Prebiotic Chemistry & Early Earth Environments

THE GOAL

Investigate the delivery, synthesis, and fate of small molecules under the conditions of the Early Earth and the subsequent formation of proto-biological molecules and pathways that lead to systems harboring the potential for life.

PC

Precursors

- HCN
- Formaldehyde
- Phosphate
- CH_4, H_2
- Thiols

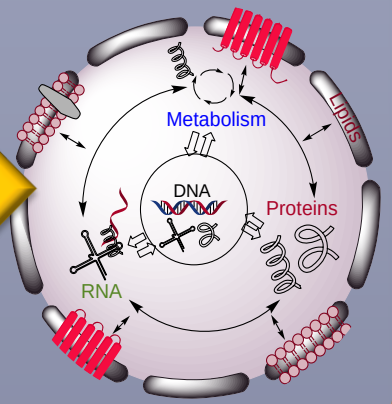
Build Blocks

- Amino acids
- Hydroxy Acids
- Nucleobases
- Fatty Acids
- Metabolites

Oligomers

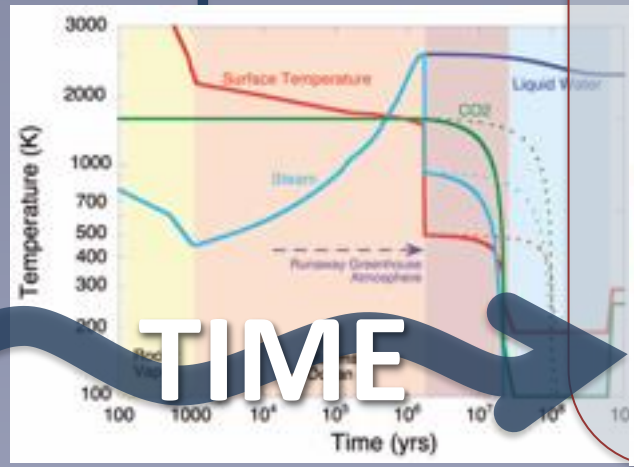
- Thio/depsipeptides
- Proto-RNA
- Carbohydrates
- Lipids
- Geo/metabolism

Life



E_3

Atmospheric Evolution

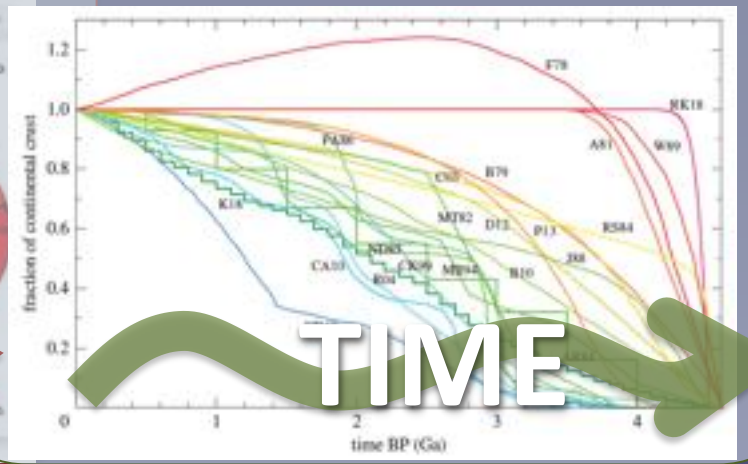


TIME

Impact History

TIME

Crustal Evolution



TIME

How are we promoting our enterprise?

Seminar Series/YouTube Channels
Workshops/Workshop Reports
Sessions at National Meetings (AGU/AbSciCon)
Special Journal Issues
Resurrect OOL GRC
Minisymposia
Self-Analysis

REGISTER FOR THE 2024 SEMINAR SERIES HERE!

