

# Mesozoic Oceanic Anoxic Events: Records from India and future scope

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## ABSTRACT

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This paper presents an assessment of the Mesozoic Oceanic Anoxic Event (OAE) studies carried out from India. It provides a summary of the research work pursued on biostratigraphic, isotopic and organic geochemical proxies for establishing Oceanic Anoxic Events (OAEs) from the Mesozoic sedimentary sequences of the Indian subcontinent. From Indian sedimentary basins, studies are available on OAE 1a, OAE 1b, OAE 1d, OAE 2 and OAE 3. From the Cauvery Basin records of OAE 1b, OAE 1d, OAE 2 and OAE 3 are available. From the Spiti Valley, records are present only of OAE 2 (Chikkim Formation) and the possibilities of late Valanginian Weissert Event (W–OAE). Latest Hauterivian Faraoni Event (F–OAE) and OAE 1a are expected to be present in the Giumal Formation. Nonetheless, the Black shale from Rudramata Shale, Jhuran Formation from Kutch Basin indicate possible late Jurassic OAE based on the character of sedimentary facies and organic geochemical results. There is also the possibility of OAE 1a and OAE 1b in the Ukra and Upper member of the Bhuj Formation. This paper aims to provide a comprehensive introduction on global and regional OAEs records from Indian subcontinent and a significant window on available knowledge of these events in India and supply significant attention for the future research possibilities from the Indian landmass.

**Key-words**—Oceanic Anoxic Event, Mesozoic, Black Shale, Spiti Himalaya, India.

## INTRODUCTION

THE Mesozoic Era (time span approx. 186 Ma) is an important and remarkable time period in the Earth's history as it witnessed the rifting of the Pangaea Supercontinent and the opening–spreading of the Atlantic and Indian oceans. Mesozoic Era brackets the time interval sandwiched between two extreme events of biodiversity crisis, i.e. the end Permian mass extinction (~ 252 Ma) marking the base of the Triassic Period (start of the Mesozoic Era) and the Cretaceous–Paleogene mass extinction (around 66 Ma) marking the end of the Cretaceous Period (end of Mesozoic Era). Each extinction event records major change in atmosphere and ocean composition and its impact on bio–diversity (extinction–adaptation–radiation) and it provides crucial information in understanding of anthropogenic climate change.

During the Mesozoic time, the global oceans experienced many catastrophic events that affected the major chemical compositions in oceans and the atmosphere. The CO<sub>2</sub> increase in the atmosphere affects the composition of the ocean and atmosphere, which is reflected in the sedimentary basin as

changes in sediment dynamics–pattern, palaeo–redox, pH of the ocean, nutrient supply, etc. These events are recognised as deposits of dark colored laminated shale, highly rich in organic carbon content and sulphides (Jenkyns, 2010). These events are known as Oceanic Anoxic Events (OAEs) and are widely documented from a single isolated basin to quasi–global scale and from shallow coastal zones to the deepest parts of the open ocean (Jenkyns, 2010; Schlanger & Jenkyns, 1976).

In pelagic and neritic habitats, during periods of extreme greenhouse temperature, three global OAEs (Toarcian–OAE, OAE 1a and OAE 2) are marked by a carbonate crisis (Weissert *et al.*, 1998; Cobianchi & Picotti, 2001; Herrle & Mutterlose, 2003). In comparison with current populations, the excess CO<sub>2</sub> released from volcanoes during OAE prevented biocalcification in reef communities (Langdon *et al.*, 2000), along with planktonic foraminifers (Barker & Elderfield, 2002) and calcareous nannoplankton (Riebesell *et al.*, 2000). After surplus CO<sub>2</sub> was drawn down by accelerated weathering and burial of organic matter, carbonate sedimentation restarted and possibly the rate of nutrient delivery also slowed down.