

A Simplified Mars Sample Return Mission:

**Maximizing Science, While
Minimizing Cost and Risk**

or

How Many Times Do We Have to Discover Water on Mars?

- **Discovered by the Vikings**
- **Discovered by Mike Carr**
- **Rediscovered by Mars Odyssey**
- **Discovered Again by MER Rovers**
- **Rediscovered by Mars Express**
- **Prediction: Water Will Be Discovered for the First Time by MSL**

Besides...

**Looking for Water is sooo Two NASA
Administrators Ago**

What Do We Bring Back?

- **A Datable Basalt**
- **A Sample of Windblown Dust**
- **Local Soil**
- **An Isolated Sample of Atmosphere**

What Instruments and Tools Are Necessary?

- **Imaging Camera**
- **RAT and/or APXS**
- **Sampling Tool**
- **Scoop**

Where Should We Sample?

- **A Previously Unsampled Location**
- **2-3 b.y. Basaltic Terrain (Cannot Be Too Old or Too Young)**
- **Terrane With Enough Areal Extent To Be Datable by Crater Counting**

A Datable Basalt: Pros and Cons

1. Minimizes Scientific Risk

- Almost Certain That This Type of Sample Can be Found**
- As MER Experience Has Shown, This is Not Necessarily True for Sedimentary Samples**
- Basalts Are Datable - Sedimentary and Metamorphic Rocks May Not Be**

A Datable Basalt: Pros and Cons

2. Maximizes Scientific Return

- Results Can Be Applied to All of Mars**
- Calibration of the Martian Crater Count Can Be Used to Predict Crater Fluences on Other Planets**
- Science Return is Largely Risk-Free**
- Going to a New Site Increases Our Martian “Ground-Truth”**

A Datable Basalt: Pros and Cons

3. Minimizes Cost

- Mission is Relatively Simple**
- Analytical Instrumentation Minimal**
- Roving is Minimal**

4. Caveat

- Cannot Date a Basalt if it is Too Altered -
Use RAT? APXS?**

Windblown Dust

1. **Probably Analogous to Terrestrial Loess**
2. **May Yield a Good Compositional Average of the Martian Crust**
3. **Ubiquitous**
4. **Could Contain Micro-fossils (e.g., Lunar Anorthosites)**
5. **No Cons**

Local Soil/Regolith

- 1. Presumably Different Than Windblown Dust**
- 2. Mixture of Dust and Locally-Derived Materials**
- 3. May give Insights into Weathering and Soil Formation Processes**

Atmospheric Sample

1. Ubiquitous
2. Some Measurements Need to be Done in Terrestrial Labs (e.g., Ne?)
3. Some Modest Discrepancies Between SNC Meteorites & Viking Measurements (e.g., $^{40}\text{Ar}/^{36}\text{Ar}$)
4. Don't Allow Interaction With Samples During Return

Recapitulation: Don't Get Greedy!

- **To Make Sample Return Viable, We Must Devise a Low-Risk, Affordable Mission**
- **Minimize Roving and Sample Selection**
- **Select a Landing Site With Application to the Whole Planet \pm Solar System**
- **Analyze in the Lab, not on Mars**