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A Student-Designed Approach to ESA's ExoMars Mission

M. K. Spencer and the PSSS study team
Planetary Science Summer School (PSSS)

A Planetary Science Summer School (PSSS) is hosted by JPL annually to train a group of early-career scientists (graduate and post-doctoral students) for NASA mission planning. This work presents the results of the 2006 design study modeled after the European Space Agency's (ESA) ExoMars Rover. The PSSS students designed a mission commensurate with the science goals of the ExoMars mission, but within the mass, design, and cost constraints of a NASA mid-class rover. This, in turn, allowed them to evaluate the feasibility of the proposed ExoMars mission. Primary science goals include the search for subsurface biology (extant or extinct) in context with geological morphology, and demonstration of subsurface core sampling. The rover's enabling instruments include an ultra-sonic drill capable of producing cores at a depth of 1 meter, and a Panoramic Camera for surface navigation. The analysis instruments are the MAHLI (Mars Hand Lens Imager) and an AP-MALDI with GCMS (Atmospheric Pressure Matrix-Assisted Laser Desorption/Ionization instrument with Gas Chromatograph Mass Spectrometry).

Results of the study indicate that ESA's ExoMars is a difficult mission to design within a $900 million cost cap and 180 kg maximum mass. However, most of the primary science goals for ExoMars were satisfied by the student design, with about one-fifth of the proposed ExoMars instruments. The design of the instrument suite highlighted the major difficulties associated with indisputable detection of biological material.