PLANS FOR A 1996 MARS SAMPLE RETURN MISSION; D. P. Blanchard, NASA Johnson Space Center, J.P. deVries and R.D. Bourke, Jet Propulsion Laboratory.

The science objectives for the study of Mars in the post-Viking era are primarily geological and geophysical. With the first order knowledge that present life on Mars is unlikely, the objectives for further study are defined by the need for primary information about the planet Mars and its atmosphere which is essential to understanding its place in the evolution of the solar system. This same information has important second order effects on the debate over the probability of past life on Mars.

The highest priority post-Viking science objectives as outlined by the Committee on Planetary and Lunar Exploration (COMPLEX) are:

1. The intensive understanding the details of the diversity of local materials at the surface of Mars.
2. Understanding the circulation of the atmosphere.
3. Understanding the dynamics of the interior of the planet.
4. Understanding of the interaction of the solar wind, the magnetic field and the upper atmosphere.
5. Understanding of the chemistry and geology of the planet at a global scale.

The poster that this abstract accompanies describes a Mars Sample Return Mission that directly addresses the first of these objectives. The mission is being designed to return variety of both surface and subsurface samples. The most accurate landing techniques will be used to place the lander near geologically interesting features. A capable rover will be an essential element of the sample collection strategy to maximize the diversity of the samples. The sample collection and return systems will keep the samples at Mars ambient conditions or colder to preserve the abundances and distribution of volatile components. Instrumentation will be carried to conduct experiments only feasible in situ and to perform some limited preliminary characterization for purposes of choosing among candidate samples for return.

The returned sample suite will include soils, small pebbles, core tubes of soil up to 1 meter in length, cores of solid rocks, chips of rocks and atmospheric samples. The objective is to collect a variety of fresh and weathered materials from a variety of sites. The investigations on these samples will include complete chemical and petrographic analysis, classification of the various rock types, analysis of the oxidation states of the materials, a complete investigation of the distribution and abundances of the volatiles in the first two meters depth of the surface, and investigations of minor constituents and physical properties of the samples. From this set of investigations will come information on elements (C,N,P,S,Na,Cl) vital to life and the more complete information on the role of water on the surface of Mars.

There are several advantages to a sample return mission:

1. Laboratory instruments have greater precision and sensitivity than flight instruments.
2. There is infinite opportunity for reconfiguring experiments to take advantage of initial results and unexpected discoveries.
3. The range of techniques available in a laboratory or a consortium of laboratories can not be duplicated on a space craft.

Flight instruments will never have the resolution and sensitivity of laboratory instruments. Many instruments in a state of the art analytical laboratory have requirements for components which are very massive or require large amounts of stable power. Neither of these are easily accommodated on a spacecraft instrument. There is extremely limited opportunity for reconfiguration of either the instrument or the experiment to take advantage of the information in the first results. Space craft instrumentation allows the experimenter a narrow avenue of attack which is limited by the preknowledge of the problem to be attacked and by the state of the art in instrumentation which is frozen into the spacecraft design several years before launch.

Planetary Quarantine is an important consideration for both the Mars lander and the Earth return vehicle. Quarantine of the Earth return vehicle or at least those parts of it that will enter Earth's biosphere is an open issue at this stage in our planning. Options range from full biological challenge in an isolated module of the space station to the concept of a hermetically sealed canister delivered unopened from the surface of Mars to the surface of Earth.

The protection of Mars is also a matter for a policy decision. For the Viking mission the "Probability of Growth" of a hardy terrestrial organism on Mars was estimated at $Pg = 3 \times 10^{-9}$. NASA adopted a conservative value of 10^{-6} which required the complete heat sterilization of the Viking landers. In light of the results from the Viking missions, COMPLEX estimated that a value of $Pg = 10^{-10}$ would not be an unreasonable working value "for the subpolar regions within 6 cm of the surface," $Pg = 10^{-9}$ for depths greater than 6 cm and $Pg = 10^{-7}$ for polar regions. These new estimates, if adopted, might permit an unsterilized lander and an orbiter altitude of less that 500 miles.

Quarantine procedures must be consistent with the primary scientific objectives of the mission and must not compromise the investigations on the returned samples. The most stingent operational constraint on any quarantine measure is the preservation of the volatiles both in abundance and in distribution within the returned samples.

REFERENCES: deVries J.P., Norton H.N. and Blanchard D.P. (1984) Mars Sample Return Mission: 1984 Study Report. NASA JPL D-1845