

Mono Lake and the GFAJ-1 Bacterium

NASA reported in early December 2010 about the discovery of a new bacterium that can metabolize with arsenic. Other living things require phosphorus as well as carbon, hydrogen, oxygen, nitrogen and sulfur biologic compounds to have homeostatic metabolism. NASA claims the DNA molecule itself substitutes arsenic for phosphorus and is the very first organism discovered to have the ability.

Mono Lake is in east central California in Mono County. It has been around about 800,000 years. It receives runoff from the Sierra Nevada Mountain Range. The water accumulated has nowhere to go; it can only evaporate away. The Lake over time can only build up in minerals and salts. The waters in this lake are very salty and have a pH of 9 or more. The lake is rich in arsenic. It is poisonous to most organisms. The Lake can't support fish and only the brine shrimp survives which feeds the migratory birds. This is where the GFAJ-1 bacterium was discovered.

The GFAJ-1 bacterium will have homeostatic metabolism on both phosphorus and arsenic; and, it prefers phosphorus much more than the arsenic. The organism will multiply greatly with the phosphorus. It multiplies slowly with the arsenic. Evidence shows it still needs some phosphorus to thrive. When the bacteria are grown in the laboratory and on arsenic, the bacteria are large and bloated about 2.5 microns long. They appear to store the toxic by-products of arsenic.

Phosphorus is element no 15 on the Mendeleev's periodic table and arsenic is element no 33. The two elements have a similar chemistry. The phosphates are less soluble and more stable than arsenate compounds. The phosphates are essential to support the nucleotides of DNA molecule. This is called the phosphate deoxyribose backbone and it supports the nucleobases such as the adenine-thymine and guanine-cytosine base pairs. The adenosine triphosphate nucleobase and the cytidine triphosphate nucleobase make ester bonds to the backbone. Since arsenates are less stable it makes for a less stable arsenate deoxyribose backbone. The bacterium has to cope somehow to the hostile environment; it may manufacture a waxy substance called poly-beta-hydroxybutyrate to help stabilize homeostatic metabolism by desiccation.

I remain skeptical about all of this. This was reported by Felisa Wolf-Simon who is an astrobiologist for NASA. I think it needs more confirmation by another laboratory to be sure. We need to know how much phosphorus this organism needs to live and how it is able to thrive on the arsenic.