Organizers: James Eguchi, Albert Fahrenbach, David Fialho, Rebecca Guth-Metzler

2024 Seminar Series #31-40 (coming soon)

2023 Seminars #21-30

2022 Seminars #11-20

2021 Seminars #1-10

PCE3 Prebiotic Chemistry

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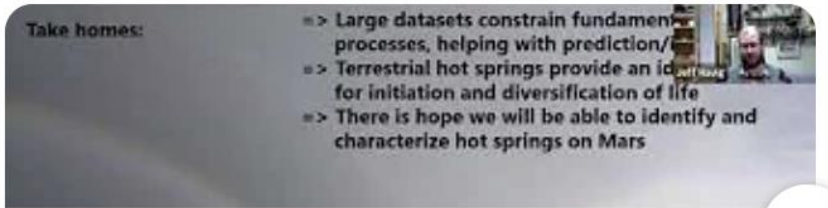
For You



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1 Overview
PCE3 Prebiotic Chemistry • 1.6K views • 3 years ago

2 Overview - Biochemistry meets Prebiotic Chemistry - Ram Krishnamurthy
PCE3 Prebiotic Chemistry • 1.9K views • 3 years ago

3 Genetics - Hannes Mutschler
PCE3 Prebiotic Chemistry • 490 views • 3 years ago

1.9K views

4 Metabolism - George Cody
PCE3 Prebiotic Chemistry • 572 views • 3 years ago

5 Chemical Evolution - Moran Frenkel-Pinter
PCE3 Prebiotic Chemistry • 1.6K views • 3 years ago

1.6K views

Frontiers in Prebiotic Chemistry and Early Earth Environments

Workshop Report | Published: 07 July 2022
Volume 52, pages 165–181, (2022) Cite this article

Origins of Life and Evolution of Biospheres

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Ulrich F. Müller, Jamie Elsila, Dustin Trail, Saurja DasGupta, Claudia-Corina Giese, Craig R. Walton, Zachary R. Cohen, Tomislav Stolar, Ramanarayanan Krishnamurthy, Timothy W. Lyons, Karyn L. Rogers & Loren Dean Williams

2022 Workshop

2021 Workshop

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PCE3 Session at the San Francisco AGU Meeting

Exploring the Intersection of Early Earth Environments, Prebiotic Chemistry, and Life's Emergence

Dec 11, 2023 10:20 AM Pacific Time (US and Canada)

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Exploring the Intersection of Early Earth Environments, Prebiotic Chemistry, and Life's Emergence

The Washington Post
Democracy Dies in Darkness

Giant space rock made Earth's ocean boil but also helped early life

By Joel Achenbach

December 19, 2023 at 6:00 a.m. EST


AbSciCon
Providence, Rhode Island, USA
5-10 May 2024

Townhall at AbSciCon 2024

Life's Origins, Distribution and Detection

Timothy W. Lyons (timothyl@ucr.edu, University of California, Riverside); Karyn L. Rogers (rogerk5@rpi.edu, Rensselaer Polytechnic Institute); Ramanarayanan Krishnamurthy (rkrishna@scripps.edu, Scripps Research); Loren Dean Williams (ldw@gatech.edu, Georgia Institute of Technology).

Around four billion years ago, chemical and geological processes on the ancient Earth established the molecular keystones of biology, paving a path to life. The complexity of organic molecules increased, leading ultimately to RNA, DNA, protein, polysaccharides, membrane-forming amphiphiles, and the roots of biology. Environmental energy was harvested and invested in functional biopolymers. In this Townhall, representatives from NASA Research Coordination Networks will discuss current views, including new models of processes that might have initiated and nurtured life on Earth and life elsewhere in the universe. The session will focus in particular on physical environmental and chemical backdrop of life's beginnings. Discussions will also explore the possibility of life elsewhere in the solar system and beyond, and on methods to detect it. The town hall will appeal to a wide astrobiological audience by highlighting relationships between planetary evolution, prebiotic chemistry and

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Special Issue 1 (in Astrobiology) on Early Earth Environments

TOC

Well populated with excellent authorsbv(diverse/early-mid career).

