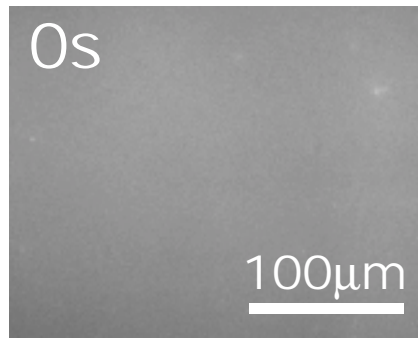


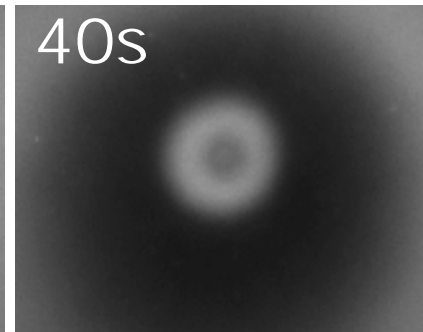
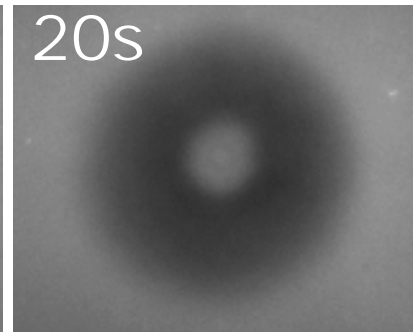
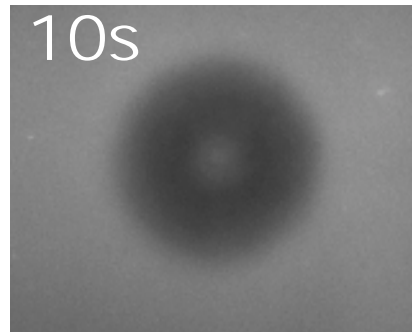
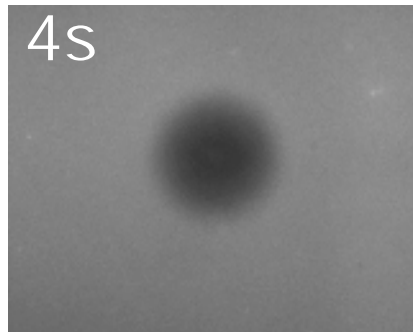
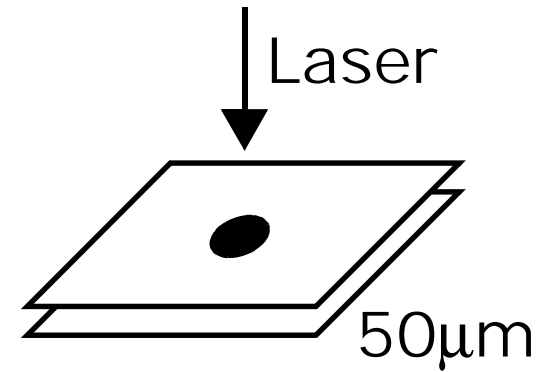
Accumulation of Biopolymers by
Convection + Thermophoresis:
Implications for prebiotic evolution?

