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Introduction: The analysis in Earth laboratories of samples that could be returned from Mars is of extremely high interest to the Mars exploration community, and on an international basis. IMEWG (the International Mars Exploration Working Group) is currently exploring options to involve the international community in the planning for returned sample science, including the analysis of the returned samples. The Mars 2020 sample-caching rover mission is an essential component of the Mars Sample Return campaign, so its existence constitutes a critical opportunity—MSR is more real now than it has ever been. The Mars 2020 samples, when returned, would provide the basis for performing a variety of Earth-based experiments including ones related to the search for the signs of life.

Why Now?: There are two main reasons why an updated analysis of the science potential of MSR is now appropriate:

1. The last major analysis of the specific scientific objectives of MSR, and how they translate to sample types and sample quantities was the MEPAG E2E-iSAG (End-to-End International Science Analysis Group) analysis carried out in 2010-11 (and published in early 2012). Since then, there have been advances on several different fronts that may change our perception of the scientific priorities for MSR:

- The number of Mars meteorites in our collections on Earth has now grown to over 100 (this number was 55 in 2011), and includes one brecciated sample that has a different age from all the other martian meteorites, and is thus presumably representative of a different region of Mars. What has changed from our investigations into this set of samples?
- The Curiosity rover landed on Mars (Aug. 2012) after E2E completed its work, and has since operated successfully for more than 5 years. It has analyzed a number of solid samples (both rocks and regolith) as well as the martian atmosphere. In addition, scientific output from the wealth of data returned by orbiter missions since 2011, such as NASA's Mars Reconnaissance Orbiter and Mars Odyssey, as well as ESA's Mars Express, has been fundamentally important in shaping and improving our understanding of the martian surface. Do any of these discoveries change the priority of Mars returned sample science?
- Research on terrestrial analogs, especially in the general field of astrobiology, has blossomed. We have a better understanding of the relationship of life to its environment, and of changes with time.
- There have been substantial improvements in our ability to handle and analyze very small samples. A highly visible example is the work that has been done on the Hayabusa samples (JAXA), and many instrumentation developments around the world. Does this meaningfully change what can be learned from returned martian samples of constrained size?

2. As part of the planning for the potential investigation of the samples after they arrive on Earth, we need a systematic analysis of which measurements would need to be made on the samples. This information can be used by successor teams to derive an instrument list and the logical sequencing of analyses. This is key input into planning for one or more sample receiving facilities (and its/their functionalities), for one or more curation facilities, and for certain key operational decisions.

Results: We have constructed a framework of 6 primary objectives related to the analysis of martian samples. For the life-related objective, four environmental divisions were made (hydrothermal, sedimentary, subaerial, and rock-hosted), because the strategies and kinds of samples are very different. For each objective, a logical set of sub-objectives and/or investigations has been derived. For each of those, we have mapped out the kinds of samples desired/required to achieve the stated objective/sub-objective, as well as the essential measurements to be made on the samples. Interim results are presented for discussion/feedback in the form of a set of objective-oriented abstracts, which will be followed after the conference by a full report.

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