1. Forward Chapter: volume introduction, overarching motivations, etc., with brief intro to each chapter.
2. Stellar evolution and earliest solar system history.
3 and 4. Accretionary history/delivery, planetary, and Hadean geodynamics, Part 1 and Part 2
5. Impact history and related surface evolution.
6. Physical and chemical crustal evolution.
7. Early atmospheres and oceans.
8. Geologic settings, early crust/terranes, lithospheric fluids.
9. Terrestrial abiotic synthesis of simple precursor molecules (atmosphere, surface, and subsurface reactions, etc.) (e.g., HCN, CH_4, acetate, CO_2 reactions; first steps)
10. Formation of building blocks (e.g., sugars, nucleotides, amino acids), the next steps, still simple molecules, building toward organic complexity, atmospheric organic reactions, etc.
11. Processes acting on building blocks (e.g., peptides, polysaccharides, nucleic acid chains, complexification, chemical/molecular evolution (building blocks to polymers).
12. Biochemistry meets prebiotic chemistry, genetics, metabolisms.
13. Earliest evidence and rewinding life's clocks.
14. Controversies, hot topics, synthesis, and common/shared themes.

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The Origins of Life Gordon Conference 1982-2020.

We have begun discussions with the GRC to
determine if it is possible to reinitiate the OOL GRC.
Will report back later.

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TIPCEEs – Topics in PCE3

Mini symposia on specific/provocative topics
½ day, virtual, w/ 4-5 pre-recorded talks
Moderated panel/breakouts
Expected outcomes: new collaborations, hypothesis papers, scientific & community evolution

"Impact of Impacts"
"Hydrothermal Origins?"
"RNA… Is it still a world?"