Dieter Braun

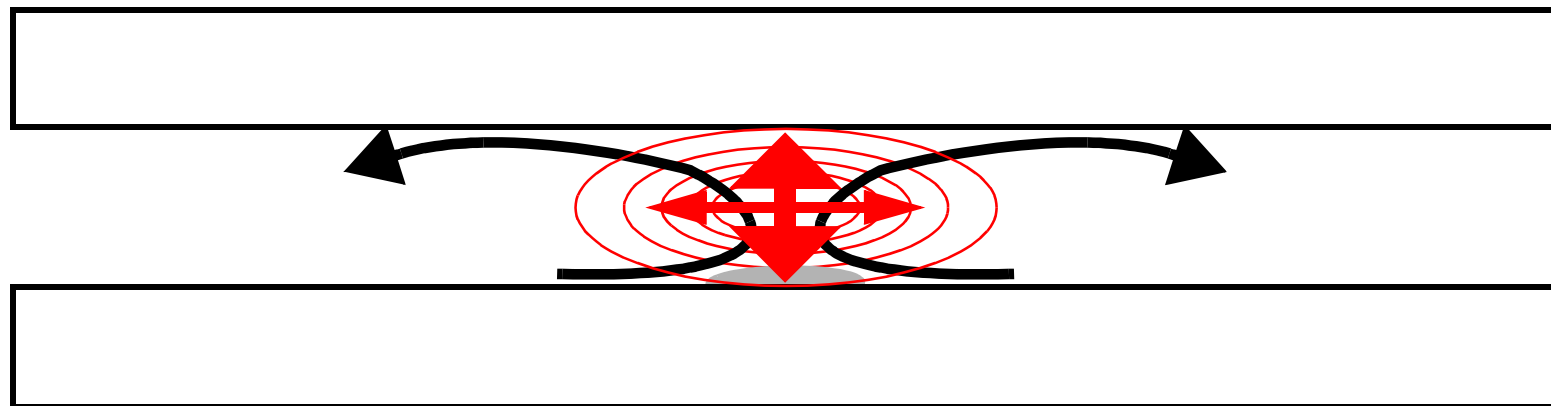
Microconvective Accumulation



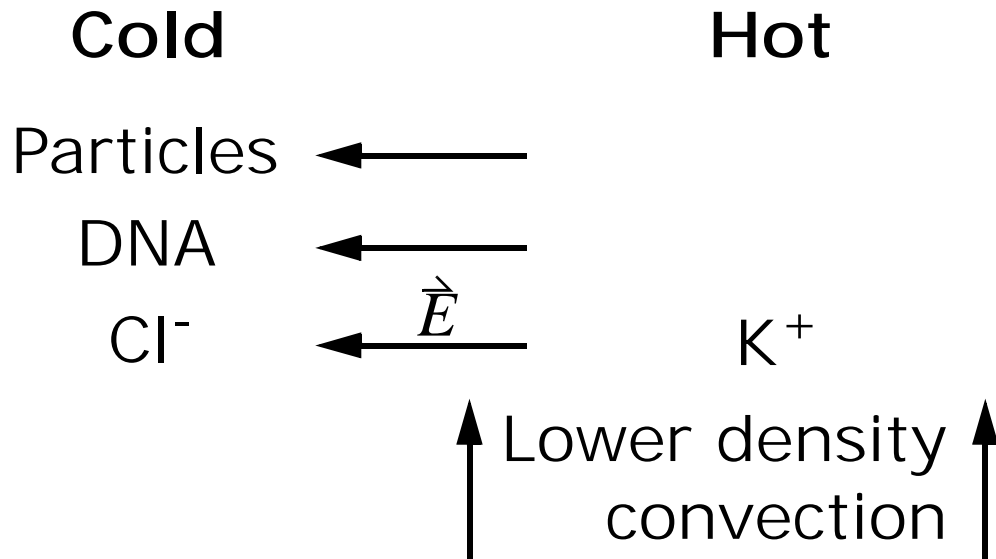
