Off-World field science performance: Results from the Pilbara space suit trials.

D. Willson[1], J. C. Rask[2], S. C. George[3], P. de Leon[4], J. Blank[5], R. Bonaccorsi[5], J. Slocombe[6], K. Silburn[7], H. Steele[8], M. Gargarno[9] and C.P. McKay[10].

(1) KISS Institute of Practical Robotics, NASA Ames Research Center, building 245, Moffett Field, CA 94035, USA, (david.willson@nasa.gov)

(2) Dynamic Corporation, Space Biosciences Division, NASA Ames Research Center, Moffett Field, CA 94035, USA

(3) Department of Earth and Planetary Sciences, Macquarie University, North Ryde, NSW 2109, Australia

(4) Department of Space Studies, University of North Dakota, Grand Forks, ND 58202, USA

(5) SETI Institute - 189 Bernardo Ave., Suite 100 Mountain View, CA 94043. USA

(6) Creators Orb education and training consultants, 5 Hann Court, Redwood Park, SA 5097

(7) Casula High School, Myall Rd, Casula, 2170 NSW, Australia

(8) Wesley College, The University of Sydney, New South Wales 2006, Australia

(9) Department of Imaging and Applied Physics, Curtin University, Kent Street, Bentley, WA 6102, Australia

(10) NASA Ames Research Centre, Space Science & Astrobiology Division, Building 245, Moffett Field, CA 94035, USA

Abstract

Scientist astronauts undertaking off-world field science will be faced with spacesuit limitations in vision, human sense perception, mobility, dexterity, the spacesuit fit, and the psychological fear of death from accidents all causing physical fatigue. This will affects their field skills and reduce their field science performance.

Future astronauts undertaking EVA on Mars could be searching for, in dangerous unexplored terrains, visible biosignature evidence for past life such as stromatolite or microbalite fossils, a very significant discovery if found and proven. The effectiveness of scientist astronauts to employ their field science skills will be critical to finding, characterizing and proving biosignature fossils.

As such, we conducted field trials at the 'Pilbara Dawn of life Trail' field with field scientists and non-field scientists using the University of North Dakota's NDX-1 pressurizable spacesuit to assess and rank the effectiveness of scientist astronauts employing their field observation skills while looking for evidence of proof of past life.

We argue the 3.45 Ga stromatolite fossils at this location are a reasonable analog for hypothetical similar fossils at Nili Fossae on Mars based on similarity of rock chemistry, age and an aqueous environment and moderate temperature history.
We conclude that when wearing a spacesuit, 25% evidence is missed with more incorrect identifications compared to not wearing a spacesuit but the ability of the scientist astronaut to provide quality characterization descriptions becomes less affected by the spacesuit as the science importance of the fossil increases. Scientist astronauts with significant field science experience are more effective than non-field scientists in finding and proving evidence particularly if the science is significant.

We identified, to improve scientist astronaut off-world field science performance: (1) Technologies, in the areas of suit design and tools aimed to minimize expenditure of energy by the astronauts and maximize their field science performance; and, (2) Astronaut training, aimed to improve field science performance and competencies in off-world field technology operation. The field trial data collected satisfies the requirements of the "EVA performance and crew health" component of NASA's human research program.