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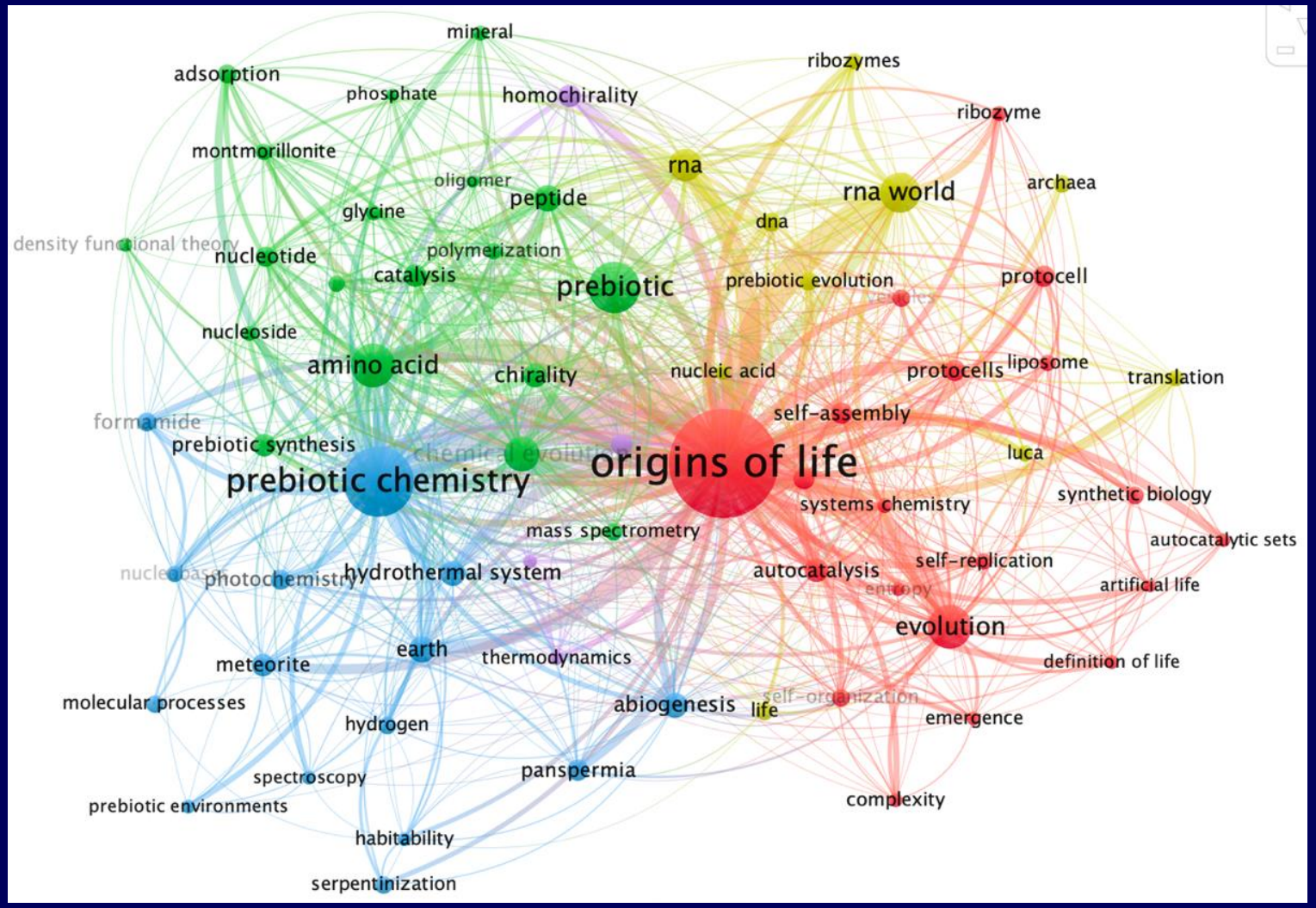
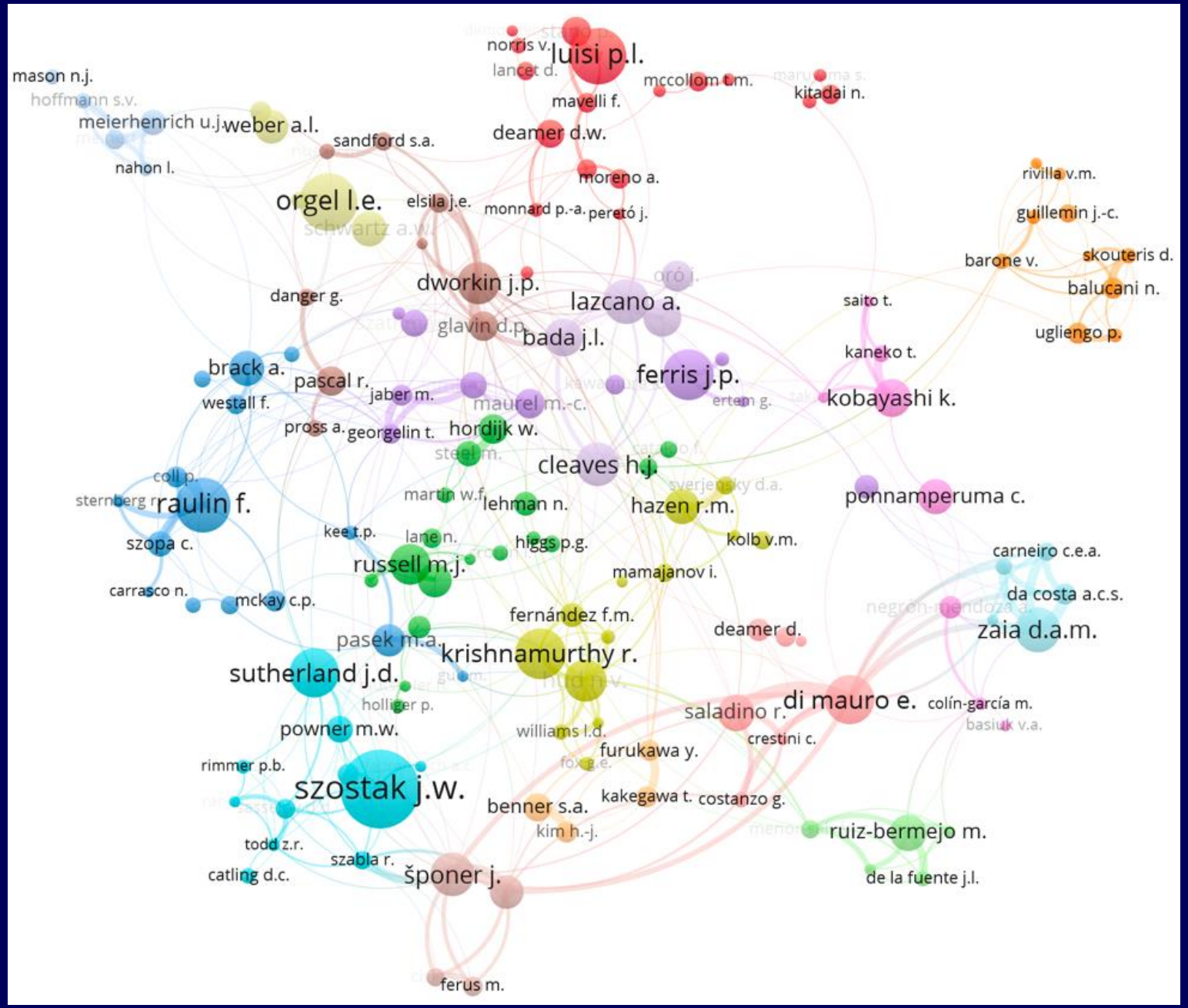


