

POTENTIAL CANADIAN CONTRIBUTIONS TO CHALLENGE AREA 1: SCIENCE INVESTIGATIONS

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Introduction: The Canadian Space Agency (CSA) has been an active partner in NASA's planetary science program in the last decade, contributing the MET weather station to the NASA Mars Phoenix Scout Mission, APXS on Mars Science Laboratory, and the Osiris Rex Laser Altimeter (OLA). The scientific interests of the Canadian community are outlined in the 2009 'Canadian scientific priorities for the Global Exploration Strategy' report [1], with many synergies with MEPAG Goals 1-4. Participation in a Mars Sample Return mission is a goal of the CSA.

Canadian Mars instrument concepts: CSA has funded several instrument concepts, phase 0 studies and some prototyping activities in recent years. These reflect new science investigation interests from the Canadian scientific community, however many concepts build on heritage from Canadian terrestrial space missions. Several of these are of direct relevance to challenge areas presented at this workshop.

Orbiter payloads:

Mars trace gases (MATMOS concept): ACE-FTS on Canada's Scisat-1 mission built by ABB in Quebec addressed the spectral range, high spectral resolution and parts per trillion sensitivity requirements needed for Mars trace gas science, and has been the basis of Canada's involvement in the MATMOS investigation.

Near surface imaging: (Synthetic Aperture Radar): Canada's terrestrial Radarsat 1 and 2 provide heritage for a Mars orbiter SAR concept with C- and P-band and radiometry. Performance goals are a depth capability of 3-10m sediment/10-100m in ice (P-band) and a spatial resolution as good as 20m (C-band, dual polarisation) that can support a range of science investigations into near surface ice and climate-driven changes to surface sediments.

Wind measuring instrument (DYNAMO concept): This is an imaging interferometer for orbital observations of wind and temperature using limb observations with 5km vertical resolution and horizontal wind speed precision of $\pm 5\text{ms}^{-1}$ from 15-50km (day) and 50-75km (night). The DYNAMO concept (PI W. Ward, UNB) derives from Canada's WINDII instrument on UARS.

Surface mineralogy (CHIMERA concept): The Canadian Hyperspectral Imager for Mars Exploration and Resource Assessment (CHIMERA) uses a spectrometer based on the Dyson design form. The instrument mass is less than 20 Kg and the power less than 50 W. It covers the wavelength range from 0.9 to

3.6 μm , with a swath width higher than 30 km, a spatial resolution of less than 30 m and a spectral resolution of 12 nm or better, at a SNR higher than 150. This orbital instrument was further developed into a concept called HALO which combined global orbital mineralogy with a surface rover based optically stimulated luminescence (OSL) investigation of geological materials for age dating.

Surface payloads:

APXS: This instrument has flown on Pathfinder and MER and a Canadian APXS investigation is currently on board Mars Science Laboratory with PI Ralf Geller, UGuelph. It provides elemental abundances of rocks and soils from Na to Zn at high precision. A next-generation instrument is being studied.

Microscope (TEMMI): This is a 3D microscope for a Mars surface rover concept that has recently been prototyped with 2-4 μm /pixel resolution and 250 μm depth of field and 8 wavelengths from UV to VIS.

Other investigation concepts studied or in development: LIBS, micro-Raman, GPR, nanosat concepts (eg. MOMENT- high resolution mapping of magnetic anomalies on Mars)

Sample manipulation: As part of Canadian stimulus activities, a Mars Exploration Rover prototype has been built with a manipulator and mini-corer, building on a strength in space robotics demonstrated by the Canadarm2 on ISS, and strengths in drilling from the mining industry. Canadian dexterous manipulators have been adapted for medical applications, and could also be a contribution to a Mars Sample Receiving facility for sample handling activities.

Analogue missions: The Canadian Analogue Research Network program provided funding for Canadian-led teams to develop planetary science investigations using Canadian analogue sites. Canada provides a wide range of analogues for Mars: eg. dry polar environments, cold springs, hypersaline springs, impact craters, the archaean-age Greenstone belt, ophiolites, deep mines. Recently CSA has funded analogue missions to look at operational concepts for Mars missions seeking signs of life. Prototypes delivered from CSA's stimulus investments may be available for use by the community for future analogue missions.

References: [1] CSEW6 steering committee, Canadian Science Priorities for the Global Exploration Strategy <ftp://ftp.asc-csa.gc.ca/users/TRP/pub/CSEW/CSEW6/>, 2009