Pandoravirus: Missing link discovered between viruses and cells

October 14 2013

Researchers at IGS, the genomic and structural information laboratory (CNRS/Aix-Marseille University), working in association with the large-scale biology laboratory (CEA/Inserm/Grenoble Alpes University) have just discovered two giant viruses which, in terms of number of genes, are comparable to certain eukaryotes, microorganisms with nucleated cells. The two viruses – called "Pandoravirus" to reflect their amphora shape and mysterious genetic content – are unlike any virus discovered before. This research appeared on the front page of *Science* on July 19, 2013.

With the discovery of Mimivirus ten years ago and, more recently, *Megavirus chilensis*, researchers thought they had reached the farthest corners of the viral world in terms of size and genetic complexity. With a diameter in the region of a micrometer and a genome incorporating more than 1,100 genes, these giant viruses, which infect amoebas of the *Acanthamoeba* genus, had already largely encroached on areas previously thought to be the exclusive domain of bacteria. For the sake of comparison, common viruses such as the influenza or AIDS viruses, only contain around ten genes each.

In the article published in *Science*, the researchers announced they had discovered two new giant viruses:

- Pandoravirus salinus, on the coast of Chile
- Pandoravirus dulcis, in a freshwater pond in Melbourne, Australia

Detailed analysis has shown that these first two Pandoraviruses have virtually nothing in common with previously characterized giant viruses. What's more, only a very small percentage (6%) of proteins encoded by *Pandoravirus salinus* are similar to those already identified in other viruses or cellular organisms. With a genome of this size, *Pandoravirus salinus* has just demonstrated that viruses can be more complex than some eukaryotic cells. Another unusual feature of Pandoraviruses is that they have no gene allowing them to build a protein like the capsid protein, which is the basic building block of traditional viruses.

Despite all these novel properties, Pandoraviruses display the essential characteristics of other viruses in that they contain no ribosome, produce no energy and do not divide.

This groundbreaking research included an analysis of the *Pandoravirus salinus* proteome, which proved that the proteins making it up are consistent with those predicted by the virus' genome sequence. Pandoraviruses thus use the universal genetic code shared by all living organisms on the planet.

This shows just how much more there is to learn regarding microscopic biodiversity as soon as new environments are considered. The simultaneous discovery of two specimens of this new virus family in sediments located 15,000 km apart indicates that Pandoraviruses, which were completely unknown until now, are very likely not rare.

It definitively bridges the gap between viruses and cells – a gap that was proclaimed as dogma at the very outset of modern virology back in the 1950s.

It also suggests that cell life could have emerged with a far greater variety of pre-cellular forms than those conventionally considered, as the new giant virus has almost no equivalent among the three recognized

domains of cellular life, namely eukaryota (or eukaryotes), eubacteria, and archaea.

More information: "Pandoraviruses: Amoeba viruses with genomes up to 2.5 Mb reaching that of parasitic eukaryotes". Nadège Philippe, Matthieu Legendre, Gabriel Doutre, Yohann Couté, Olivier Poirot, Magali Lescot, Defne Arslan, Virginie Seltzer, Lionel Bertaux, Christophe Bruley, Jérome Garin, Jean-Michel Claverie, Chantal Abergel. *Science*. DOI: 10.1126/science.1239181

Provided by Commissariat a l'Energie Atomique (CEA)