Profile: Robert Hazen
Code Name: Hazenite

According to Robert Hazen, a mineralologist and astrobiologist at the Carnegie Institution of Washington's Geophysical Laboratory, the ideal origin of life research would be to "find and demonstrate a geochemically plausible way of creating a group of molecules that spontaneously organize themselves to make its own copies" (Hazen). Beginning from a young age, Hazen was fascinated by long extinct arthropods and trilobites, propelling his further research on the role of minerals in the origin of life. He is currently investing how the first organic chemicals formed then found each other four billion years ago.

Hazen received his B.S. and M.S. in Earth Science at the Massachusetts Institute of Technology in 1971 preceding his Ph.D., which he acquired at Harvard University in the field of Mineralogy and Crystallography in 1975. His postdoctoral Fellowship with NATO at Cambridge University confirmed his current scientific inquires transforming scientific advances in the quest for life's origins. Hazen's recent book, *Genesis*, lends insight to the way his mind works and his fervent desire to understand from the very beginning.

Since 1996, Hazen has been dedicated to the mineral interface of the origin of life. Any plausible origins scenario must be consistent with geochemical constraints and so Hazen developed a new approach to mineralogy called Mineral Evolution, which investigates the co-evolution of the geosphere and biosphere.

Hazen and his team have been using "pressure bombs," metal containers that pressurize and heat minerals to the equivalent of the environment inside the earth

in order to test if this type of setting might be where life ultimately began (Fields). These “pressure bombs” are extremely dangerous – if something were to go wrong the explosion would destroy a large part of the building. Therefore, the user operates the experiment behind an armored barrier (Fields).

During Hazen’s first experiment with the “pressure bomb,” his small concoction of water, pyruvate, and a carbon dioxide producing powder had turned into thousands of different compounds. Later experiments proved that the combination of nitrogen, ammonia, and other early earth molecules ultimately created tons of organic molecules including amino acids and sugars (Fields). Hazen was able to create the important building blocks of life. These experiments showed that the basic molecules of life are able to form in volcanoes and near hydrothermal vents (Fields). It is also possible that some of these molecules came from outer space for space rocks contain compounds similar to sugars, fatty acids, and nucleobases found in RNA and DNA (Fields).

In an interview in 2000, Hazen stated that “making the basic building blocks of life is easy,” the hard part is how were they perfectly incorporated as so to create living things. “We’ve got a prebiotic ocean and down in the ocean floor you’ve got rocks…and basically there’s molecules here that are floating around in solution, but it’s a very dilute soup. So, the chances of a molecule over here bumping into this one, and then actually a chemical reaction going on to form some kind of larger structure is just infinitesimally small,” Hazen explains. The current understanding is that rocks might have been what brought the amino acids find each other.

Hazen believes his work is not limited to the study of the beginning of life: "Amino-acids-sticking-to-crystals is everywhere in the environment. It's every rock, it's every soil, it's the walls of the building, it's microbes that interact with you teeth and bones, it's everywhere." Life has played a huge role in geology and how the biosphere and geosphere co-evolved. Most of the time Earth was ruled by microbes; It took a long time for microbial life, which arose about 4 billion years ago, to have a considerable effect on the Earth – the early microbes acted as catalysts, propelling chemical reactions on Earth's volatile surface (Hazen).

Hazen is not only one of the leading scientists investigating the origin of life, but he is an honest and curious human. Hazen is eager to give lectures on his findings, and when he does get the chance to speak, he shines – he stands up straight, he enunciates, he easily receives respect and attention. This command could stem from his many years spent as a professional trumpeter. Music is not his only personal pleasure; Hazen also enjoys collecting trilobites and brass band artwork (some of his collections are on display at The National Museum of American History and The National Museum of Natural History). He also enjoys writing 18th- and 19th-century poems about geology, some of which have been published. Hazen is a great and inquisitive man with many interests. It takes patients and dedication to be a great scientist, but it takes innate curiosity and the genuine joy in understanding to be a groundbreaking one.