# Report on samples taken by remote probe from a subterranean cryovolcanic chamber on the satellite JEN 658204 Zeta-2


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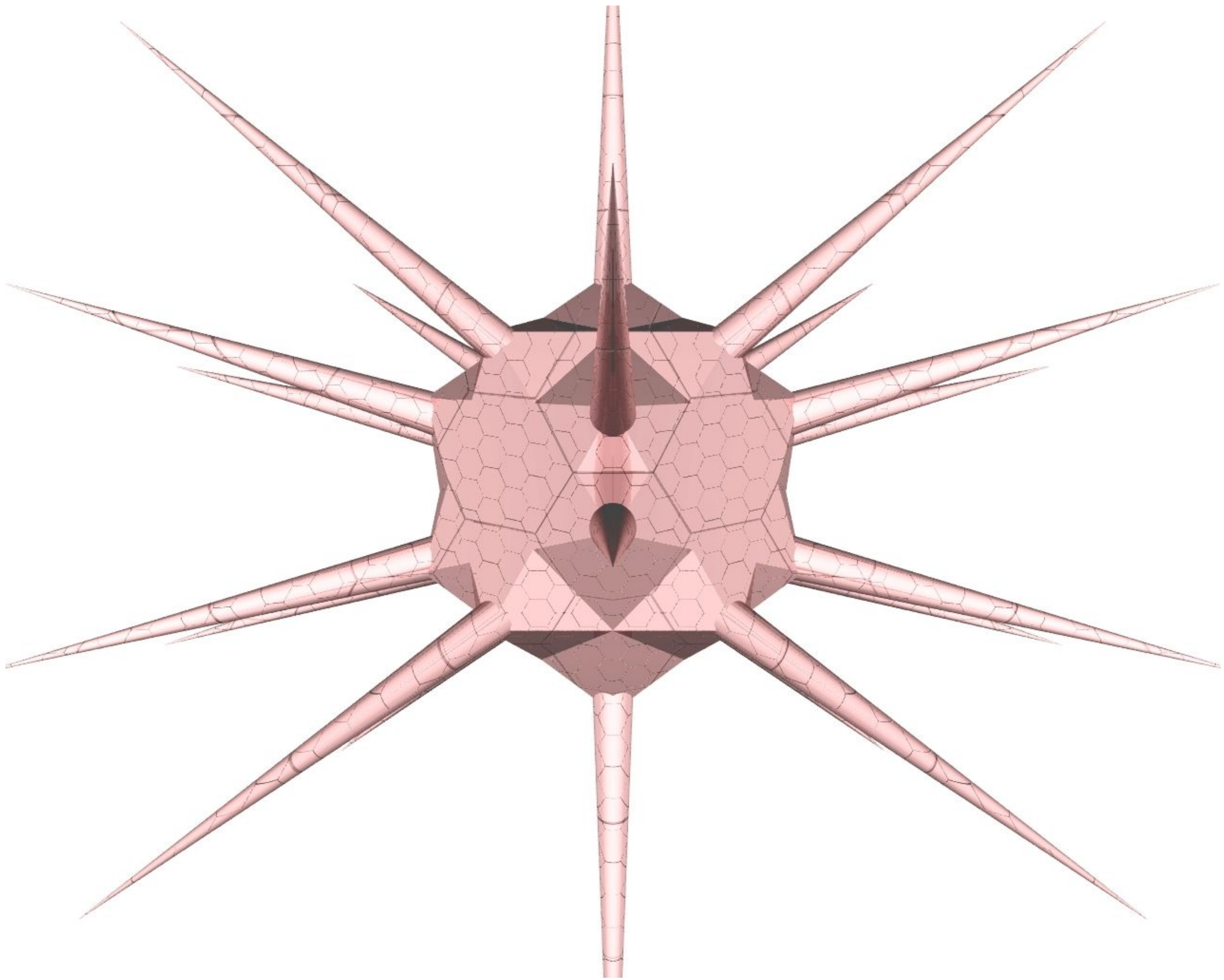
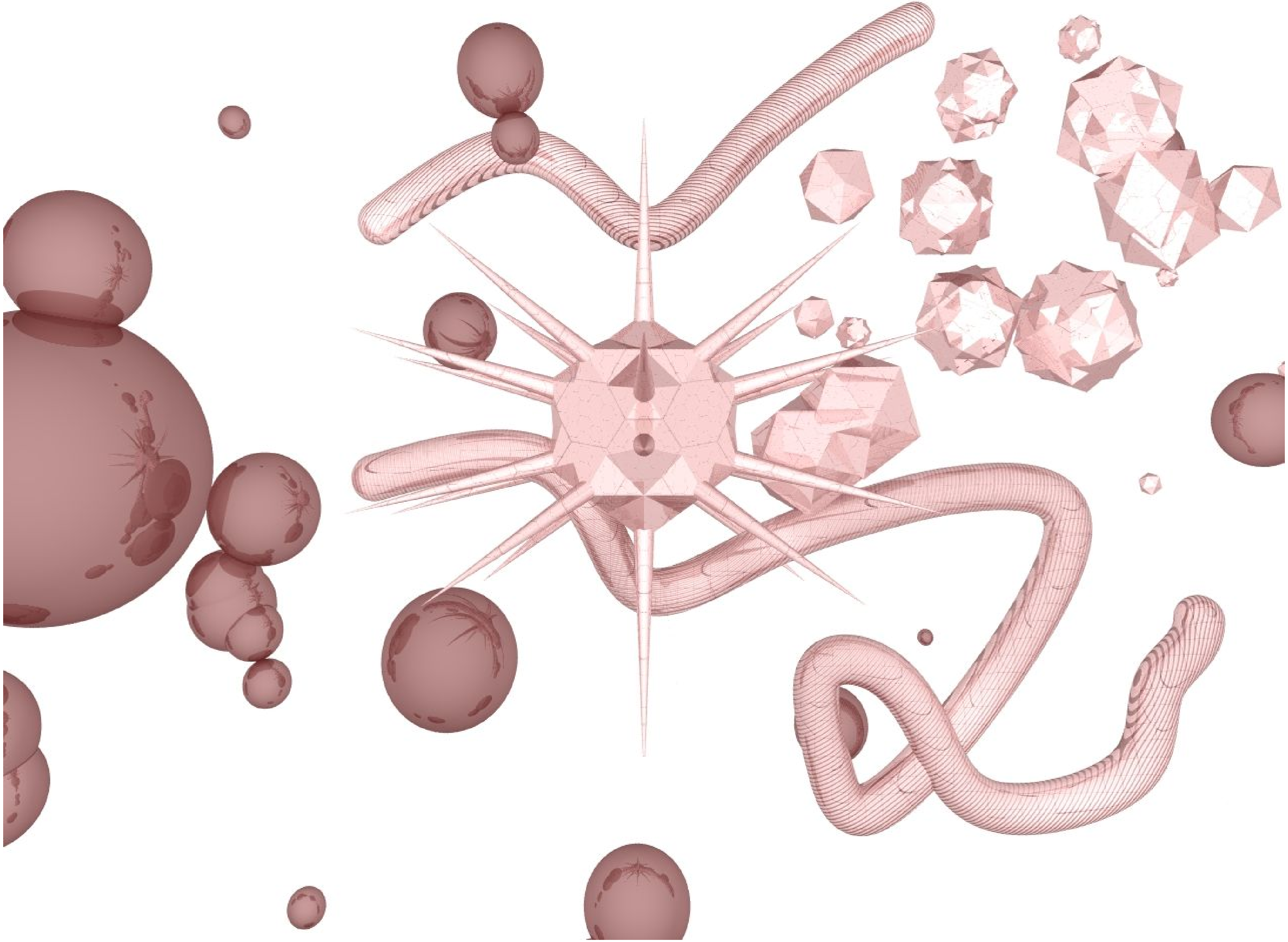
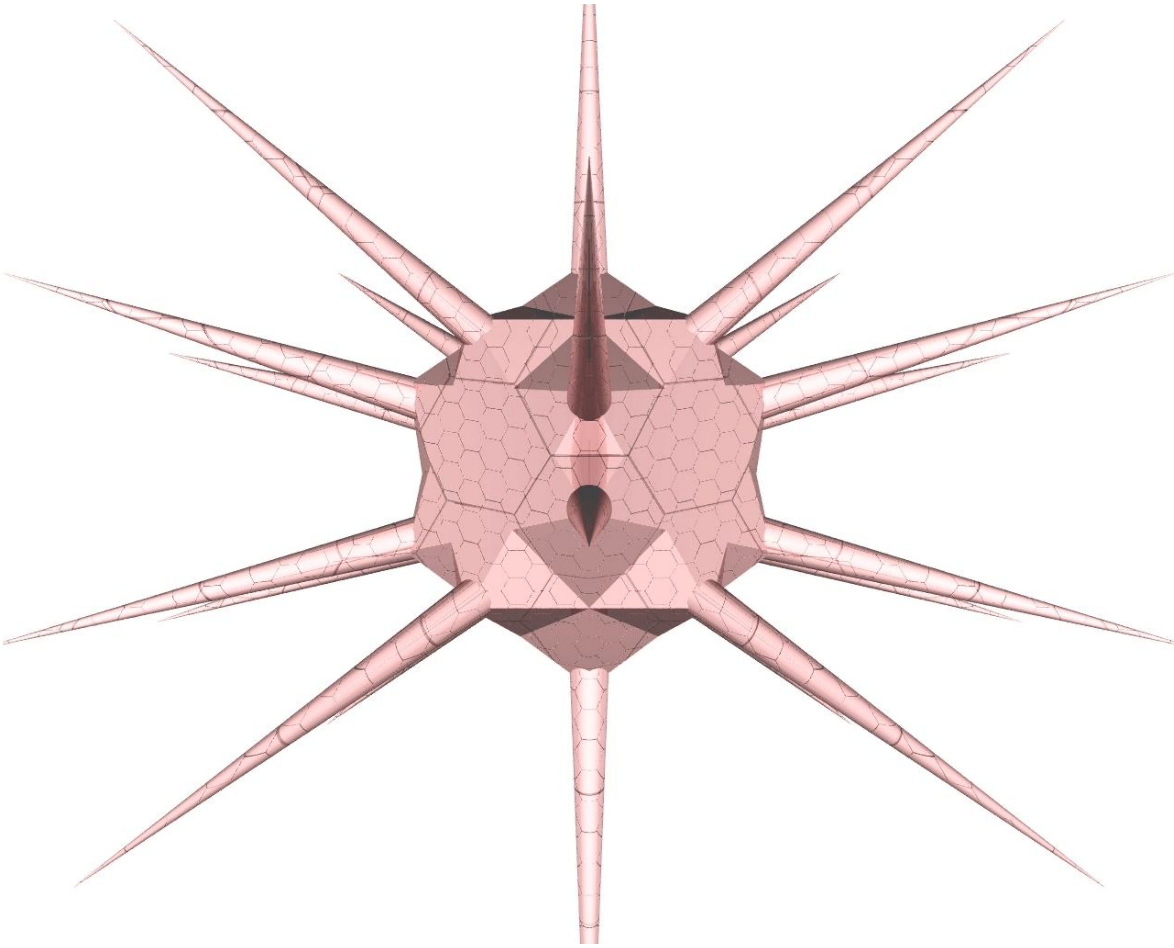
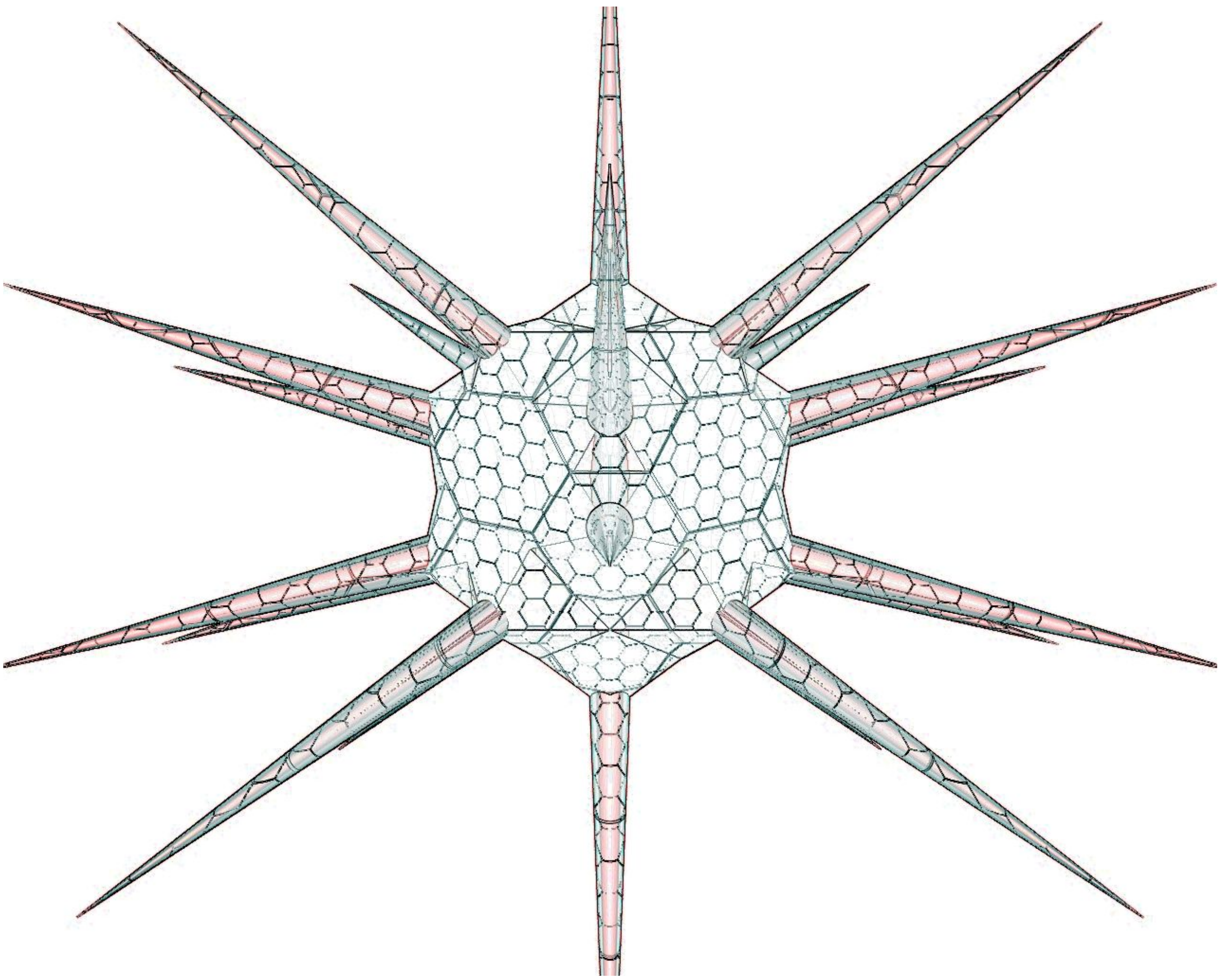
***UGA Starstrider***









Analysis of the liquid confirmed that it was an ammonia rich solution at -42°C. Analysis of the foam revealed a high density of coacervate microspheres, ranging mostly from 1 to 10 micrometres. These microspheres comprised a variety of polymers, principally polyphosphenes (polymers of molecules comprised principally of phosphorus and nitrogen containing P=N double and P–N single bonds). These microspheres are predicted to be ephemeral, despite their apparent ability to grow by selectively absorbing chemicals from the surrounding ammonia solution which they synthesise into a variety of polymers using polyphosphane and polyphosphene catalysts and despite their apparent ability to multiply by budding and binary fission. Under the conditions present these microspheres probably assemble spontaneously. This chemistry is consistent with pre-cellular prebiotic forms on cold worlds where mean temperatures are below the freezing point of water.

