

Abstract: Returning samples from the surface of Mars has been a goal of the planetary science community since the success of the Mariner and Viking missions in the 1960s and 1970s. Landing spacecraft on Mars, triaging, collecting and packaging samples, and returning them to Earth in a manner that protects the biological integrity of both planets is technologically very challenging. For many years, Mars sample return was always seen as something that could be done about 10 years in the future – but that future never arrived and indeed current prospects continue to be uncertain. Although Mars has generously delivered her own samples to Earth in the form of more than 65 distinct Martian meteorites, it is evident that these samples do not provide a representative sampling of the Martian crust and are unlikely to answer the crucial question of whether or not life ever arose on that planet. Early reports of fossil microbes within fractures of the oldest of these meteorites, ALH84001, have not withstood subsequent scrutiny.

For the past two decades, NASA's Mars exploration program has successfully employed a "follow the water" strategy in an attempt to identify and characterize potentially habitable geological settings that could be the sites of present or past life. Ancient habitable environments, including a remarkable variety of sedimentary and hydrothermal settings, have been identified at multiple locations by both of the Mars Exploration Rovers - Spirit and Opportunity - and by the recently landed Mars Science Laboratory – Curiosity. Vastly improved orbital remote sensing techniques also hold great promise for identifying habitable sites from orbit. Accordingly, there is now strong support within the planetary science community to obtain samples from Mars and beginning a campaign for Mars sample return was among the highest priorities recommended in the recent NRC Planetary Science Decadal Survey. The financial and technical difficulties are so great that it will likely require a level of international cooperation that is rarely seen in planetary exploration. It is also now recognized that this endeavor will take at least three mission opportunities - or about a decade of time. On the other hand, it remains to be seen if the recently announced 2020 rover will make significant progress towards Martian sample return. This lecture will

review the current state of planning for a Mars sample return campaign and describe one possible set of missions that could be used to achieve Mars sample return.