Rogers and co-workers curated a dataset of over 10,000 published works from 1887-2023. The dataset specifically targeted the origin of lie and prebiotic chemistry, but excluded exoplanets, Mars, etc.

This network diagram shows collaborations by co-author. Each node represents an author in the network, and each edge (connecting line) represents a published work which was co-authored. The thickness of the lines represents the number of co-authoring instances.

Thomson, Hendler, Rogers, in prep



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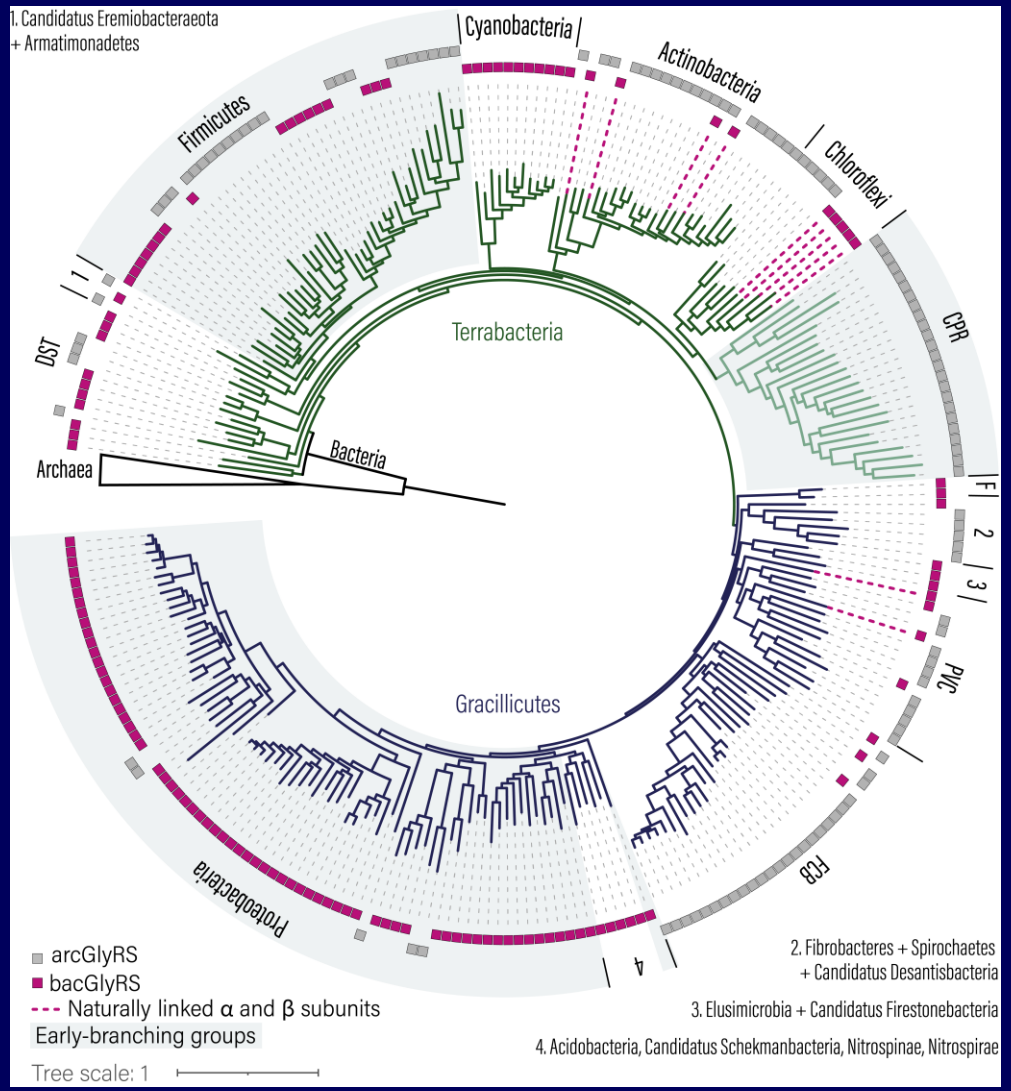

