भौतिक अनुसंधान प्रयोगशाला, अहमदाबाद

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“The oceanic geochemistry of the transition metals: tools to quantify the history of the oxygenation of the surface Earth”

Prof. Derek Vance

Professor, Department of Earth Science,

ETH Zürich, Switzerland

https://youtu.be/JCPLlHPDeqU

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Abstract

The progressive oxygenation of the surface Earth is a planetary-scale process that is intimately linked to the evolution of the Earth's biosphere. It involves a history that is characterised by long periods of stability, often accompanied by evolutionary stasis, punctuated by periods of rapid change. The first significant O_2 likely appeared in the atmosphere during the first half of Earth history, made possible by the evolution of oxygenic photosynthesis. However, the much higher levels of surface Earth O_2 required to oxygenate the oceans came much later, contributing to a complex array of drivers that led to the appearance of the first complex multi-cellular life close to the Precambrian-Cambrian boundary. There is an emerging consensus that the deep oceans did not emerge from anoxia (no dissolved O_2) until well after this, towards the end of the Paleozoic Era. Many geochemical tools have been used to document this outline history, as well as many of the details within it. This talk will focus on a relatively new set of tools, some still emerging, some relatively mature, involving the geochemistry and isotope geochemistry of the transition metals. The solution chemistry of these metals in seawater, their speciation, solubility, and isotope transformations, is often controlled, either directly or indirectly, by redox-related processes. The group at ETH Zürich has helped to pioneer these tools, with an emphasis on a deep and comprehensive understanding of the modern processes that control their oceanic budgets, their cycling within the water column, and their loss from the seawater solution to sediments. It is only with this detailed mechanistic understanding of the controlling processes, that applications to Earth history can be robust. This talk will review this modern developmental work, and introduce some key applications to the study of the oxygenation of the oceans.

The Speaker

Prof. Derek Vance is Professor of Geochemistry in the Department of Earth Science at ETH Zürich, Switzerland. In the past he has worked on mantle geochemistry and has used geochronology and metamorphic petrology to understand mountain belts such as the Alps and Himalaya. For the past 10-15 years, however, he has focused on understanding the geochemistry of the surface Earth. This has involved the quantification of the global cycles of trace elements through investigations of the inputs to the dissolved pool of the oceans, and outputs to various kinds of sediments. An important long-term objective is to use this effort, targeted at understanding modern budgets, to understand the chemical evolution of the surface Earth in the past. Prof. Vance obtained his Ph.D. in geochemistry at the University of Cambridge, UK. He has served as a co-editor in chief for Earth and Planetary Science Letters, as an editor of Geochemistry, Geophysics, Geosystems and as an Associate Editor for Geochimica et Cosmochimica Acta. He is currently President of the European Association of Geochemistry and Head of Earth Sciences at ETH Zürich. In 2019 he also served on the PRL decadal review panel.

About PRL

The Physical Research Laboratory (PRL), known as the “cradle of space science” in India, is one of the premier research institutes founded in 1947 by Prof. Vikram Sarabhai, a renowned Cosmic Ray Scientist, a great visionary and institution builder. PRL played a seminal role in producing a highly motivated cadre of space scientists and the technologists of highest international repute. The first scientific rocket launched from Thumba on 21st November-1963 and many other rockets launched thereafter contained payloads developed at PRL. Dr. Sarabhai initiated many of these scientific and technical activities at PRL which eventually led to the formation of the Indian Space Research Organization (ISRO). Therefore, PRL is known as the “cradle of space science” in India. Further, the research in the area of Plasma Physics expanded to the formation of the Institute of Plasma Research (IPR).

As an institution PRL is unique in that it conducts fundamental research in a wide range of research areas from the Earth to the cosmos, and comprising Astronomy and Astrophysics; Solar Physics; Space and Atmospheric Sciences; Theoretical Physics; Geosciences; Atomic, Molecular and Optical Physics, Astrochemistry; and Planetary Sciences and Space Exploration. PRL is one of the rare research institutes of international repute wherein research in such diverse fields of sciences is carried out using several state-of-the-art experimental facilities that exist under one umbrella.

Along with the ongoing research, several new initiatives have been taken up during the last few years. The Multi-Application Solar Telescope (MAST) at Udaipur Solar Observatory has been operationalized. PRL initiated scientific programmes in frontier areas of research, which include a search for exo-planets, laboratory studies of interstellar grains, laboratory synthesis of cold astromolecules and experimental studies in the field of quantum optics. PRL is also developing several scientific payloads as a part of ISRO’s larger vision and contributing to roadmap for competitive scientific exploration of the solar system and beyond. In particular, PRL has been contributing significantly not only in building instruments for space missions, such as Chandrayaan-1, Chandrayaan-2, AstroSat and upcoming Aditya-L1, Chandrayaan-3 and planetary and space missions, but also by bringing out new and insightful science results.

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