



A REPORT ON THE EXPEDITION OF NASA SPACEWARD BOUND INDIA PROGRAMME, LADAKH, INDIA, 09TH AUGUST – 19TH AUGUST, 2016

The NASA Spaceward Bound Program is an initiative of NASA Ames Research Center to promote researchers from various backgrounds to conduct astrobiological experiments in remote, extreme environments on Earth which has apparent similarities with the Moon and Mars. In addition, the involvement of the students and teachers in these activities is equally important to popularise the space science. The NASA Spaceward Bound Program has previously been conducted in the Mojave Desert, USA, North Dakota, USA; Idaho, USA, Western Australia, Namibian Desert, UAE, Antarctica; high Arctic regions, New Zealand. This year the Birbal Sahni Institute of Palaeosciences (BSIP), Lucknow alongside the Mars Society Australia organized a NASA Spaceward Bound India expedition in Ladakh (J & K) during August 9th-19th, 2016. This expedition was a continuum of annual Spaceward Bound Programs under the supervision of the NASA Spaceward Bound Group at NASA Ames Research Center, US with the non-financial participation. The event was inaugurated on 8th August, 2016 in New Delhi in the presence of Chief Guest, Prof. Ashutosh Sharma, the Secretary, Department of Science and Technology, Government of India, New Delhi.

The expedition team consisted of six educators, eight PhD students, and sixteen scientists from various disciplines and two media persons were also involved in the expedition to Ladakh. During the expedition, the team members went up to 5359 meters to collect the Ultra Violet (UV) resistant microbes at Khardung La and also at Tangla La pass. In the Leh regions, namely, Panamik, Chumathang and Puga Valley Hot Water Springs proved to be unique spots where water boils up to 82°C. Palaeolake sites at Khalsar, Tsokar and active cold desert dunes at Hunder were also targeted for sampling. Samples for scientific purposes were collected from these sites to study microbial diversity, biomarkers, carbon sourcing and metabolism in hot-spring system, and source of unusually high Boron in Puga hot-spring, role of B and Mo in catalysing the RNA strand formation and the possibility of thermoacidophilic bacteria within Venus cloud had been discussed.

Molecular phylogenetic studies have demonstrated that thermophiles are the most primitive organisms implying that life on this planet probably started in hydrothermal springs (Allen and Oehler, 2008). Similarly, life forms have also been recorded from other extreme environments, e.g. psychrophiles thrive at low temperatures, thermophiles at high temperature, acidophiles at low pH, alkaliphiles at high pH, piezophiles under extreme pressure, xerophiles at desiccation, and halophiles at salinity (Magan, 2007; Rothschild and Mancinelli, 2001). Organisms of the three domains of life (Archaea, Eubacteria and Eukaryotes) are found in extreme environments (Seckbach and Oren, 2007). Therefore, extreme environments are no longer considered uninhabitable but are the potential sites to study the advent of life on earth and other planets hosting such environment like Mars. Since the last few decades, the data produced on extremophiles coupled with environmental conditions on other planets suggest that life may have been existing in more places than we think. As Ladakh hosts pristine, subzero environment with meagre precipitation and hot-spring zones scattered around Indus Suture Zone, it can be used as a model to study life in extreme environments and their implications for astrobiology.

For the last few decades, various space agencies of different countries are preparing for missions to conduct a search for life on inaccessible planets in the solar system. In this international endeavour, the outcome of such expedition will be helpful in planning and conceptualising the future interplanetary missions. For example, as a part of our expedition team in Ladakh, scientists from Lulea University, Sweden tested their provisional instrument that will be the part of Mars 2020 mission. The scientists from the Birbal Sahni Institute of Palaeosciences (BSIP), Lucknow, India, opted to study carbon metabolism in the hot-spring biota maintaining a high biomass at a temperature above 70°C which does not support photosynthesis activity. For this purpose, in-situ incubation experiments were conducted on hot-spring biota at Panamik, Chumathang and Puga sites. The collected samples are yet to be analysed, therefore a meeting has been proposed in November-December (2016) to discuss the results and further roadmap of NASA Spaceward Bound India programme. The results will be published in scientific journals and presented at public platform; also, the future plans and the importance of such studies will be telecasted through multimedia for experts and the common man. It will be a great opportunity for the common person to know about such expeditions and their importance. Undoubtedly, the media has an important role in spreading this information.

Besides the scientific activities, the expedition team members interacted with the students at SECMOL, Leh; Panamik Higher Secondary School, Sumur; Nomadic Residential School, Puga and Rangdum Middle School, Leh in Leh-Ladakh region as an outreach activity of this programme, motivating young students to opt science as their favourite subject in higher studies.

The expedition ended on 21st August, 2016 with the valedictory session held at Amity Institute of Aerospace Engineering, Noida. In the concluding session, all the participants presented their evaluations, ideas and future collaboration possibilities.



First Row: Audra Phelps, Binita Phartiyal, Parag Vaishampayan, Ken Silburn, Veeru Kant Singh, Rosalba Bonaccorsi, Shamim Ahmad, Kamakshi Aiyar, Luke Steller, Rakesh Mogul, Annalea Beattie, Johanna Bergstrom-Roos, Kunal Mehra, Restaurant owner.

Second Row: Anushree Srivastava, Chaitanya Mungi, Preeti Nema, Mukund Sharma, Randheer Singh, Niraja Bapat, Sanjay Limaye, Sudha Rajamani, Michael Wing.

Third Row: Mark Boryta, Sanjoy Som, Jen Blank, Savannah McGuirk, Arif Hussain Ansari, Jonathan Clark, Siddharth Pandey.

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