

Spaceward Bound India 2016: An Overview of the first Astrobiology Expedition to the Roof of the World. S. Pandey^{1,5}, J. Clarke², R. Bonaccorsi^{3,4,5}, J. G. Blank^{3,5}, R. Mogul^{5,6}, M. Sharma⁷, and the team of SB India 2016⁸.

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Introduction: The first Spaceward Bound India (SBI) expedition, to the Ladakh region in the Indian Himalayas, was made in August 2016. Part of the NASA Ames Research Center's Spaceward Bound series, which brings educators and research scientists together in field settings to study astrobiology, SBI was organized by Mars Society Australia (MSA) and the Birbal Sahni Institute of Palaeosciences (BSIP), India, with guidance from veteran NASA SB participants based at Blue Marble Space Institute of Science (BMSIS), NASA ARC and SETI Institute. 31 participants, representing 9 countries, comprised the expedition members.

Choice of Field Arena: Ladakh is a unique, extreme altitude (3500-5700 m above sea level), cold desert region that offers road access to a number of microbial life-supporting extreme environments, including glacial deposits, sand dune ponds, hot springs, saline lakes, and permafrost regions. These can be reached by car or truck within 1-3 days of travel from Leh, the largest city (~30K) in the region and the base of operations for our expedition.. The program, packed with both research and education work, involved field and evening discussions and hands-on activities that helps connect students, teachers, and educators to work together in astrobiologically relevant remote extreme environments in the region. Researchers within the team conducted experiments, made geomorphological observation records, field tested a Mars mission flight instrument prototype and collected environmental data and samples for lab work. The education component of the expedition covered field and evening discussions between participating scientists, educators and students as well as interactions with local remote school student groups on select days. A field site visit involved terrain descriptions, landscape evolution descriptions, and astrobiology relevance given by the geologists and veteran Spaceward Bound members. Students and educators helped the researchers collect samples and log environment data, thereby getting hands-on field training. Being an international interdisciplinary team working in a remote setting at reduced oxygen levels, the format could also be developed to simulate and test several human-centric psychological and operational aspects of future international Moon and Mars human missions.

Another advantage of SBI was that it allowed Spaceward bound veteran members, new to the Ladakh region, to work alongside Indian researchers actively studying the terrain who were nonetheless unfamiliar with the integrated astrobiology-science approach of Spaceward Bound expeditions. Everyone on the expedition was learning something from another and from the region. The planning and execution of the expedition has helped connect Astrobiology research and education teams from India with those in Australia, US, and Sweden, and has led to formation of several joint research groups in the fields of Microbial Diversity, Geochemical mapping, Geomorphology, and Palaeoscience Research. Key findings from the science groups shall be discussed at a workshop in the near future in India. The conclusions from the findings from the visited sites shall pave the way towards the formation of a long term astrobiology exploration roadmap for Ladakh. Plans are underway for feasibility studies for a Mars Analog Research Station India with a support base in New Delhi. Some in the team are involved in the formation of a proposed Centre for Astrobiology at the BSIP, which would be crucial to support future field and lab work, facilitate inter lab collaboration and workshops for students in the country. India, a space faring nation with its recent success to put a spacecraft in Mars orbit, Mars Orbiter Mission or 'Mangalyaan', has much to offer to the world in helping answer key questions about Life in the Universe.

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