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# SELF-MIXING IN THE EARTH'S ATMOSPHERE, OCEANS, AND SUBSURFACE

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Chemical and physical disequilibrium in the Earths oceans, atmosphere and subsurface can lead to gigantic convective flows of methane and carbon dioxide. Examples in the atmosphere and oceans include the turbulent plumes formed during the Icelandic volcanic eruption (2010) and the large number of methane plumes found recently in the Arctic Sea (2013). In the sub-surface, when carbon dioxide dissolves in the water contained in the porous rock, the heavy CO2-rich fluid sinks driving vigorous laminar convection [1]. A further example is the flow of dissolved methane under osmotic forces in the porous rock near mud volcanoes on the seabed [2]. In this talk, we focus on how the interaction between hydrodynamics and chemistry can drive fluid flow, including examples that are thought to be of relevance for the origin of life [3].

## References

[1] Cardoso S.S.S. and Andres J.T.H. (2014). *Geochemistry of silicate-rich rocks can curtail spreading of carbon dioxide in subsurface aquifers*, Nature Comm. **5**:574, doi:10.1038/ncomms6743.

[2] Silvana S. S. Cardoso, Julyan H. E. Cartwright. (2016). *Increased methane emissions from deep osmotic and buoyant convection beneath submarine seeps as climate warms*, Nature Commun. **7**, 13266, doi: 10.1038/ncomms13266.

[3] Yang Ding, Bruno Batista, Oliver Steinbock, Julyan H.E. Cartwright, Silvana S.S. Cardoso. (2016). *Wavy membranes and the growth rate of a planar chemical garden: Enhanced diffusion and bioenergetics*, Proc. Nat. Acad.Sci., 113 **(33)**, 9182-9186, doi/10.1073/pnas.1607828113.

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