

## THE END TO END MARS SAMPLE RETURN CAMPAIGN.

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**Introduction:** Mars Sample Return (MSR) is a top priority for the next decade of space exploration [1]. Returned samples would allow their detailed investigation by the most advanced instruments on Earth providing new insights into the history of Mars. The success of MSR would require multiple flight missions and a subsequent non-flight project, a scenario now termed the “MSR Campaign”. The campaign objectives need to be understood in detail at an early stage in order to plan the role of each component mission. The End to End International Science Analysis Group (E2E-iSAG) was chartered by the Mars Exploration Program Analysis Group (MEPAG) to undertake this task by building on efforts of previous MEPAG-chartered groups. Since August 2010 the E2E-iSAG has been (1) defining potential objectives, (2) defining candidate criteria for sampling and landing sites definition (3) defining reference landing sites (4) developing a first draft of a returned sample measurement plan, and (5) initial inputs to technology planning for the overall sample return campaign (from the first mission to the analysis of samples on Earth), and not just one segment of this program.

**Results:** The scientific objectives proposed by E2E-iSAG are, in priority order (1) Critically assess any evidence for past life or its chemical precursors, and place detailed constraints on the past habitability and the potential for preservation of the signs of life, (2) Quantitatively constrain the age, context and processes of accretion, early differentiation and magmatic and magnetic history of Mars, (3) Reconstruct the history of surface and near-surface processes involving water, (4) Constrain the magnitude, nature, timing, and origin of past planet-wide climate change, (5) Assess potential environmental hazards to future human exploration, (6) Assess the history and significance of surface modifying processes, including, but not limited to: impact, photochemical, volcanic, and Aeolian, (7) Constrain the origin and evolution of the martian atmosphere, accounting for its elemental and isotopic composition with all inert species, (8) Evaluate potential critical resources for future human explorers. With an additional obvious but unprioritised objective - determine if the surface and near-surface materials contain evidence of extant life.

The findings of the E2E-iSAG most relevant to the meteoritical community are those involving sample selection, sample sizing and sample distribution once back on Earth. Sample types of highest priority to the objectives listed above are: (1) Lacustrine or hydrothermal deposits, (2) Hydrothermally altered rocks, (3) Low-T fluid-altered rocks, (4) Unaltered Igneous rocks, (5) Regolith, (6) Airfall dust, and (7) Atmosphere, rocks with trapped atmosphere. Subsurface rocks made accessible by either drilling or natural excavation would be desirable. Sample suites would be preferable for some sample types. The total proposed returned sample mass would be about 500 g with a proposed subdivision of this amount between sample numbers and types detailed in the E2E-iSAG report. With decades of experience involving curation and analysis of extraterrestrial samples, the meteoritical community may have a new opportunity to apply their skills to Mars samples returned by a campaign of dedicated space missions.

**References:** [1] Squyres S.W. et al. 2011. The National Academies Press, Washington D.C.