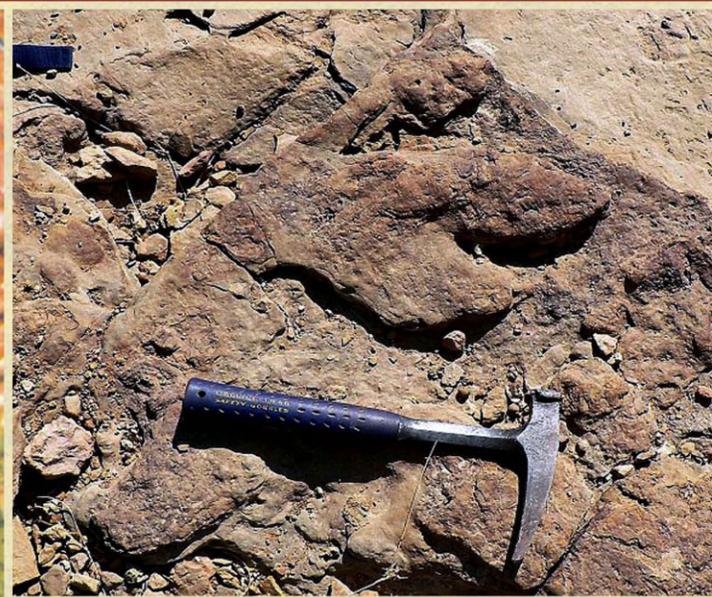


# Geology of Rajasthan (Northwest India)

*Precambrian to Recent*

A.B. Roy & S.R. Jakhar





**GEOLOGY OF RAJASTHAN**

**(Northwest India)**

*PRECAMBRIAN TO RECENT*

## THE BOOK

Rajasthan is amongst the very few regions in the world, which have well-preserved records of a continuous geological history from the Middle Archaean to the present day. This across-the-board volume is based on the critical analyses of the voluminous and the most recent database on the protracted geological history of the terrain. Considered as the paradise of Indian geology, the region is central to the understanding of geology of the Precambrian Indian Shield and Phanerozoic cover successions. The book is also amongst the most illustrative treatise on the geology of a region published in recent years. It contains 350 figures (including a large number of photographs) of which there are no fewer than 93 geological maps of the key regions. Besides, the book contains the most recently revised large-sized coloured geological map of the State of Rajasthan.

### The Book

**A. B. Roy**, M. Sc., Ph. D. (Jadavpur University), Retired Professor of Geology, Mohanlal Sukhadia University, Udaipur, is working as the Senior Scientist of the Indian National Science Academy. Earlier, he was engaged in research as an Emeritus Fellow of the All India Council of Technical Education. He worked on different aspects of Geology of Rajasthan for over 3 decades. He was elected Fellow of the Indian Science Academy in 1989, and of the Indian National Science Academy in 1990. He is recipient of National Mineral Award in 1993. He was awarded a gold medal in 1998 by the Directorate of Mines and Geology, Government of Rajasthan, for his contributions to the mineral sector development in Rajasthan. Professor Roy received Bellur Rama Rao Centenary Award (2000), which is the highest award bestowed by the Geological Society of India for his lifetime contributions in the field of Precambrian geology. He has over 80 publications to his credit including research papers, book reviews and edited volumes.

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# **GEOLOGY OF RAJASTHAN** **(Northwest India)** ***PRECAMBRIAN TO RECENT***

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*Dedicated*

*to*

*all those who are*

*keen to know about the geology*

*of this part of the Indian Shield*



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## PREFACE

Rajasthan was constituted as an independent State in 1956 out of the conglomeration of a number of princely States along with regions of Ajmer and Merwara. Earlier, the combined region of princely States used to be known as Rajputana.

The State of Rajasthan is endowed with a number of distinct physiographic and geologic features. Barring a small part of northern Gujarat, this is the only State in India, which witnessed invasion of tropical desert much after the Indian subcontinent became a part of the Asian continental mass. The Aravalli Mountains lying astride the entire length of the State in the NE-SW direction constitutes another unique geomorphic feature. The mountain range eventually stalled the march of the desert eastward and protected the most fertile territories in the east from its eastern flanks to as far the distance as the Pacific coast of Hong Kong.

Because of the recent arid and semiarid climate in the State, and also because of the extensive deforestation and consequent soil erosion, a very substantial part of the hills and pavements outside the dune-covered areas are without any soil cover. The nudity of nature, unfortunately though from human point of view, however, has made Rajasthan a geologists' paradise. Excellent geological maps prepared from different parts of Rajasthan (Coulson, 1933; Gupta, 1934; Gupta and Mukherjee, 1938; Heron, 1917a & b, 1936, 1953) not only attest to this but also unravel intricate geological relationships between different stratigraphic entities. No wonder that a number of important concepts, including that of Eparchaeon Interval have emerged from the geological history of Rajasthan.

Rajasthan is amongst the very few regions in the world, which has well-preserved records of a continuous geological history for over 3500 million years before present, from Middle Archaean to present day. This is quite consistent with the available geochronological data. Such being the span of the geological history of the region, it is but natural that Rajasthan is gifted with several landmark features including mineral resources.

Emergence of the blue-green algae and its virtual explosion along the winding shorelines of the Aravalli Epicontinental Sea during the Early Proterozoic is one such feature. The prolific growth of algal colonies helped to build up the richest formations of stromatolitic rock phosphate in the region.

