Experimental evolution of functional vesicles in hydrothermal environments

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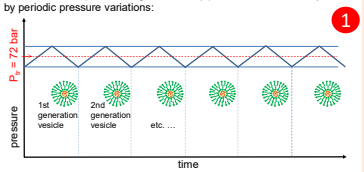
evolution experiment

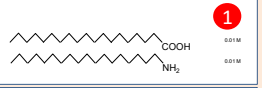
induction of multiple vesicle generations (up to 10 000 in 3 weeks) by periodic pressure variations: 1



conditions for peptide formation: 2

pH ~ 3, T = 120°C

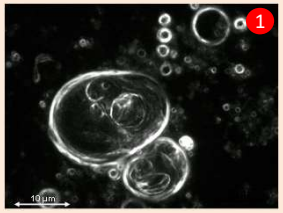
water + carbon dioxide 1



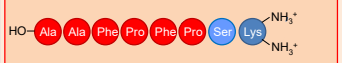
2

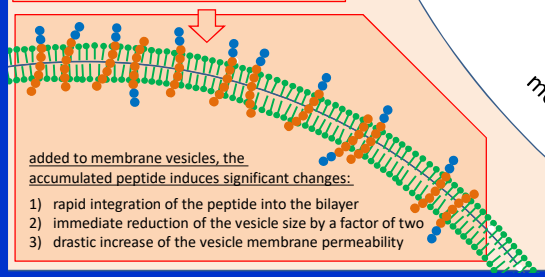
polar:	non-polar: (0.007 M each)
Glycine	Alanine
Serine	Proline
Threonine	Valine
Aspartic acid	Leucine
Glutamic acid	Isoleucine
Lysine	Phenylalanine

1



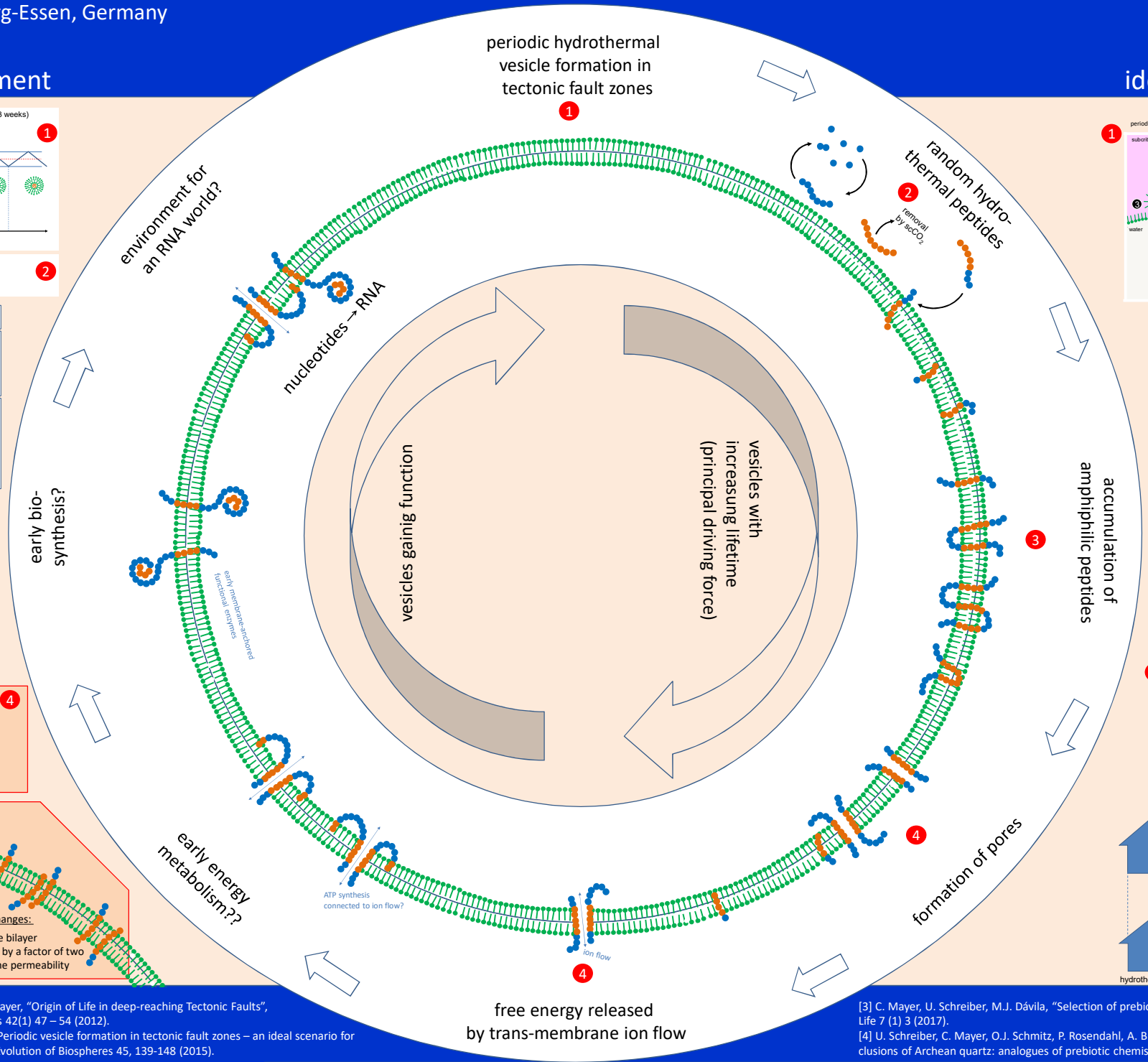
after several hundred generations: 3 4
particularly successful peptide species:



