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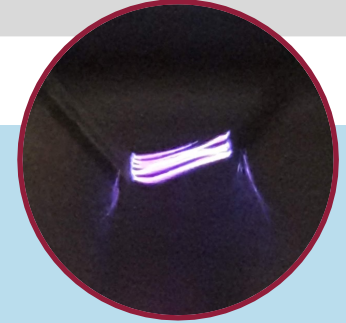
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Nitrogen fixation by lightning and its role for early life on Earth and exoplanets



Patrick Barth  (He/Him)

PhD Student

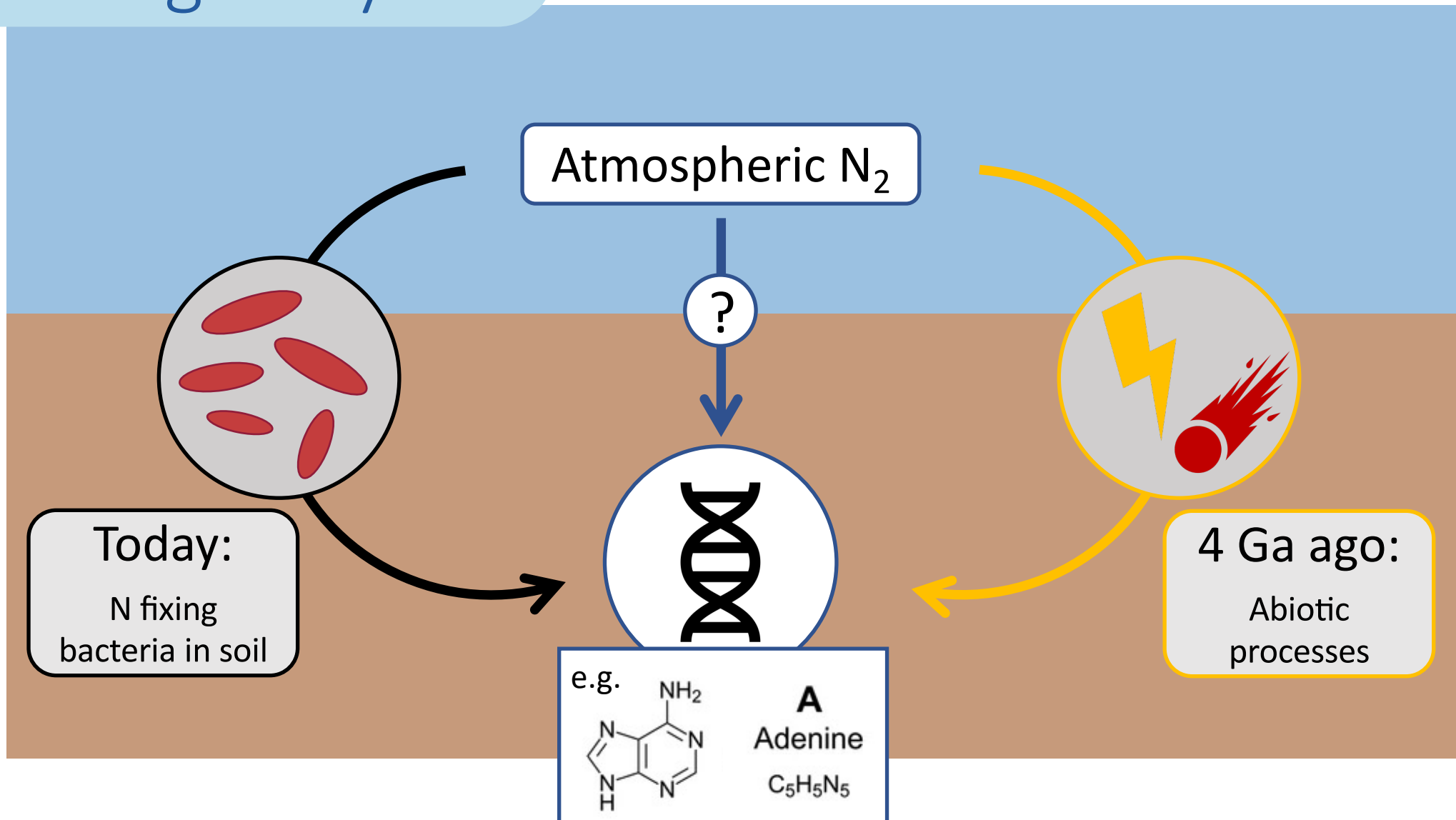
University of St Andrews
Space Research Institute, ÖAW
Graz University of Technology



with Eva Stüeken, Christiane Helling,
Lukas Rossmannith, Wendell Walters,
Yuqian Peng, Mark Claire

