Thermophoretic Properties of Aqueous Formamide Solutions and Accumulation in Hydrothermal Pores

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Formamide is one of the important compounds from which prebiotic molecules can be synthesized, provided that its concentration is sufficiently high. For nucleotides and short DNA strands it has been shown that a high degree of accumulation in hydrothermal pores occurs, so that temperature gradients might play a role in the '*origin-of-life*' [1]. We show that the same combination of thermophoresis and convection in hydrothermal pores leads to accumulation of formamide up to concentrations where nucleobases are formed. The thermophoretic properties of aqueous formamide solutions are studied by means of Infra-Red Thermal Diffusion Forced Rayleigh Scattering. These data are used in numerical finite-element calculations in hydrothermal pores for various initial concentrations, ambient temperatures, and pore sizes. The high degree of formamide accumulation is due to an unusual temperature and concentration dependence of the thermophoretic behaviour of formamide. The accumulation-fold in part of the pores increases strongly with increasing aspect ratio of the pores, and saturates to highly concentrated aqueous formamide solutions of approximately 85 wt% at large aspect ratios. Time dependent studies show that these high concentrations are reached after 45-90 days, starting with an initial formamide weight fraction of \$$10^{-3}$ wt% that is typical for concentrations in shallow lakes on early earth [2].

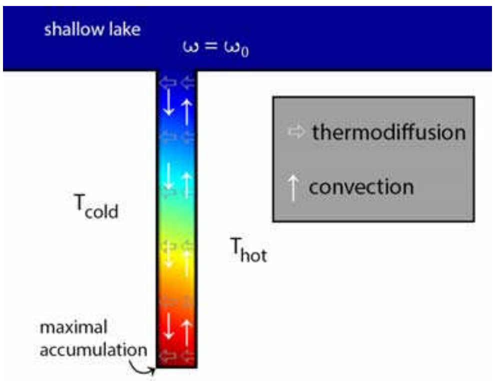

Fig. 1. Contour plot of the concentration profile connected to a reservoir in the stationary state. The vertical and horizontal arrows mark the convective and thermodiffusive flow, respectively.

References

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