THE SSU IS FROM MARS, THE LSU IS FROM VENUS. A. S. Petrov[1], Burak Gulen[2], L. D. Williams[1], [1]School of Chemistry and Biochemistry, Georgia Institute of Technology, Atlanta, GA 30332-0400, anton.petrov@biologygatech.edu, [2]Department of Chemistry, Technical University of Munich, Munich, Germany, 85748.

We previously described a three dimensional comparative method that allowed temporal ordering of events in the evolution of the large ribosomal subunit (LSU) rRNAs [1]. In these rRNAs, 'insertion fingerprints' are seen to mark sites of known rRNA expansions. A similar accretion model has been developed for the evolution of the SSU [2].

The evolution of the ribosome undergoes via elementary accreation processes that can be grouped into six phases (Fig. 1). In Phases 1 and 2, forming stable catalytically active units; the subunits evolve independently from each and temporal relationships between the subunits are undetermined. In Phase 3, subunit association is initiated, mediated by the recent expansion from minihelix to L-shape tRNA. In Phase 4, the ribosome is a non-coding diffusive ribozyme with proto-mRNA as a positioning cofactor. In Phase 5, the ribosome further expands to an energy-driven, translocating, decoding machine. In Phase 6, the ribosome matures, marking completion of the common core.

Despite similar accretion mechanisms that drive the eveolution of the ribosomal subunits, the SSU and LSU show significant differences in structure, morphology and function:

i. *Domain Structure*. The SSU is dendritic and the LSU is monolithic.

ii. *Flexibility*. The SSU is intrinsically flexible, while the LSU is rigid except on its periphery [3].

iii. *Shape*. The SSU is oblate spheroid and the LSU is hemispheroid

iv. Termini Strand Association and Dissociation. The 3' and 5' termini of the SSU rRNA are dissociated, while the termini of the LSU are associated via base pairing.

v. *The CPK*. A central pseudoknot and the separated strand termini form the ancestral core of the SSU, in comparison to simple stem-loop topology in the core of the LSU.

vi. *Expansions*. Over more recent evolution (*i.e.*, in eukaryotes) the LSU has continued to expand and gain function, while the SSU has undergone far more modest expansion.

Observations inferred from the accretion model suggested that some subunit-specific characteristics arise from singular events that took place early in ribosomal evolution and directed long-term outcomes.

References: [1] A. S. Petrov et al. (2014). *Proc. Natl. Acad Sci. U. S. A, 111*, 10251-10256. [2] A. S. Petrov et al. (2015). *Proc. Natl. Acad Sci. U. S. A, 112*, 15396-15401. [3] M. Paci, G. E. Fox, (2015) *Nucleic Acid Research, 43*, 4640-4649.

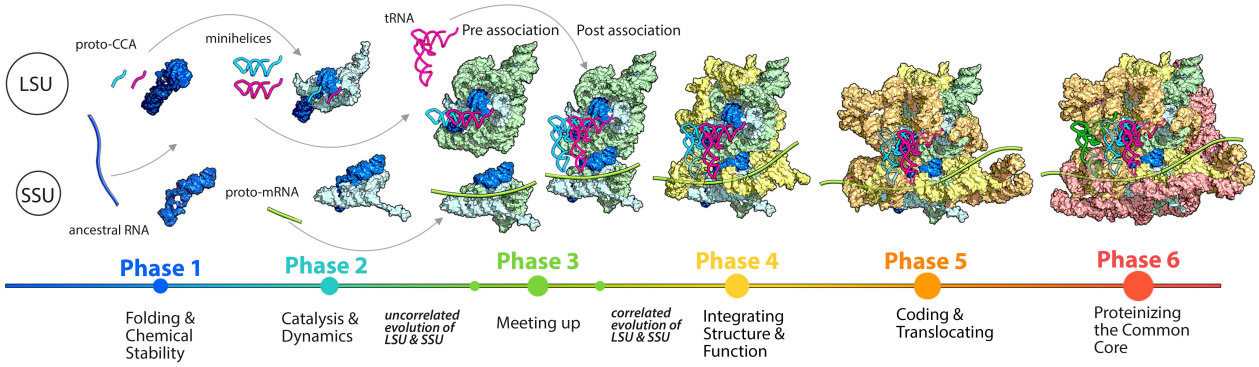

Figure 1. The first six phases of the accretion model of ribosomal evolution [2].