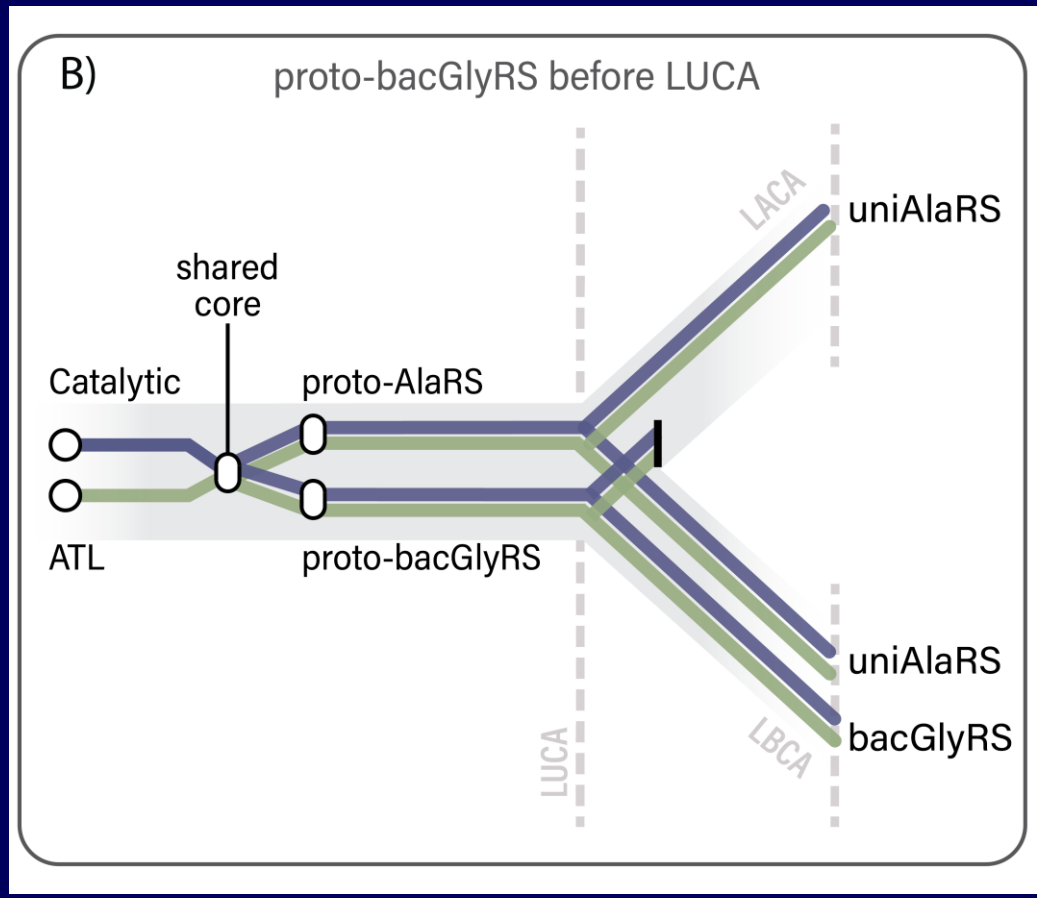

Thank You

Figures (art) courtesy Claudia Alvarez Carreno & Loren Williams