecraft movement), or time-delay integration. The high flyby velocities require short exposures, image motion compensation, or observations from considerable distance (e.g., longer focal lengths and larger apertures). Large data volume requires a large spacecraft data buffer, an internal instrument data buffer, or real-time data compression. The difficulty facing the successful Pluto Fast Flyby imaging investigation will be overcoming these technical challenges within the extremely limited mass (~2 kg) and power (~2 W) available.

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A DTA/GC FOR THE *IN SITU* IDENTIFICATION OF THE MARTIAN SURFACE MATERIAL. R. L. Mancinelli[1], M. R. White[1], and J. B. Orenberg[2], [1]NASA Ames Research Center, Moffett Field CA 94035, USA, [2]Department of Chemistry and Biochemistry, San Francisco State University, San Francisco CA 94132, USA.

The composition and mineralogy of the martian surface material remain largely unknown. To determine its composition and mineralogy several techniques are being considered for *in situ* analyses of the martian surface material during missions to Mars. These techniques include X-ray fluorescence, X-ray diffraction, α-proton backscattering, γ ray spectrometry, mass spectrometry, differential thermal analysis (DTA), differential scanning calorimetry (DSC), and pyrolysis gas chromatography. Results of a comparative study of several of these techniques applicable to remote analysis during MESUR-class missions indicate that DTA/GC would provide the most revealing and comprehensive information regarding the mineralogy and composition of the martian surface material [1].

We have successfully developed, constructed, and tested a laboratory DTA/GC. The DTA is a Dupont model 1600 high-temperature DTA coupled with a GC equipped with a MID detector. The system is operated by a Sun Sparc II workstation. When gas evolves during a thermal chemical event, it is shunted into the GC and the temperature is recorded in association with the specific thermal event. We have used this laboratory instrument to define experimental criteria necessary for determining the composition and mineralogy of the martian surface *in situ* (e.g., heating of sample to 1100°C to distinguish clays). Our studies indicate that DTA/GC will provide a broad spectrum of mineralogical and evolved gas data pertinent to exobiology, geochemistry, and geology. Some of the important molecules we have detected include organics (hydrocarbons, amides, amines, etc.), CO_3^{2-}, NO_3^-, NO_2^-, NH_4^+, SO_4^{2-}, H_2O, and CO_2. The technique can also discern the mineral character of the sample (i.e., clay vs. silicates vs. glasses; degrees of hydration, etc.) [2]. It is thought that the surface of Mars consists primarily of an amorphous juvenile silicate material similar to palagonite with not more than 15 wt% clay [3]. This type of mixture is easily determined by DTA/GC using the high-temperature (1100°C) capability of the DTA [1,2]. This is important to the definition of mission analytical techniques, which must be able to analyze samples ranging from those containing no clay or evaporites to samples composed of