The Five great Mass Extinction Events – What was their cause and when is the next?

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The causes of mass extinctions of marine life remain a matter of debate. Some scientists consider that meteorite impacts are the cause, others propose that major volcanic eruptions have regularly wiped out life on Earth.

In this talk I will present data on temporal variations in the concentrations of trace elements in early-formed sedimentary pyrite determined using an advanced laser technique pioneered in our laboratories at UTAS. The results show that the trace element concentrations in the oceans have varied in a cyclic fashion, by several orders of magnitude, over the last 700 million years. We interpret these cycles to indicate that 600 to 520 million years ago the oceans went through a dramatic increase in nutrient trace element and mean oxygen content caused by a collision of tectonic plates ultimately leading to the Cambrian explosion of life. Four major cycles of variation then follow related to further global tectonic plate collisions: Late Cryogenian to Late Ordovician, Early Silurian to late Devonian, Early Carboniferous to Late Triassic and Jurassic to Quaternary. Oxygen maxima, indicated by Se, U and Mo proxies, occur at 540, 390, 310 million years ago and the present day, supporting previous models. Oxygen minima, indicated by trace element minima, occur at 700, 455, 365 and 200 Ma. Extended periods of trace element drawdown in the oceans have led to extreme deficiency of some elements that are critical for life. The periods of extreme Se depletion coincide with the mass extinction events at end Ordovician, Late Devonian and the Triassic-Jurassic boundary, suggesting that Se-deficiency in the oceans may be a contributing cause of three of the five great mass extinction events.

Ross Large is a Distinguished Professor of Geology at the University of Tasmania and the recent past director of the CODES ARC Centre of Excellence in Ore Deposits. He gained his BSc (Hons) from the University of Tasmania in 1969 and PhD from University of New England in 1973. For ten years Ross worked in the mineral exploration industry. In 1984 he joined the University of Tasmania, and five years later established the Centre for Ore Deposit and Exploration Science (CODES). Under his leadership CODES grew to become recognized as one of the top industry collaborative ore deposit research centers in the world. Ross has over 100 publications in international journals and has gained a number of international awards for his research. His current research interest is the chemistry of past oceans and relationships to evolution, mass extinction and mineral deposit cycles. Ross is the President of the Royal Society of Tasmania and the Chair of the Tasmanian Division of The Academy of Technology, Sciences and Engineering.