UNIVERSITÄT DUISBURG ESSEN

Open-Minded

From Molecules to Pre-LUCA World

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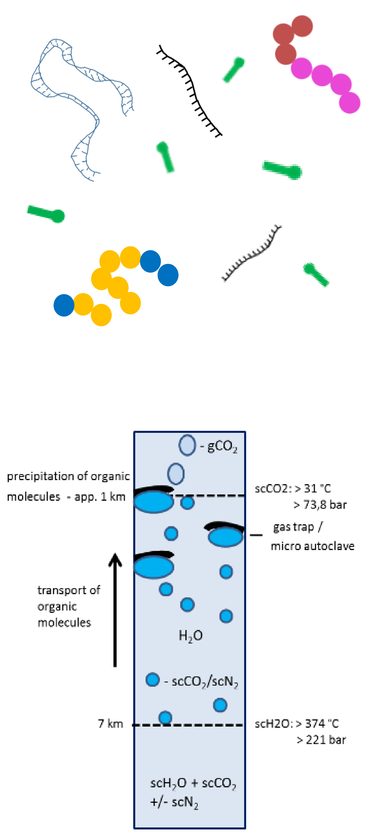
Phase I

Formation and Accumulation

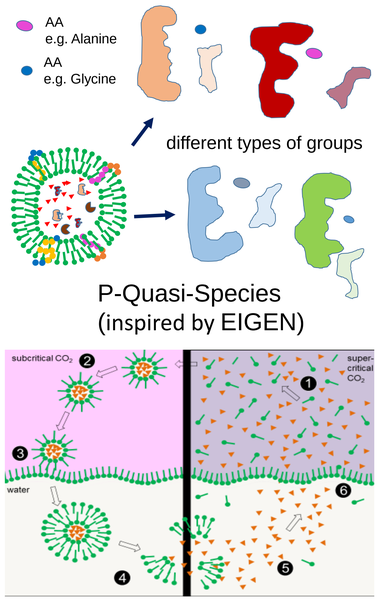


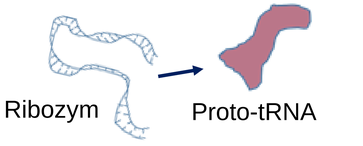
Documents from fluid inclusions

- Separation of $scCO_2$ bubbles from hydrothermal water
- Collection of organic molecules
- Reaction to peptides and nucleotides in $scCO_2$
- Enrichment of molecules in micro-autoclaves after change from $scCO_2$ to gCO_2
- pH 3,3 to 6 depending on mixture of $scCO_2$ and scN_2 and phase transitions

Phase II

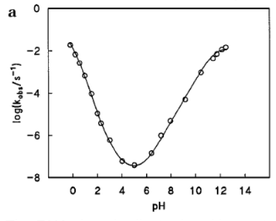
Selection





Partly experimentally proven

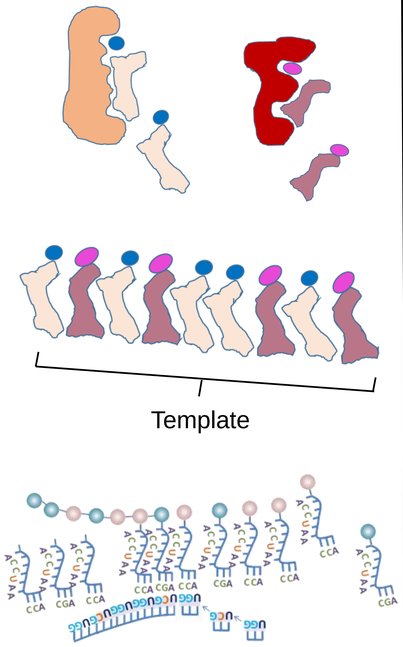
- Cyclic vesicle formation and selection of peptides
- Development of ribozymes



The RNA phosphodiester bond is most stable at pH 4-5 at 90°C. Hydrolysis of the inucleoside 3',5'-UpU at 90°C as afunction of pH. Oivanen et al. (1998)