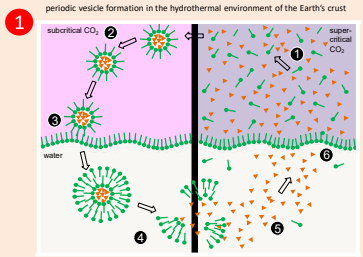


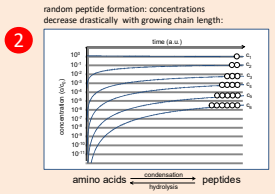
added to membrane vesicles, the accumulated peptide induces significant changes:

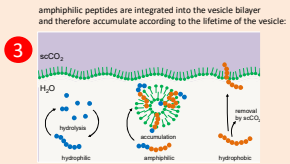
1) rapid integration of the peptide into the bilayer
2) immediate reduction of the vesicle size by a factor of two
3) drastic increase of the vesicle membrane permeability

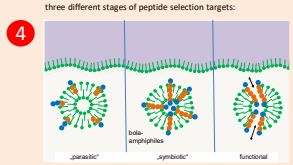


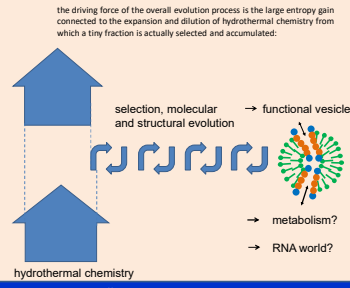
idea and simulation











[1] U. Schreiber, O. Locker-Grütjen, C. Mayer, "Origin of Life in deep-reaching Tectonic Faults", Origins of Life and Evolution of Biospheres 42(1) 47 – 54 (2012).
[2] C. Mayer, U. Schreiber, M.J. Dávila, "Periodic vesicle formation in tectonic fault zones – an ideal scenario for molecular evolution", Origins of Life and Evolution of Biospheres 45, 139-148 (2015).
[3] C. Mayer, U. Schreiber, M.J. Dávila, "Selection of prebiotic molecules in amphiphilic environments", Life 7 (1) 3 (2017).
[4] U. Schreiber, C. Mayer, O.J. Schmitz, P. Rosendahl, A. Bronja et al., "Organic compounds in fluid inclusions of Archean quartz: analogues of prebiotic chemistry on Earth", PLOS ONE 10.1371 (2017).