Astrobiology- when Microbiology meets Earth Sciences

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Part 1:
Atmospheric biosignatures as tools in search for Life on exoplanets.

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The first exoplanets have been discovered about 20 years ago. Until then, speculations about a second Earth were nothing but science fiction. Thanks to the Kepler mission that has made ground-braking contributions to planetary discovery, we now have a list of almost 2000 confirmed exoplanets. Among the confirmed planets many are found in multiplanetary systems and have earth-like properties in terms of their size, composition, and distance to the central star. The discovery of planetary systems in our galaxy has triggered the need for the development of methods to evaluate whether living organisms are present on exoplanets. Among complementary approaches, the approaches focusing on the study of the atmospheric gas composition have been in the forefront. In particular, the search for gasses that could be produced by organisms, as we know them from Earth, has attracted most attention. The prime candidate is atmospheric oxygen at high concentrations and far from its chemical equilibrium is. We have chosen a different approach that addresses the role of living matter on atmospheric processes such as cloud formation and precipitation. These processes have an impact on the total planetary cloud cover and albedo, which may in future be studied by remote detection techniques. In is seminar I will present our ideas and concepts.

Part 2:
Eroded silicates as sources of hydrogen peroxide, sinks for methane and their implications for bacterial survival.

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The Gas Exchange Experiments (GEx) and the Labeled Release Experiments (LRx) conducted by the Viking Landers demonstrated that the Martian soil releases O_2 upon humidification and contains compounds capable of oxidizing organic matter. This has been attributed to the presence of reactive oxygen species (ROS) in the soil. However, the dominant source of ROS in the Martian soil remains unresolved. Here we show that eroded silicate can oxidize water to the level of hydrogen peroxide (H_2O_2). Taking into consideration the composition of the Martian atmosphere we calculate that reactive wind-eroded silicate on Mars could produce 7 to 31 nmol H_2O_2 per cm^3, which would account for the reactivity observed in the LRx and at least partly account for the O_2-release observed in the GEx. Wind erosion thus seems to have a considerable impact on the reactivity of the Martian soil and therefore could affect the durability of organic compounds as well as living organisms on Mars. Furthermore, the reactivity of wind-eroded silicates should thus be considered a potential selective factor during the history of life on Earth and on other silicate planets. Information of the effect of eroded silicates on the survival of different microbial strains is included. In addition, I will present and discuss data that erosion of silicates not only produces reactive oxygen species but that they may also serve as sinks for methane and thereby contribute to the recently reported dynamics of methane in the Martian atmosphere as well as source for methylated chlorites.