5kbp DNA



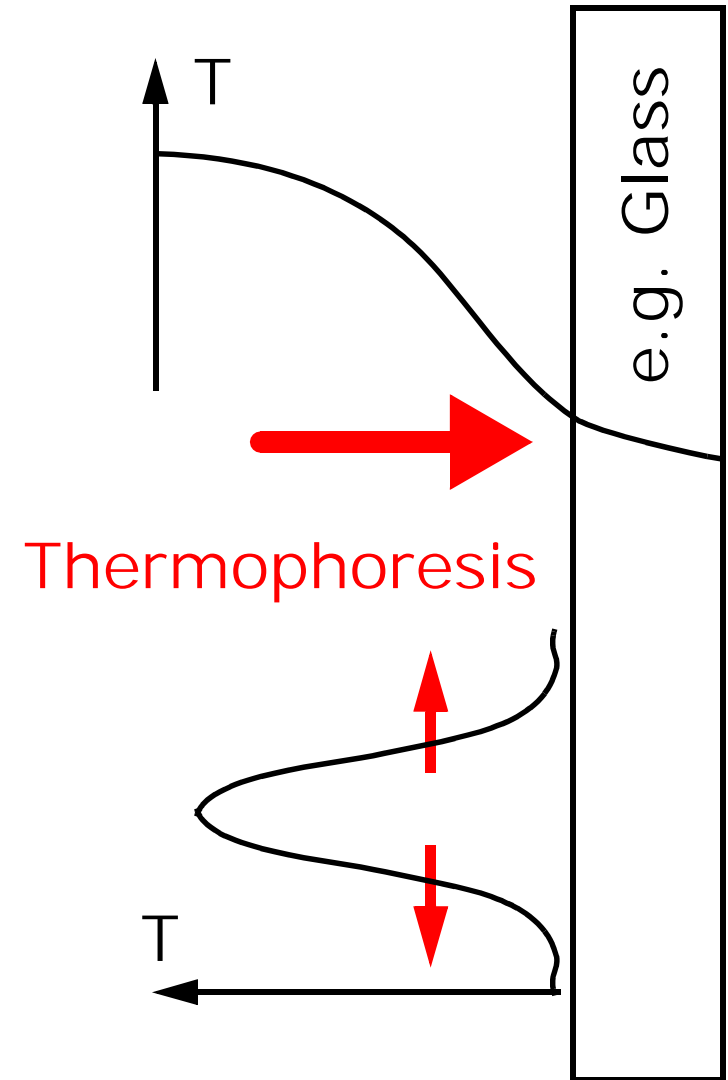
Mechanism



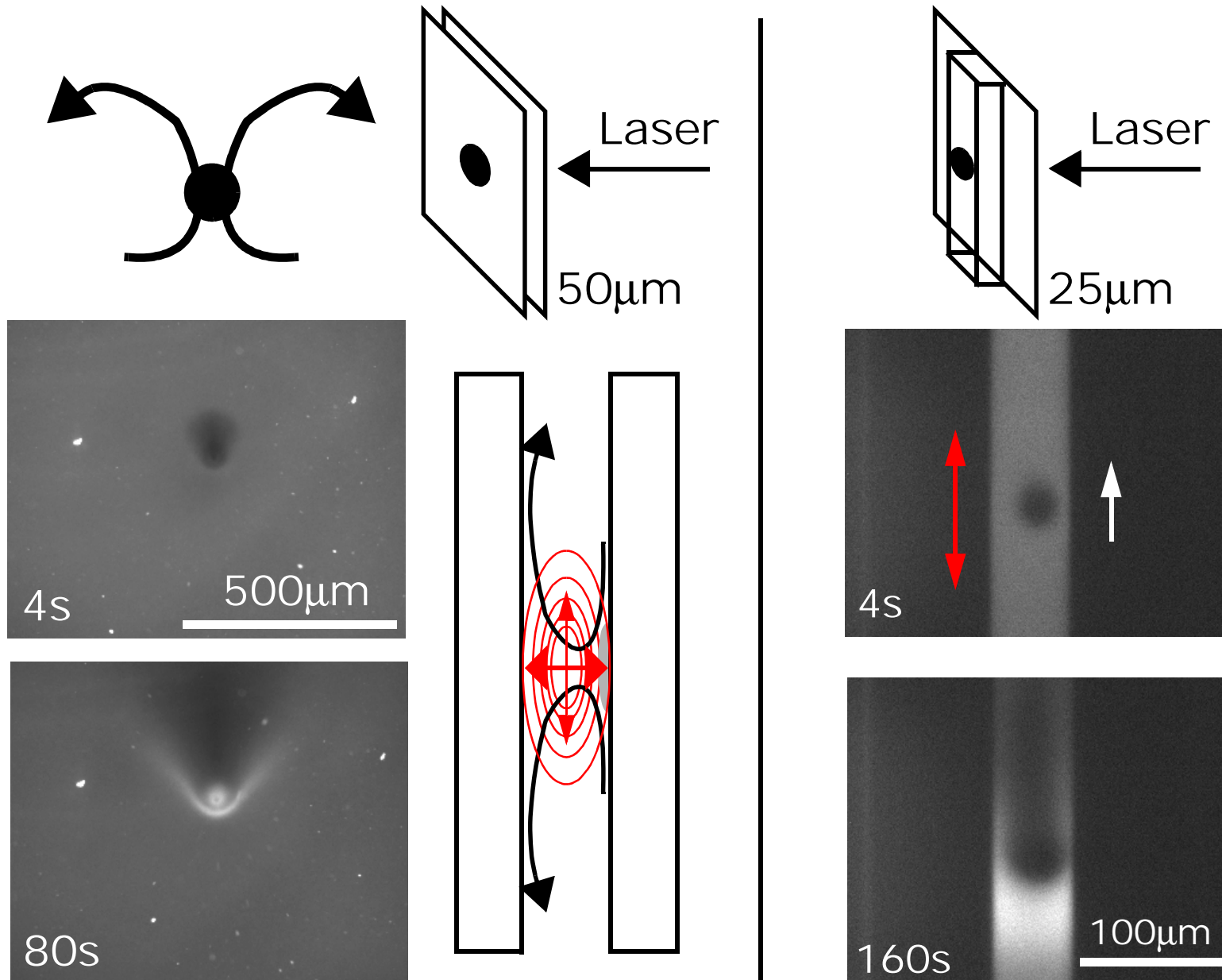
Thermophoresis...



