The University of Oxford Department of Earth Sciences

EARTHSCIENCES

UNIVERSITY OF OXFORD

Evolution of oxygen sensing in algae and early plants

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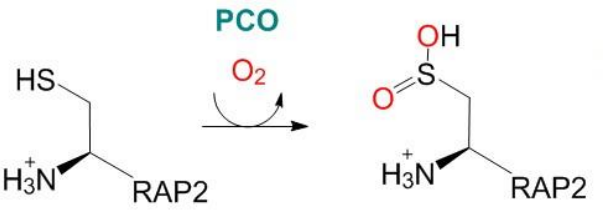
Key Research Question	**How has the evolution of oxygen in the environment shaped the land and ocean photosynthesisers?**

Overview

Oxygen is a highly reactive compound to life and yet is key to its physiology in an aerobic world. Over geological history, as a result of oxygenic photosynthesis, the oxygen content has increased in the atmosphere and ocean, although parts of the Earth surface remain anoxic even today. The so-called oxygen minimum zones (OMZs) of the ocean are expanding as a result of increased anthropogenic warming. Flooding of the land, which creates anoxia in soils, is becoming more prevalent in some areas. As a result, it is increasingly important to understand how oxygen availability has guided evolution in the past and may affect selection and survival of photosynthesisers in the future.



This project aims to understand how plants sensed and responded to changes in oxygen availability as they evolved to colonise the land. This will be achieved by investigating the biochemical, proteomic and physiological responses of different plant and algal lineages to changing oxygen availability. The Plant Cysteine Oxidases (PCOs) have recently been identified as the master biochemical switch that dictates the physiological response of higher plants to lowered oxygen (Scheme) [1, 2]. We have also identified PCOs in early plants (e.g. liverworts) and some freshwater algae such as *Chara braunii* and *Klebsormidium nitens* but no functional form has yet been identified in the Chromalveolates, the algal group which dominates the modern ocean. Interestingly, preliminary work suggests that PCOs have different oxygen sensitivity in higher plants than in the early plants and algae, suggesting a link oxygen sensitivity evolved with a change in plant habitat.

The work in this project will aim to unravel the evolution of the physiology and PCO sensitivity to oxygen and to explore whether the better tolerances to periodic anoxia allowed plant transitioning onto land. The findings may explain why the land became green and the oceans red, will reveal how ocean algae may cope with increasing OMZs and will inform genetic approaches for engineering flood tolerance into crop plants.

Applicants would preferably have a background in Biochemistry/Chemical Biology/Chemistry/Joint with Earth/Environmental sciences.

Methodology

Methods to be used will include: Phytoplankton Culture and sterile techniques, Enzyme kinetics, and Proteomics.

References & Further Reading

[1] Weits D et al 2014 Nat Commun X:XX

[2] White M et al 2017 Nat Commun X:XX

Further Information

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