Another landmark feature is the development of base-metal deposits. Rajasthan is the largest repositories of lead, zinc, silver and tungsten in the country. The State's share of the total national reserves of these metals is almost 95 per cent. Also significant as far as the States mineral resources are concerned are the huge reserves of SMS-grade limestone in the Jurassic beds of Jaisalmer region. Rajasthan not only supplied whitest marbles from Makrana for the construction of the Taj Mahal at Agra as well as the Victoria Memorial at Calcutta, the main source of red sandstones, which adorn the Red Forts of Delhi and Agra, was also in this State. Today, Rajasthan contributes more than 90% of Indias production of different variety of marbles, including the olive green serpentinite, commercially known as the green marble.

It is evident that the geological history recorded in the Precambrian Aravalli crust is long and protracted. Geochemical and geochronological studies in this perspective helped to recognise the development of early greenstone belts over a sialic basement probably earlier than 3300 million years ago.

Rajasthan along with Gujarat witnessed the first major impact of separation of the Indian continental block from the Gondwana Supercontinent during the Jurassic, about 180 million years ago. The same period ushered in a couple of WNW-ESE trending linear basins through encroachment of sea into the continental areas. Outburst of plume related Deccan volcanicity during the Mesozoic-Cenozoic transition has also left mark in Rajasthan in the form of mafic flows as well as intrusions of alkaline mafic and felsic magmas. Though the youngest Precambrian platform deposits of western Rajasthan provide evidence of gradual transition from Precambrian to Phanerozoic, no well-documented Palaeozoic succession is known in the State. There are, however, indirect indications of the presence of  $500 \pm 50$  Ma old granitoids as subcrops in western Rajasthan.

The youngest Quaternary period had also very significant imprints in the geological history of Rajasthan. It was during this period that region attained its geomorphic character, including the evolution of the Thar Desert and formation of numerous saline lakes. Our early ancestors perhaps witnessed the youngest neotectonic events that vastly changed the geomorphic landscape of the region including the migration and ultimate extinction of the legendary river, the Vedic Saraswati. Indeed the terrain of

Rajasthan is a unique component of the Indian shield. Understanding of geological evolution of such a territory would obviously be an educative exercise.

Stimulus for writing a book on 'Geology of Rajasthan' covering all aspects of geological problems of this part of the Indian Shield came from scores of students, research scholars, teachers and a large number of earth scientists the world over with whom we had the opportunity to interact on diverse aspects during fieldwork in Rajasthan. We felt very strongly about the need of having a comprehensive volume under a single cover. We realised that the necessity is not just for a textbook satisfying the academic needs of students and teachers, but also for an across-the-board volume based on detailed information and systematic analysis of all the available data within the framework of modern concepts to cater the need of field geologists and the future research workers. We felt the need of integration of vast amount of data that have accumulated over the years on different aspects of geology of Rajasthan. Our long association with the geology of Rajasthan, as teachers and as well as active research workers helped us immensely in comprehending and focussing on the basic problems being debated over during the last three decades. We have tried to build up a coherent story of geological evolution of the Rajasthan crust through judicious analysis of all the available data. In this process we have included a large number of illustrations in the book in order to facilitate readers to have a feeling of the rocks region. We have also incorporated quite a few detailed geological maps of critically important areas in order to provide opportunities to research workers for further detailed study in the region. Hopefully our endeavour, despite inherent limitations, will help the future earth scientists to identify potential horizons of future research in this paradise for geologists, and to enhance our knowledge on geological evolution of Rajasthan.

We are thankful to Ram Swaroop Sharma, Dhiraj Mohan Banerjee, Utpal Bose, Prasanta K. Bhattacharya, B. S. Paliwal, Prakash Kataria and few others who critically read parts of the first draft of the manuscript and made many useful suggestions. However, we would like to make it clear that we could not accommodate all the good pieces of advice of the reviewers and that any remaining deficiencies are entirely our own responsibility. We received tremendous help from all the colleagues and friends during the preparation of the manuscript. The list is too large to name them individually. Special thanks are, however, due to P.S. Ranawat, Head, Department of Geology, Mohanlal Sukhadia University, for allowing us to freely use the computer aided drafting facilities available in the Department. Most of the diagrams used in the book have been almost entirely redrafted by the junior author (SRJ). Although the illustrations have been taken from different sources, all those have been redrawn to a consistent level of detail and clarity. We are thankful to a number of earth scientists who have allowed us to use illustrative materials from their works; their contributions are acknowledged in the figure captions. A large number of line drawings and photographs used in this book came from the publishers of a number of journals, monographs, books, etc. Our sincere thanks to all of them for allowing us to use the materials listed below: Geological Society of India for the figure nos. 4.25, 4.28, 4.30, 4.30a, 5.37, 5.43, 5.57, 5.59, 5.60, 5.65, 5.74, 5.80, 5.81, 5.82, 5.83, 5.84, 5.85, 6.3, 6.7, 6.16, 6.17 We also received sundry helps from a number of persons, but we would like to make special mentions of B. L. Sharma, Subhas Chandra Khosla, Asit Ranjan Das, Virendra Kumar, Pratip Gupta, M. S. Sisodia, K. K. Sharma, K.L. Srivastava, N.S. Rathore, Vivek Laul, Sanjay Kumar, Sanjeev Rathore and Ritesh Purohit for those. In the end, we individually express our thankfulness to our respective family members who had to endure a great deal of inconvenience during the entire period when we were busy in preparing the manuscript.

Udaipur

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**Ashit Baran Roy**

**Surja Ram Jakhar**

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