...at interface



Same pattern in other geometries



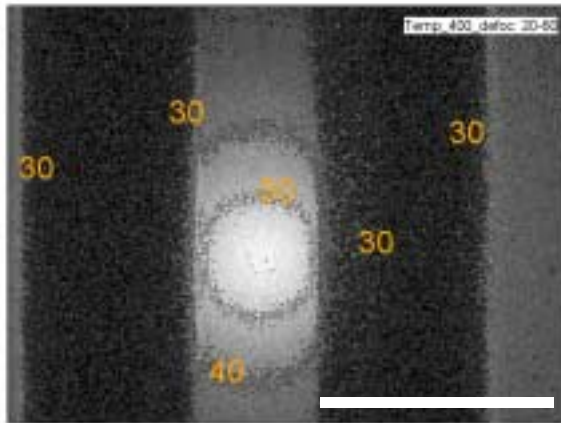
Measurement strategy for S/D

Fick's law

$$j = -D\nabla c - Sc \frac{\nabla T}{T} \stackrel{!}{=} 0 \quad \Rightarrow \quad \frac{c}{c_0} = \left(\frac{T}{T_0} \right)^{-S/D}$$

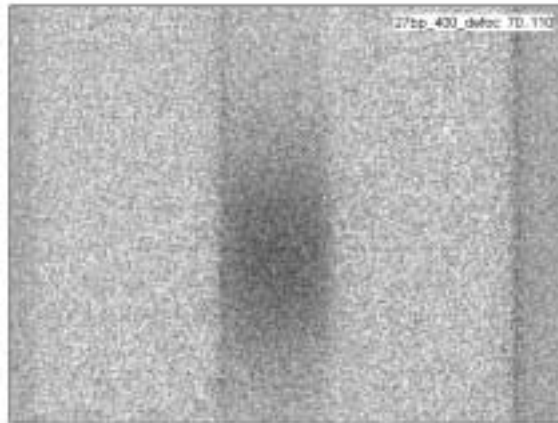
↑ Soret coefficient

Temperature T

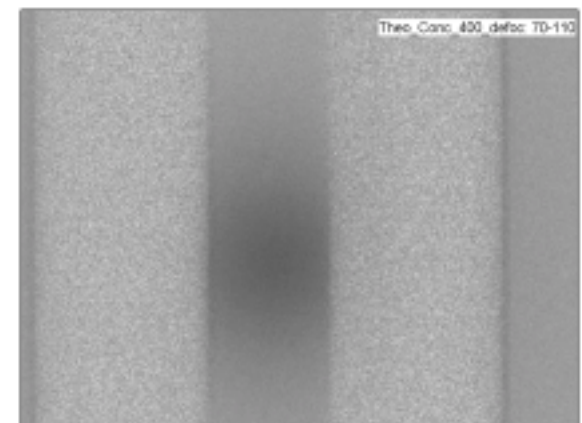


100μm

Concentration c

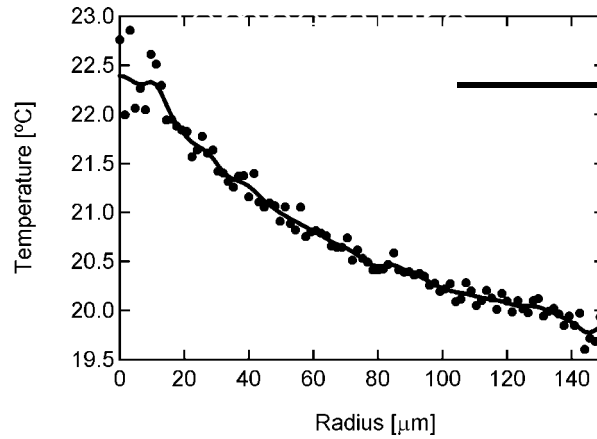
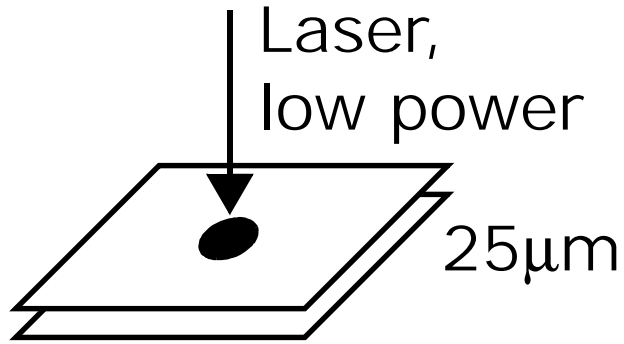


