A Simplified Mars Sample Return Mission:
Maximizing Science, While Minimizing Cost and Risk
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 ± Solar System
- Analyze in the Lab, not on Mars