'Nature's batteries' may have helped power early lifeforms

May 25 2010

Researchers at the University of Leeds have uncovered new clues to the origins of life on Earth.

The team found that a compound known as pyrophosphite may have been an important energy source for primitive lifeforms.

There are several conflicting theories of how life on Earth emerged from inanimate matter billions of years ago - a process known as abiogenesis.

"It's a chicken and egg question," said Dr Terry Kee of the University of Leeds, who led the research. "Scientists are in disagreement over what came first - replication, or metabolism. But there is a third part to the equation - and that is energy."

All living things require a continual supply of energy in order to function. This energy is carried around our bodies within certain molecules, one of the best known being ATP*, which converts heat from the sun into a useable form for animals and plants.

At any one time, the human body contains just 250g of ATP - this provides roughly the same amount of energy as a single AA battery. This ATP store is being constantly used and regenerated in cells via a process known as respiration, which is driven by natural catalysts called enzymes.

"You need enzymes to make ATP and you need ATP to make enzymes," explained Dr Kee. "The question is: where did energy come from before either of these two things existed? We think that the answer may lie in simple molecules such as pyrophosphite which is chemically very similar to ATP, but has the potential to transfer energy without enzymes."

The key to the battery-like properties of both ATP and pyrophosphite is an element called phosphorus, which is essential for all living things. Not only is phosphorus the active component of ATP, it also forms the backbone of DNA and is important in the structure of cell walls.

But despite its importance to life, it is not fully understood how phosphorus first appeared in our atmosphere. One theory is that it was contained within the many meteorites that collided with the Earth billions of years ago.

"Phosphorus is present within several meteoritic minerals and it is possible that this reacted to form pyrophosphite under the acidic, volcanic conditions of early Earth," added Dr Kee.

The findings, published in the journal *Chemical Communications*, are the first to suggest that pyrophosphite may have been relevant in the shift from basic chemistry to complex biology when life on earth began. Since completing this research, Dr Kee and his team have found even further evidence for the importance of this molecule and now hope to team up with collaborators from NASA to investigate its role in abiogenesis.

More information: The findings, entitled: 'On the prebiotic potential of reduced oxidation state phosphorus: the H-phosphinate-pyruvate system', are published in *Chemical Communications* - DOI:10.1039/c002689a