S/D=1.3



50μM 27Bb DNA

Measure S/D and $D \Rightarrow S$

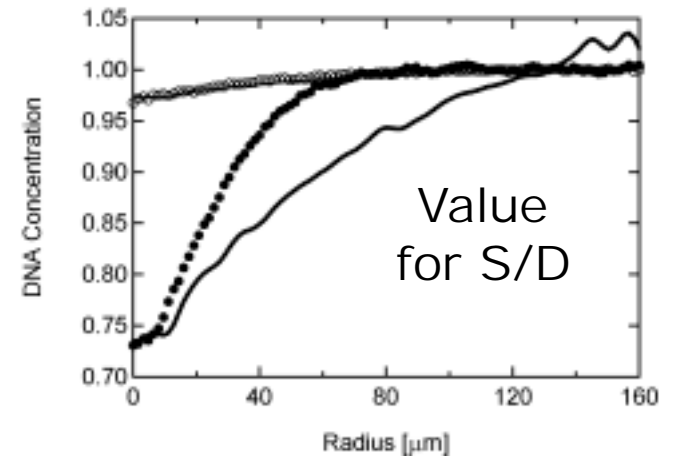
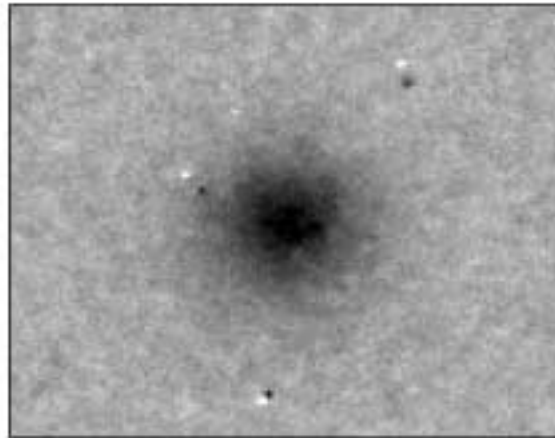
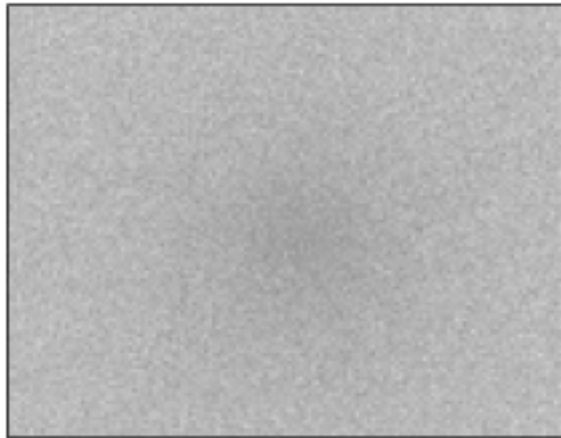


$$\frac{c}{c_0} = \left(\frac{T}{T_0} \right)^{-S/D}$$

and D from
Backdiffusion

27Bp DNA

5000Bp DNA



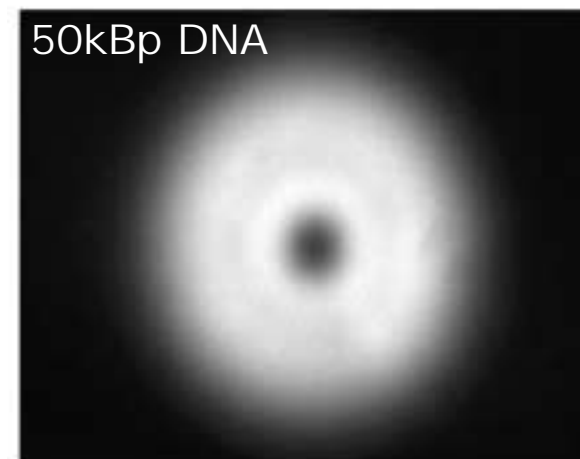
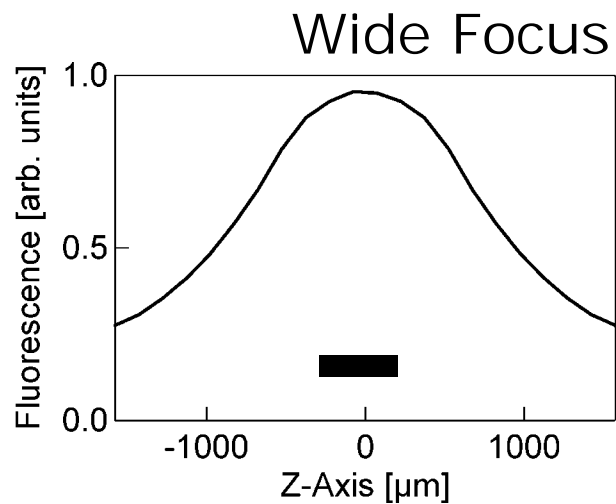
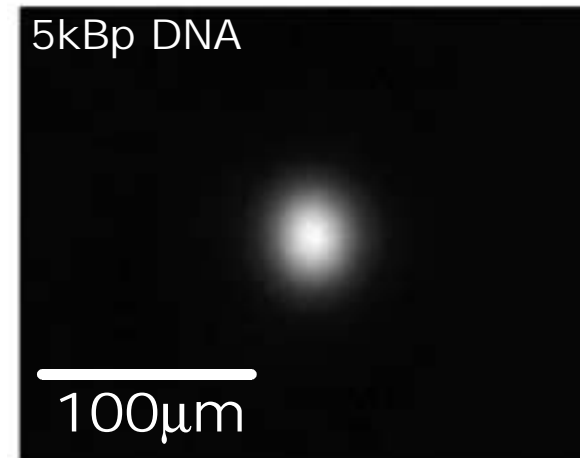
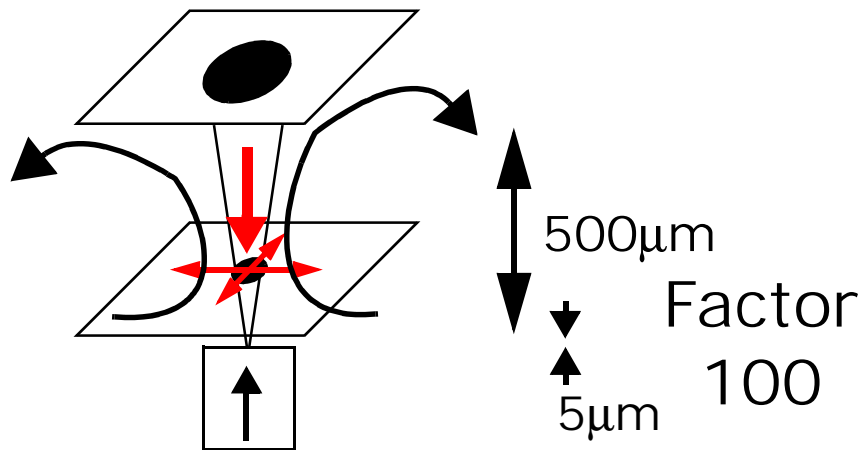
$S = 120 \mu\text{m}^2/\text{s}$

