SOLID, A SIGNS OF LIFE DETECTOR IN THE NORTHERN MARTIAN LAND SUBSURFACE. V. Parro[1], M. Moreno-Paz[1], Y. Blanco[1], A. Davila[2], J. Manchado[3], I. Gallardo-Carreño[1], C. Stoker[3] and C. McKay[3]. [1]Centro de Astrobiología (CAB, INTA-CSIC), Madrid, Spain (parrogv@cab.inta-csic.es); [2]SETI Institute and [3]NASA Ames Research Center, CA, USA.

Introduction: The search for evidence of life on Mars is the motivating goal behind the Mars Exploration Program (MEPAG, 2010). Mars is the prime target for the search for life beyond Earth mainly because of the convincing evidence for past liquid water on the surface and indications of recent liquid water activity, particularly during periods of high obliquity (about 5 Myr ago) [1]. The cold and dry conditions dominating the planet open the possibility for well preserved molecular evidence of life. All these facts motivated the IceBreaker Mission to Mars [2] for searching for molecular evidence of life in the subsurface of the permafrost in the Martian northern plains. To achieve this goal one of the payload instruments is SOLID, a life detector instrument based on antibody microarrays [3].

SOLID principle: With the Signs of Life Detector instrument, Icebreaker will search for a specific suite of carefully selected biomarkers using Fluorescence Sandwich Immunoassays (FSI) in antibody microarray format (Fig. 1). In a FSI, purposely selected antibodies (Abs) recognize and bind to desired biomarkers or antigens (Ag) with high specificity, in a manner similar to how the immune system recognizes molecules and cells that are foreign to the body of mammals. Abs recognize and bind to a small region of the Ag, called the epitope. An epitope can comprise a 3-D surface feature and shape of a specific biomolecule (conformational epitopes), or a specific sequence of small monomers such as amino acids (linear epitopes).

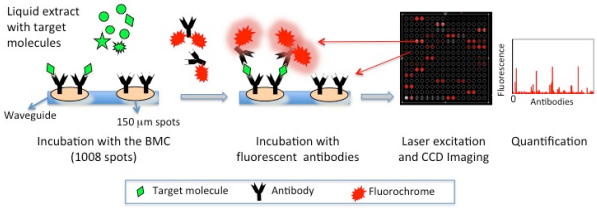

***Figure 1**. Fluorescence Sandwich Immunoassays (FSI) in antibody microarray format for SOLID.*

The presence of specific biomarkers can be revealed as a fluorescent reaction, and the relative abundance of each biomarker can then be estimated by the intensity of fluorescence. No high temperature processing of the sample is required. FSI can be performed on microarrays, where fluorescence reactions occur in purposely designed reaction spots, each spot containing one type of antibody.

SOLID immunoassay is compatible with the perchlorate and sulfate concentration found on Mars [3]. Antibodies are stable enough to survive at least a 2 years mission, high doses of gamma radiation, extreme temperature cycles, and long-term storage [4]. Antibodies on the microarray are stable under dry conditions, retaining >80% of their functionality after 48 months of storage at ambient temperature. They also are stable after high-energy protons and neutrons equivalent to a mission to Mars [5,6].

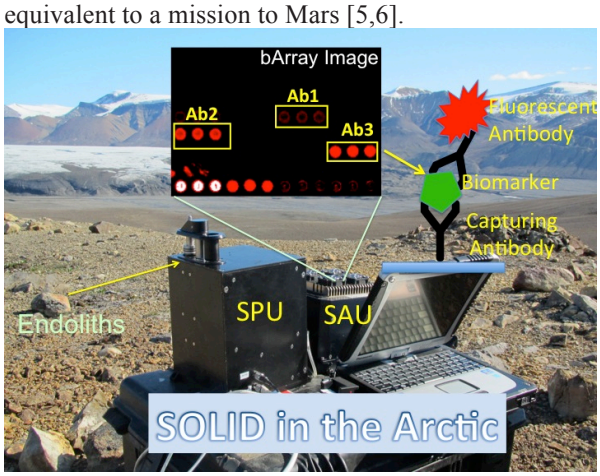

***Figure 2.** SOLID instrument in the 2013 field campaign to Canadian High Arctic.*

The SOLID Instrument: SOLID (Fig. 2) consists of two functional units: the Sample Preparation Unit (SPU) is loaded with powdered samples and generates a liquid extract by ultrasonication, and the Sample Analysis Unit (SAU) receives the liquid extract and performs FSI. SAU contains 10 individual biomarker arrays (bArray), the core analytical component of the instrument. Each bArray is a glass slide (0.3 x 2.6 cm) printed with 1008 immuno-reactive spots 150 µm in diameter and 250 µm apart. Each spot is printed with a single capturing Ab specific for a biomarker. Additional reactive spots are used to accommodate replicates of each Ab, thus providing redundancy to assess reproducibility, and for calibration and control.

References:

[1] Richardson & Mischna (2005) *JGR: Planets* 110.E3. [2] McKay et al. (2013) *Astrobiology* 13: 334-353. [3] Parro et al. (2011) *Astrobiology* 11: 15-28. [4] de Diego-Castilla et al. (2011) *Astrobiology* 11: 759-773. [5] Le Postollec et al. (2009) *Astrobiology* 9: 637-645. [6] Derveni et al. (2012) *Astrobiology* 12: 718-729 .

Additional Information: This work is being funded by the Spanish Ministry of Economy and Competitiviness grant no. AYA2011-24803.