Further analysis revealed the presence of smaller acellular particles, varying from 20 to 200 nanometres in diameter. These particles were often well-formed, comprising a shell of polyphosphene subunits in a regular array with spherical, cubic, octahedral or dodecahedral symmetry. Filamentous particles were also detected. These geometries are the simplest and most stable ways to enclose an interior space with repeating subunits. The interior of these hollow particles contained polythiophosphenes (PTPs) (polymers of molecules containing phosphorus, nitrogen and sulphur in their skeletons). These particles appeared to be inert, but further analysis revealed that once inside the ephemeral microspheres they unfold to release their PTP cargo. This naked PTP catalysed the synthesis of several catalytic polyphosphanes and also its own synthesis and the synthesis of the shell polyphosphenes. They rely upon the selective permeability of the microsphere membranes to create a favourable and an enclosed environment where necessary molecules can be sequestered and concentrated. They also rely upon crude polythosphanes and polyphosphenes present within the microsphere, acting as catalysts of very low efficiency, but with considerable diversity. When the microspheres eventually run-down metabolically, which they do after several generations, or when the environmental conditions change, causing degradation of the microsphere membranes, the PTPs become enclosed in polythosphene shells which spontaneously assemble around them. When the damaged microspheres disperse, the polyphosphene shells serve as protective containers for the PTP molecules, until new microspheres are encountered or until conditions again favour the assembly of microspheres. It is not certain whether the particles are able to penetrate intact microspheres, or whether the microspheres form around them.

Thus, it appears that we have a primitive system of pre-cellular (acellular) life. The polythosphene/PTP particles help protect the PTP molecules which are acting as genetic molecules, encoding the information for particle production. The microspheres resemble those that form spontaneously in the laboratory under certain conditions and are prebiotic. Together the microspheres and the polythosphene/PTP particles constitute a living system. The latter are in many ways similar to virus particles which infect true cells rather than microspheres. This lends evidence to the notion that viruses may be descendents of the first pre-cellular life-forms on their respective worlds. The protection of the PTP genetic material in these acellular particles allows it to endure and evolve despite the instability of the microspheres. Eventually, this material may evolve means of stabilising the microspheres, in which case the first cells would be born.

Polyphosphenes have several advantages of C-based organics, namely the abundance of nitrogen (as ammonia) and the ability of polyphosphenes to maintain structural flexibility at these low temperatures, enabling them to function better as catalysts than nucleotides or proteins. Even so, at these low temperatures evolution is expected to be slow. At this stage of biotic evolution, chemical reactions are also much slowed by the fact that many of the catalysts are not yet optimised. The question remains as to how long a world remains in this primordial stage, and in the case of JEN 658204 Zeta-2 there is still the possibility that life is evolving more rapidly in a deep subterranean ocean of ammonia or water. Otherwise, we predict that evolution on this world will progress at about one hundredth the rate of a warm life-bearing planet.