$S = 130 \mu\text{m}^2/\text{s}$

40nm Beads: $S = 45 \mu\text{m}^2/\text{s}$

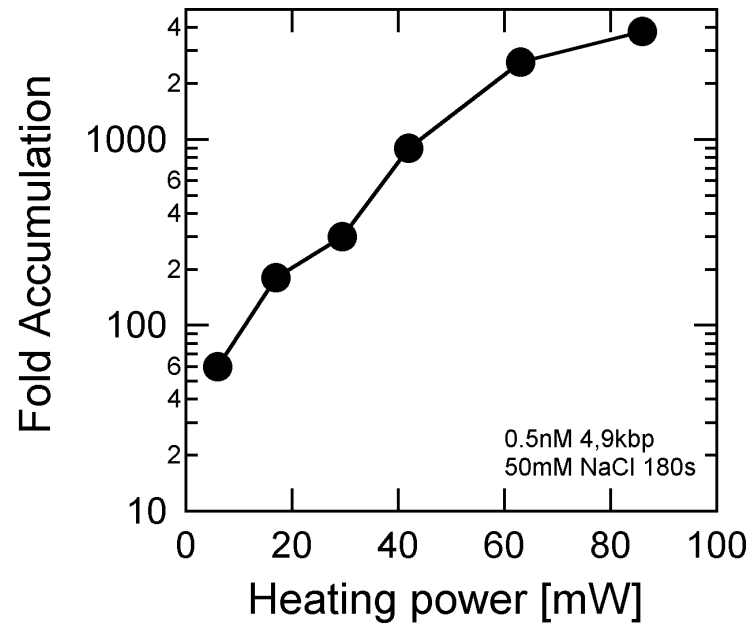
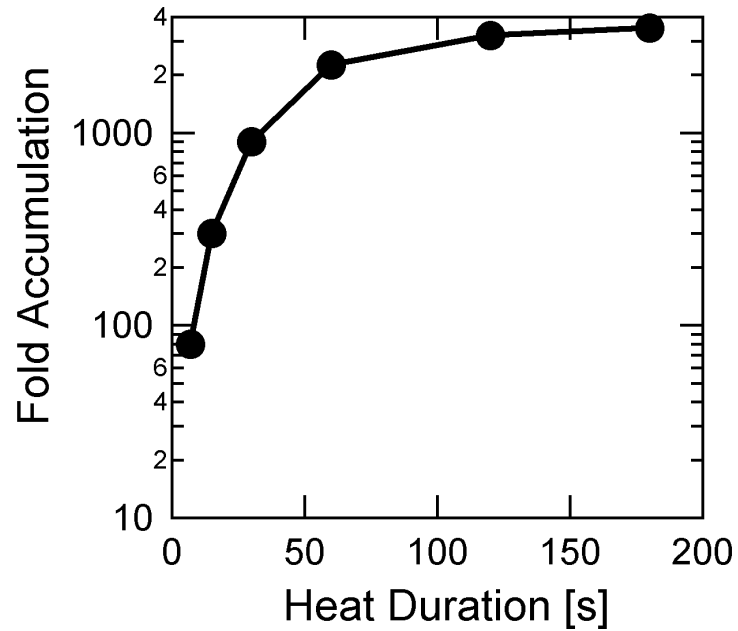
S undetectable for 500mM NaCl

Convective Concentration of DNA



30fold Fluorescence enhancement
=> 3000fold Accumulation

Dependences



No accumulation for
>500mM NaCl or >20mM MgCl₂

Implications for Prebiotic Evolution?

