FIELD AND LABORATORY STRATEGIES IN THE SEARCH FOR CHEMOLITHOTROPHY IN THE MERIDIANI REGION. Charles S.Cockell, Open University, Milton Keynes, MK7 6AA.

Introduction: The search for life on Mars, by both robotic and humn explorers, is primarily a quest for regions that have the main ingredients for sustaining life – an energy source, nutrients, liquid water, and a source of carbon. The most likely present or past inhabitants of the near-surface environment of Mars are chemolithotrophs [1,2]. Today, the surface is hostile to photosynthetic life, although this may not have been the case in the past. Any microbiological endeavour on the surface of Mars is likely to focus on one specific subset of microbiology – anaerobic chemolithotrophy.

The Search for Chemolithotrophy: I will discuss three stages in the microbiological study of Meridiani, although these three stages would apply to any region of Mars. STAGE I: Theoretical/chemical assessment. This stage involves a theoretical assessment of the types of microbiota that might inhabit or have inhabited the region of interest. In the case of Meridiani the presence of sulfate, manifested in the mineral jarosite, and the abundant presence of oxidized iron [3] suggests that sulfate and metal reduction might be a plausible method of energy acquisition for a chemolithotrophic biota. In these cases, the electron donors could be subsurface organics (if they exist), hydrogen or carbon monoxide. The empirical identification of redox couples that can support life is vital to any further microbiological study since either these redox couples can be used to guide the search for life and its biosignatures [4,5] or they can be used to guide attempts to understand the lack of evidence for life in particular environments. STAGE II: Field Science. The second stage is to go into the field and gather samples from regions that have the chemical characteristics identified in Stage I as being the most plausible sites for life. This involves EVAs to sites of interest and follow-up EVAs to gather more samples based on preliminary laboratory analysis. This work is accomplished for two purposes: 1) to gather samples that can be studied to determine the concentrations of nutrients or redox couples. Because these elements and compounds can vary on spatial scales of just millimeters, this work is best accomplished by human explorers, who can visit many different sites of interest and collect a large sample set. 2) these samples will also be used for biological analysis. Rocks that contain within them concentrations of potential nutrients and redox couples apparently sufficient to support biology would be subjct to more careful scrutiny for life/past life. STAGE III: The third stage is the laboratory analysis. Stage III is guided by the requirements identified in Stage I. In this talk I will describe the requirements for a laboratory to conduct studies of chemolithotrophs on the surface of Mars or a search for their past signatures. As each different focus in microbiology requires different practical laboratory considerations, Stage I is important for defining the laboratory requirements. Even today, given our knowledge of the mineralogy of the Meridiani region, we can identify many of the requirements for a Mars surface laboratory.

Finally, I will discuss possible mass requirements for landing a laboratory on Mars. One of the problematic decisions of a human mission to Mars is whether to take the ability to culture microorganisms to the Martian surface with its associated mass costs. If precursor missions identify life, then obviously a microbiology laboratory is required. However, if they do not find life, that may be an artifact of the sampling regimen, particularly if life is localized. To land on Mars without a laboratory and then to find life would be a failure of mission planning, given the cost of getting to Mars in the first place. Thus, I argue that regardless of the outcome of precursor missions, a microbiology laboratory should be taken to Meridiani (or anywhere else on Mars).

References: [1] Roh, Y et al. (2002) *Appl. Environ. Micro.* 68, 6013-6020 [2] Lovley, D.R. (1997) *FEMS Micro. Rev.* 20, 305-313 [3] Catling, D.C. and Moore, J.M. (2003) *Icarus* 165, 277-300 [4] Brown, D.A. et al. (1999) *Geochmica et Cosmo. Acta*, 63, 2163-2169 [5] Dong, H. (2000) *Chemical Geol.* 169, 299-318