EGU 2022 – Life as a Planetary
Phenomenon – 27th May 2022

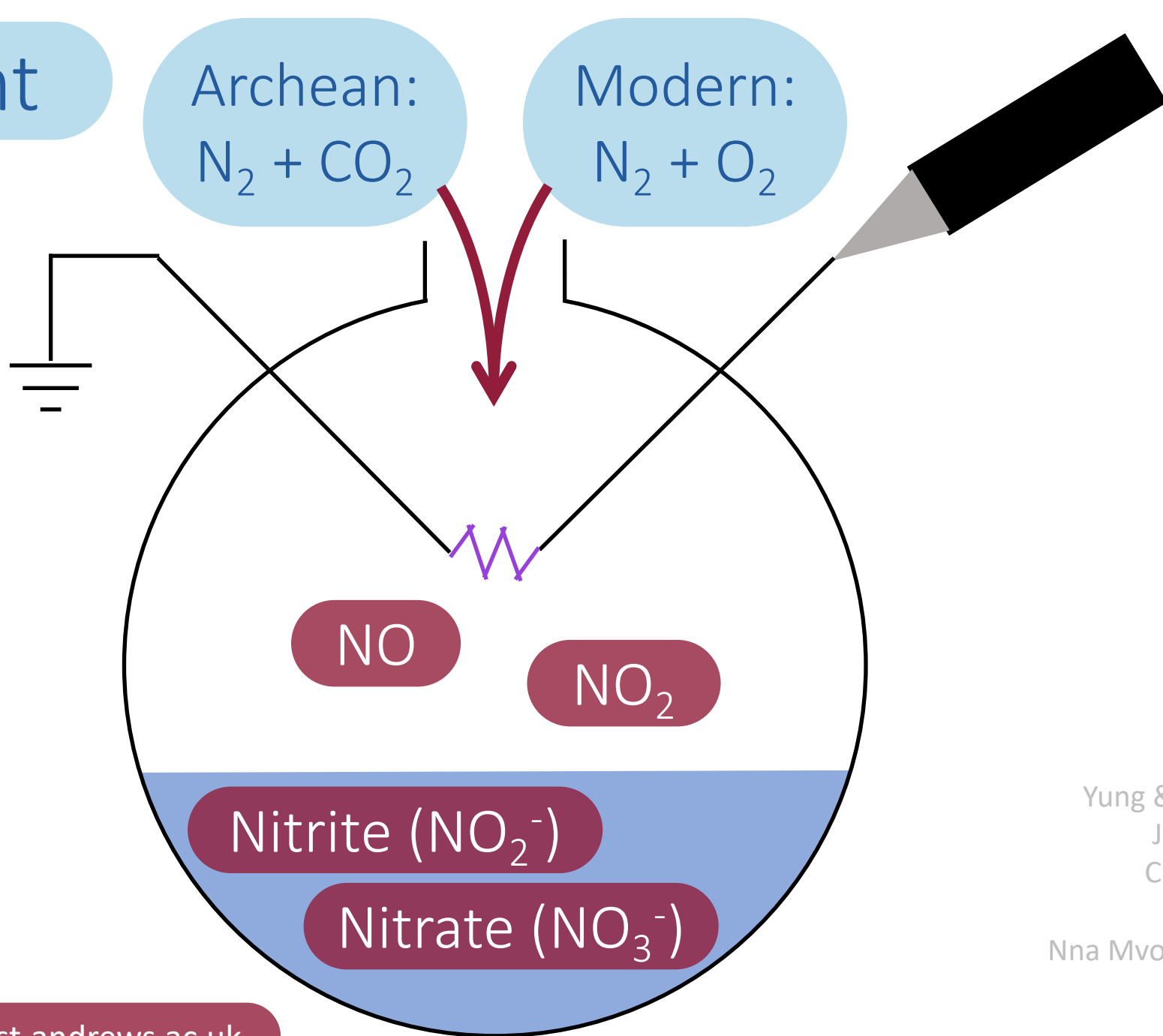
The Nitrogen Cycle



The Nitrogen Cycle



The Experiment



Yung & McElroy 1979
Joshi et al. 1985
Chameides 1986
Miller 1987
Nna Mvondo et al. 2001

Conclusions

- Nitrogen fixation seems equally efficient in Archean ($\text{N}_2\text{-CO}_2$) as in Modern ($\text{N}_2\text{-O}_2$) atmospheres
- Spark experiment can be used to simulate real lightning conditions
- Most N isotope data suggests earlier onset of biological N fixation
- One, corrected sample with potential lightning contribution



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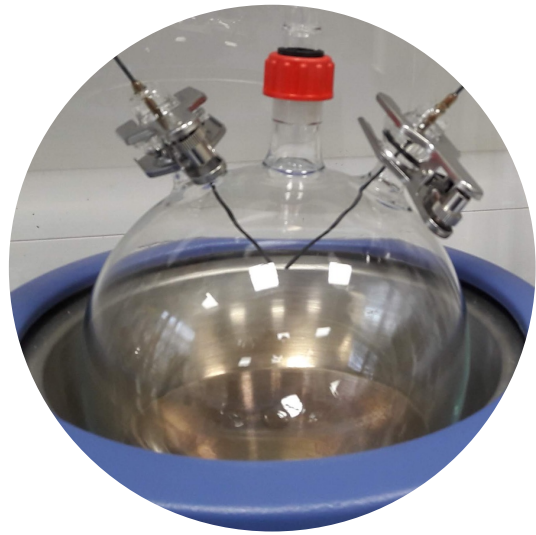


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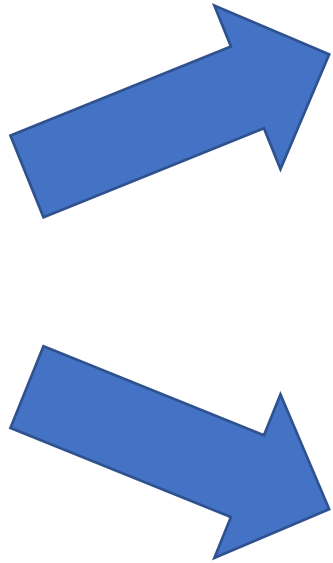
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Outlook: Simulations



~ 20 cm



Terrestrial planets
e.g. Earth

~ 12,000 km



Gas giants
e.g. HD 189733b

~ 160,000 km

ARGO

1D photochemistry & diffusion code

STAND2019

Atmospheric C/H/N/O chemistry

Rimmer & Helling 2016, 2019
Rimmer & Rugheimer 2019