



Astrobiological explorations in the NASA Astrobiology Institute: Earth analogues for Mars and beyond

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Among the terrestrial planets, Mars most resembles Earth and, as has been recently confirmed by NASA's Mars Exploration Rovers and ESA's Mars Express, there is unambiguous evidence for the role of liquid water in shaping the Martian surface. Near surface water ice is plentiful at the middle and polar latitudes, trace amounts of methane have been reported in the atmosphere and young volcanic fields are observed from orbit. Near surface hydrothermal activity remains a distinct possibility as does the presence of aquifers at kilometer depths. Thus, Mars is an increasingly attractive site for astrobiology investigation and this is reflected in the exploration programs of the world's space agencies.

Preparation for the continuing exploration of Mars has a high priority and high presence in the research programs supported by the NASA Astrobiology Institute (NAI) through its sixteen Teams. Much of this research is carried out in the field, at sites that are analogues for Martian environments, with subsequent laboratory analysis of samples. Study sites include those at temperature extremes ; permafrost in the Arctic and Antarctic, hydrothermal features of deep ocean ridges and geothermal springs. Other analogue sites of interest to NAI Teams include the highly arid Atacama Desert, the highly saline basin of Guerrero Negro and the high altitude inactive volcano of Licanabur, where shallow lakes expose microbial ecosystems to extremes of ultra-violet irradiation. In collaboration with our Associate partner, the Centro de Astrobiología, NAI scientists study the extremely acidic, iron rich conditions of Río Tinto in Andalucía. One of the chief sulfates detected by MER Opportunity is jarosite, a hydrated iron sulfate first identified in Spain and named for the Jaroso hydrothermal system in Almería. Several NAI Teams are teasing apart the details of biotic and abiotic geochemical cycles in subsurface mine microbial habitats, providing insights into

the biochemistry of early Earth and ancient Mars environments.

Instrumentation developed for these investigations, both in the lab and in the field, is being customized with extra-planetary analytical field work in view. At a Martian analogue site on the island of Svalbard in the high Arctic, NAI investigators are testing novel life detection instrumentation. Other Institute scientists search for biosignatures in samples from anoxic marine environments and deep gold mines in South Africa. Bringing NAI members together with a broader community of scientists and engineers, the Institute's Astrobiology Technology Focus Group, which welcomes additional participants, held a Mars Life Detection workshop in November, 2004.

Mars, though near and fascinating, is not the only astrobiological target in the Solar System. This presentation will provide information on current accomplishments selected from the diversity of field work and instrument development efforts throughout the NASA Astrobiology Institute, those focused on Mars will be highlighted, but a brief discussion of other activities will also be presented.