Phase III

Random combination



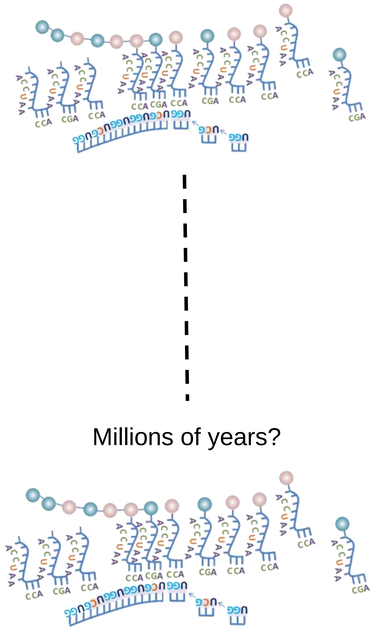
Approach for storage information about a random aminoacid chain

-- Hypothetical assumption to show a possible solution for the chicken/egg dilemma --

- Contact between peptide world and RNA world
- Semi-specific linking from aminoacid to a cognate proto-tRNA
- Random combination to peptide
- Supply of a template
- Storage of information in an emerging RNA

Phase IV

Long lasting combination check

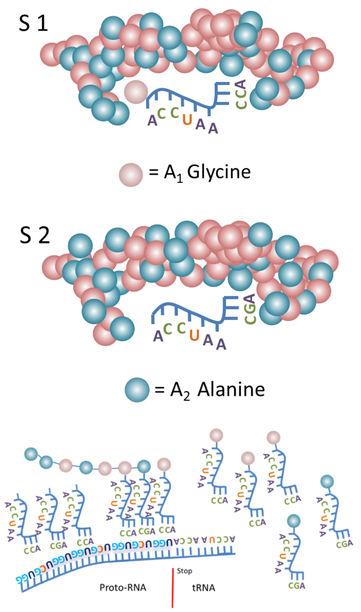


The possible result are two synthetases with two identical aminoacid species and different sequences loading two specific tRNAs

- Numerous combinations of aminoacids with probably most common species glycine and alanine
- Some combinations are stored in emerging RNA

Phase V

Principles of life



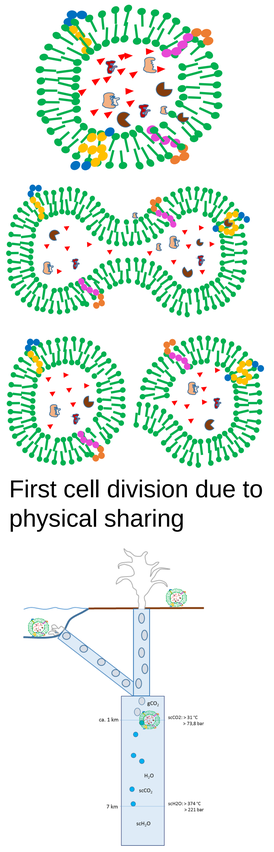
Replication of synthetases S1, S2 from Proto-RNA, parallel to Phase III with new random sequences. Herewith a development to synthetases S3, S4, S5, S6 … is possible.

Process from Phase II

- Two resulting synthetases from Phase IV with specific linking of glycine and alanine
- Information about sequences are stored in proto-RNA which is linked with uncharged tRNAs

Phase VI

Pre-LUCA World



First cell division due to physical sharing

- Loading of all nescessary molecules in excess during vesicle formation process
- Reproduction of all main compounds
- Physical sharing
- Continued reproduction in both vesicles

Schreiber U., Locker-Grütjen O., Mayer C. (2012). Hypothesis: Origin of Life in Deep-Reaching Tectonic Faults. Prebiotic Chemistry. Origins of Life and Evolution of Biospheres 42(1), 47 – 54.

Mayer, C.; Schreiber, U.; Dávila, M.J.; Schmitz, O.J.; Bronja, A.; Meyer, M.; Klein, J.; Meckelmann, S.W. Molecular Evolution in a Peptide-vesicle System Eigen M., Schuster P. (1979). The Hypercycle – A Principle of Natural Self-Organization. Springer, Berlin 1979.

Oivanen, M., Kuusela, S., Lönnberg, H. (1998). Kinetics and Mechanisms for the Cleavage and Isomerization of the Phosphodiester Bonds of RNA by Brønsted Acids and Bases *Chem. Rev.*, *98,* 961-990.