Concentration problem of early evolution
e.g. for basic polymerisation reactions

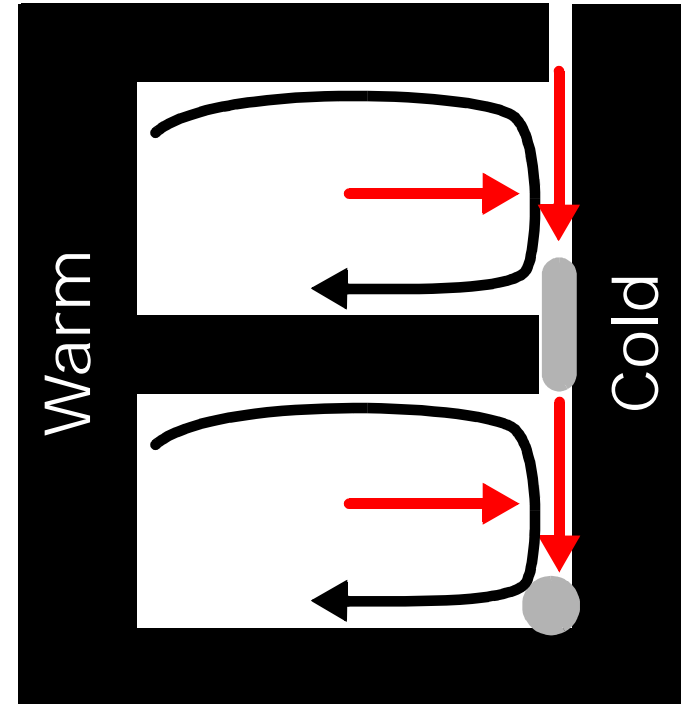
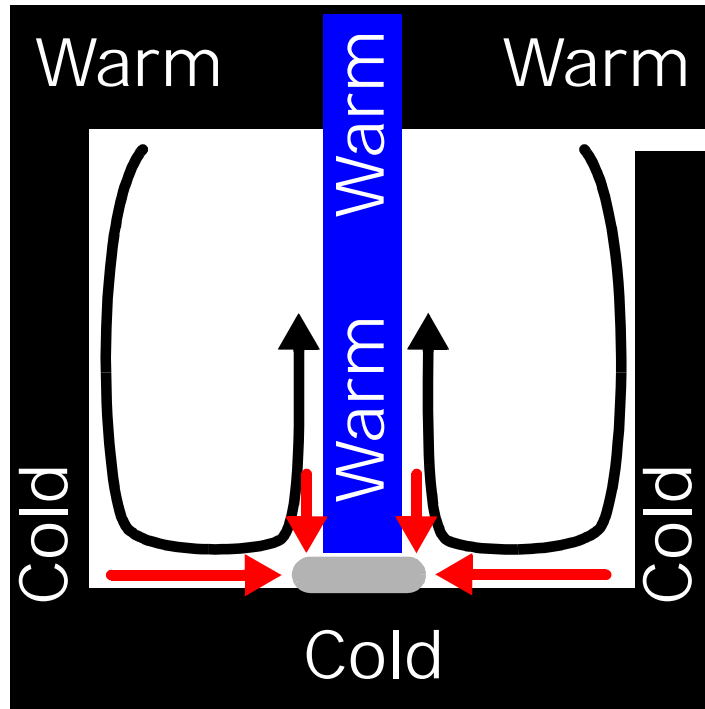
Vesicles no solution on this (?)
Evaporation schemes not stable enough

Proposition of mechanism:

Hot ocean bed applies temperature gradients,
e.g. in pores of stones

- Accumulation of particles and molecules
- 'Bioreactor' with convective temperature cycling
- Concentration feeding first metabolisms
- Catalysis at stone surface (Wächtershäuser)

