Characterization of microbial life in a natural asphalt lake and its relevance to search for life in the Solar System. Afshin Khan[1] and Dirk Schulze Makuch[1], [1]Washington State University (afshin.khan@wsu.edu)

Introduction: Pitch Lake in Trinidad and Tobago is a natural liquid asphalt desert, which is nourished by a form of petroleum consisting of mostly asphaltines from the surrounding oil-rich region. The hydrocarbons mix with mud and gases under high pressure during upward seepage, and the lighter portion evaporates or is volatilized, which produces a high-viscosity liquid asphalt residue. The residue on and near the surface is a hydrocarbon matrix, which poses extremely challenging environmental conditions to microorganisms characterized by an average low water activity in the range of 0.49 to 0.75, recalcitrant carbon substrates, and toxic chemical compounds. Nevertheless, an active microbial community of archaea and bacteria, many of them novel strains, was found to inhabit the liquid hydrocarbon matrix of Pitch Lake. The microorganisms seem to be concentrated in water droplets and water-rich veins of the upwelling hydrocarbons. These organisms have been programmed by evolution to survive anaerobically in extreme hydrocarbon environments. They thrive with a dense population of 10^7 cells per gram of asphalt [1], which indicates the possibility of microbes using oil hydrocarbons as their prime source of carbon and energy. Mineralogical analysis revealed the presence of Framboidal Pyrite. Framboids are the dominant form of pyrite in modem anoxic environments, such as in argillaceous marine, lacustrine, and salt marsh sediments. Pyrite with framboidal morphology has been collected from, and apparently forms in, the water columns of modem anoxic basins. The morphology is often preserved in ancient sedimentary rocks, for example, in shales, carbonates, and coals since the Proterozoic. In addition, pyrite framboids are found in hydrothermal veins and other ore deposit types. Their occurrence in such diverse environments suggests that the characteristics and development of framboidal texture are the results of robust processes rather than of a narrow set of physical or chemical conditions.

Study of sedimentary pyrite in the form of framboids, euhedral crystals or metasomatic masses has revealed that their surfaces are commonly covered with spheroids of about 50 nm. This applies to all the examples studied, from modern to Proterozoic. These spheroids are interpreted as the pyritized corpses of nannobacterial cells; if correct, this indicates that precipitation of iron sulfide was performed by these dwarf forms of bacteria, often associated with decaying organics.[2]

References:

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2. Robert L. Folk (2005) Nanobacteria and the formation of framboidal pyrite: textural evidence. J. Earth Syst. Sci.114, No. 3, June 2005, pp. 369–374