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Late Tithonian (Late Jurassic) palynological record from the Jaisalmer Basin (India)

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ABSTRACT

Late Tithonian (Late Jurassic) palaeobotanical records from the Jaisalmer Basin are infrequent. We report the first record of an age-diagnostic palynological assemblage of the sedimentary rocks in the Bhadasar Formation from the Jaisalmer Basin, India. The study is carried out to consider the palaeoenvironmental settings in this basin based on palynological and palynofacies investigations. A well-preserved assemblage of palynomorphs with 22 species belonging to 10 genera, including spores and pollen. The palynological assemblage is characterised by the dominance of coniferous pollen of *Callialasporites* spp. *Araucariacites* spp. along with some significant taxa viz. *Cupressacites ramachandra*, *Microcachryidites antarcticus*, *Classopollis* sp. *Podocarpidites* sp. *Pityosporites* sp. *Ginkgoretectina* spp. and *Monosulcites* sp. which suggest a Late Tithonian (Late Jurassic) age. The occurrence of conifer pollens (*Araucariacites* and *Callialasporites*) represents coastal vegetation and warm climate. However, some bisaccate pollen (*Podocarpidites*) indicates drier upland areas. Palynofacies records suggest two distinct Palynofacies Assemblages (PA – I and PA – II) correspond to the marginal oxic to dysoxic basin and the shelf to marginal transition.

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Introduction

The palynological record plays an important role in reconstructing palaeoenvironments and palaeoclimates, offering valuable insights into ancient plant communities at both regional and local scales (Abbink et al. 2004; Volkheimer et al. 2009; Galloway et al. 2013, 2015; McArthur et al. 2016; Santos et al. 2018, 2018). Moreover, palynostratigraphy has proven to be a highly reliable and precise tool for biostratigraphic dating (Traverse, 2007; Jain 2020). Establishing connections between palynomorphs and their parent plants, however, requires a thorough understanding of their botanical affinities, with in situ palynomorphs associated with macroflora being particularly useful (Filatoff 1975; Balme 1995). Determining the botanical affinity of each palynomorph enhances the accuracy of a deeper understanding of palaeoenvironmental and palaeoclimatic interpretations (Balme 1995; Abbink et al. 2004).

Palynofacies analysis has proven to be an effective tool in various fields like sequence biostratigraphy and identifying palaeodepositional environments, proximal – distal trends and shifts in oxic – anoxic conditions and water depth (Tyson and Follows 2000; Zobaa et al. 2011; Mueller et al. 2014). It serves as a valuable proxy in palaeoclimatic reconstructions, complementing geophysical and geochemical data (Mueller et al. 2014; Zhang et al. 2015). The integration of palynofloral record with palynofacies offers a robust framework for enhancing the precision of palaeoclimatic interpretations in relation to palaeophytogeography, palaeoecology, and palaeoclimatology (Césari and Colombi 2016; Lindström et al. 2016). This combined approach of biostratigraphy and palynofacies has been extensively applied to Gondwana sediments in both marine and continental contexts across various continents (Martinez et al. 2008; Zavattieri et al. 2008; Guler et al. 2013; Zobaa et al. 2013; Zhang et al. 2015; Aggarwal et al. 2015, 2017; , Agrawal, et al. 2019b; Aggarwal,et al. 2019c; Aggarwal, et al. 2019a; Murthy et al. 2019) Palynostratigraphy in combination with palynofacies studies of fossilised organic matter in sedimentary rocks has gained significant recognition in geological, palaeoecological and palaeoclimatological research (Césari and Colombi 2016; Lindström et al. 2016; Wheeler and Götz 2017). This integrated approach has become a reliable method for improving the precision and consistency of palaeodepositional studies (Götz et al. 2003; Cazzulo-Klepzig et al. 2009). However, there have been limited palynological investigations in the Jaisalmer Basin (Srivastava 1963, 1966; Mathur and Mathur 1968, 1972; Lukose 1972), highlighting the need for more detailed studies to better understand the geological history of this terrain.

Several contributions on the Mesozoic of the Jaisalmer Basin have focused on its origin through petrological, sedimentological and geographical reconstructions (Oldham 1886; Swaminath et al. 1959; Singh and Krishna 1969; Das Gupta 1975; Pareek 1980, 1981, 1984; Krishna 1987; Mahendra and Banerji 1989, 1990; Fürsich et al. 1992; Pandey et al. 2009, 2010, 2011, 2012; Bhat and Ahmad 2013; Ahmad et al. 2013, 2019, 2020, 2021, 2022; Ahmad, Ahmad, et al. 2017; Ahmad, Quasim, et al. 2017; Javed et al. 2023). However, contributions in palynostratigraphy and palynofacies from other formations of the basin are limited (Srivastava 1963, 1966; Mathur and Mathur 1968, 1972; Lukose 1972; Kumar et al. 2021, 2022). Earlier Srivastava 1963, Srivastava 1966 and Lukose 1972 suggest the Early to Middle Jurassic age of Lathi Formation on the basis of palynomorphs assemblages (i.e. *Cyathidites australis rimalis*, *C. australis*, *C. minor, Osmundacidites wellamanii*, *Dictyotriletes (Ischyosporites) crateris*, *Cingulatisporites lathiensis*, *Trilobozonosporites verrucatus*, *Triangulatisporites mathurii, Polypodiisporites rajasthanensis*, *Ginkgocycadophytus deterius* var. *majus*, *G. inkgocycadophytus nitidus*, *Monosulcites couperi*, *Monosulcites* sp., *Cupressacites ramachandrae*, *Araucariacites ghoshii*, *Inaperturopollenites indicus*, *Callialasporites dampieri*, *C. trilobatus*, *C. jaisalmerensis*, *C. barragaonensis*, *Podocarpidites* sp.,

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