Hypothetic Geometries



= > Need for experimental tests

Thanks to

Libchaber Lab

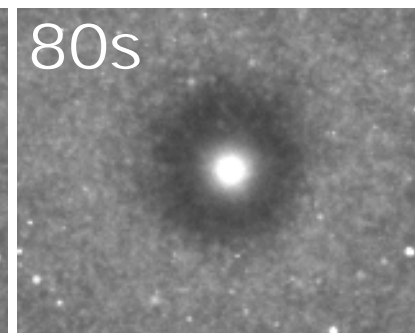
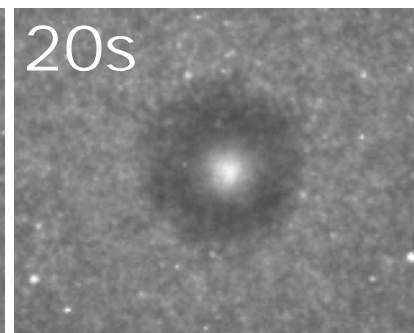
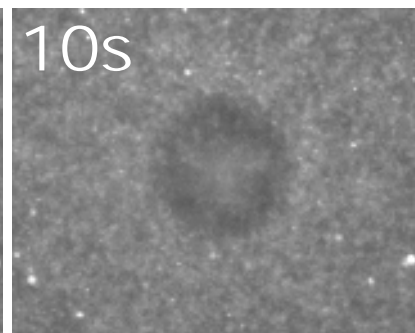
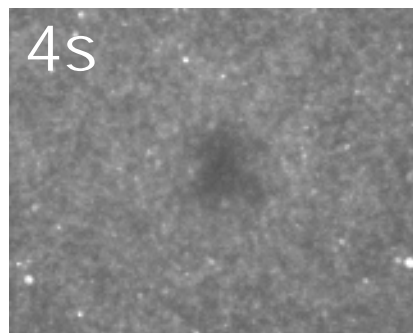
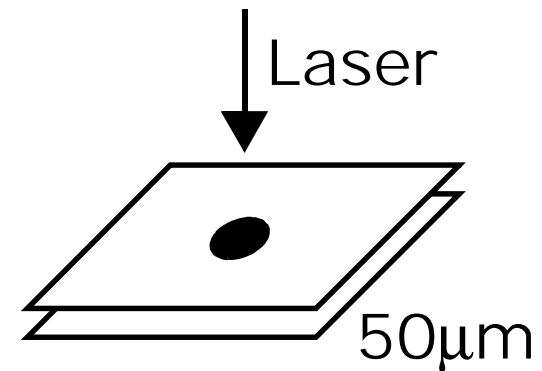
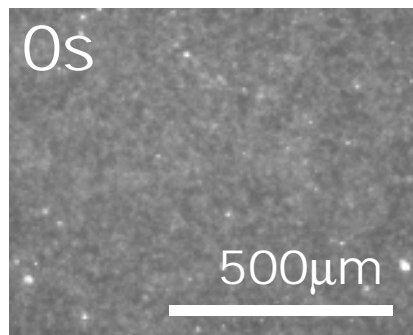
LabView

Emmy Noether Program

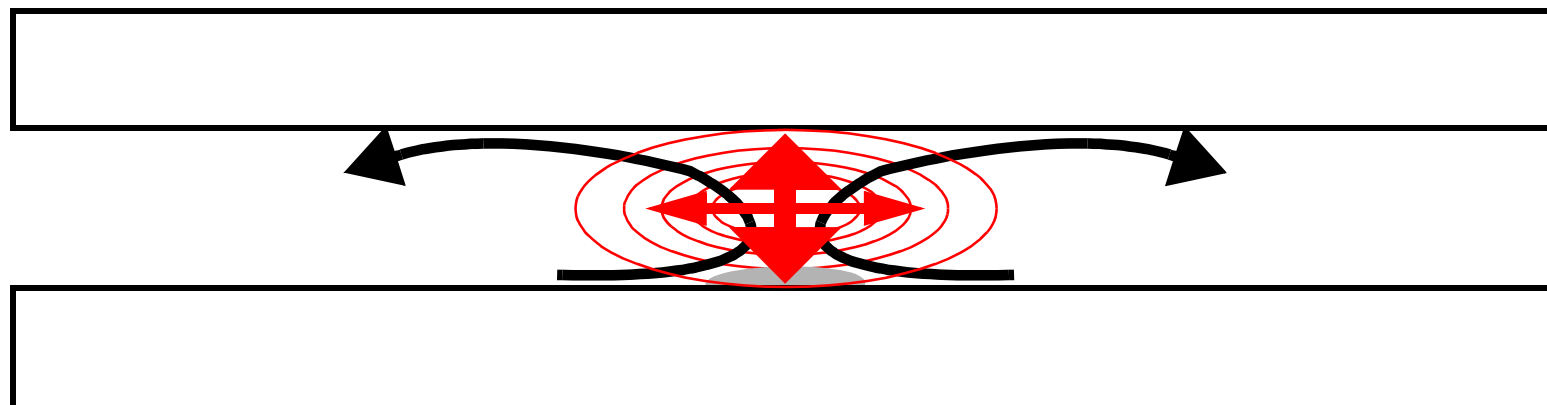
mail@dieterb.de

Microconvective Accumulation

200nm Latex Beads



Mechanism



Salt Dependence

