

The Ribosomal Protein Cluster Organization In *Asgard* Archaea – An Analysis

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Introduction: It has been proposed that the recently discovered superphylum of *Asgard* archaea may represent a historical link/bridge between the *Archaea* and *Eukarya*. The arrangement of genes in genomes is a window to understand how organisms are related. In particular, the translation machinery and the genes that encode the same have a long evolutionary history. In order to gain further insight into the evolutionary position of the *Asgard* archaea, the genome order of ribosomal protein coding genes was analyzed. The *Asgard* archaea were compared with non-*Asgard* archaeal and bacterial genomes.

Results: A core of co-occurring 15 genes belonging to the segment of the *S10* and *spc* cluster (which are characterized and established as operons in *Bacteria*), was identified as conserved in gene order, arrangement and genome location in *Asgard archaea*, non-*Asgard archaea* and *Bacteria*. This core occurs as a complete set in the genomes of *Lokiarchaeota* MK-D1 (Candidatus *Promethoarchaeum syntrophicum*), and Candidatus *Odinarchaeota* archaeon LCB_4. The genome assemblies of the other *Asgard* genomes are incomplete and occur in multiple contigs (>50) and hence this cluster is found in sections across contigs, with a section often either ending or beginning a contig.

The cluster organization is indicative of co-occurrence, if the genome was complete. A second smaller cluster comprising the homologs of the most conserved genes of the bacterial *S10* operon/cluster namely, *uS10-uL3-uL4-uL23-uL2* occurs independently on the *Asgard* genomes, separate from the rest, a feature shared by many non-*Asgard* archaea as well.

Other clusters. A new cluster *L7ae-infB* was identified to co-occur with the minor *S24e-S27ae* cluster in the two complete *Asgard* genomes. The *L7ae-infB* cluster co-occurs with the *S24e-S27ae* cluster in some (non-*Asgard*) *Crenarchaeota* (*Desulfurococcaceae*) and *Euryarchaeota* (*Methanobacteriaceae*), while it co-occurs with the (*Alpha operon*) *L18e* cluster in some (non-*Asgard*) *Euryarchaeota* (*Halobacteriaceae*).

Overall, the organization of the most universal and highly conserved *S10* and *spc* cluster in *Asgard* archaea resembles that of the non-*Asgard* *Thaumarchaeota* and the *DPANN* group.

References:

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