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An overview of Yellow Limestone deposits of the Jaisalmer Basin, Rajasthan, India

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GEOLOGY OF AREA

The Mesozoic rocks are well exposed in the Jaisalmer Basin of Rajasthan. Of these deposits, the Lathi, Jaisalmer, Baisakhi, Bhadasar formations belong to the Jurassic age. The "Yellow Limestone" is mainly confined to the Jaisalmer Formation. The Yellow Limestone occurring around the city of Jaisalmer, and around the towns of Bada Bag, Moolsagar, Kanod, Amarsagar, Chundi, Bhagata, Manria, *etc.* is widespread, occurring over an area of more than 5.4 million sq. meters. It contains 42 to 51% calcium oxide and has a maximum thickness of about 3 m. The strike of beds in general is N15°E and with a dip at an angle of 4 to 5° to the northwest and at some places it shows a quaquaversal dip. The total estimated resource of Yellow Limestone is about 8.2 million tons. The Yellow Limestone is massive and partly crystalline and traversed by pink coloured bands in some places. Fossiliferous bands are also very common. Under the microscope it shows the presence of subrounded quartz grains in the calcareous groundmass (Dashora, Bhargava, 1971; Agarwal *et al.*, 1988).

The mining of the Yellow Limestone has continued for the last several decades. It is quarried in blocks of 50 to 60 cm in length, 30 to 40 cm in width and about 30 cm in thickness. It is sawn into tiles and used as yellow marble after polishing. It has been in use since ancient time for the construction of forts, temples and buildings of various other purposes. In recent times its use has increased substantially mainly in interior flooring, wall claddings, monuments, cobble stones and for decorative purposes. With the increasing demand of this decorative stone in the world market the deposit of Yellow Limestone has become precious for us and therefore it should be scientifically mined to get maximum recovery. This deposit has tremendous scope to earn foreign exchange and has emerged as a valuable asset for the ornamental stone industry.

The Jaisalmer Formation was distinguished by Swaminathan *et al.* (1959). Narayanan *et al.* (1961) defined four members in the Jaisalmer Formation *i.e.* Joyan, Fort, Bada Bag and Kuldhar members. In addition, Das Gupta (1975) recognized the Hamira Member, whereas Kachhara and Jodhawat (1981) added the Jajiya Member. Accordingly, the Jaisalmer Formation is now divisible into six members. The Jaisalmer Formation is exposed around Jaisalmer town (26°55'N, 70°55'E) where it forms a major part of the marine Mesozoic succession of Rajasthan. The lower part of the Jaisalmer Formation is exposed to the east and southeast of the Jaisalmer city, whereas the middle part is exposed along the ridge north of Jaisalmer city and further north up to Bada Bag. The upper part of the formation is mostly studied to the west of Jaisalmer in the Kuldhar river-section and on a scarp near the village of Jajiya.

The Jaisalmer Formation (Fig. 1) consists of a thick sequence of cream, buff and brown colored, commonly fossiliferous, occasionally oolitic limestones and grayish, brownish yellow sandstones. The formation occurs extensively on the surface and is also encountered in the subsurface. The celebrated fort of Jaisalmer, built of limestone of the Jaisalmer Formation, is also known as the "Golden Fort" because of the very typical golden yellow-brown color of the stones. The Limestone beds are generally horizontal or nearly horizontal. A steep dip of beds ranging up to 30° due north or northwest has locally been observed close to some of the faults. There is also an anticlinal fold in the limestone beds with beds dipping at 20 and 22° due

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north and south, respectively. Faulting is quite commonly observed in the Jaisalmer limestones. West of the Jaisalmer, a major NNW–SSE trending fault separates the limestone of the Jaisalmer Formation from the younger shale beds of the Baisakhi Formation. Another important fault passes from Kanoj through Khuri (26°37': 70°43') forming the western boundary of the Birmania beds with the Jaisalmer Formation. Certain faults, which crosscut the major faults, are presumed to be younger post-Mesozoic faults. The Jaisalmer Formation ranges in age at least from Bajocian to Oxfordian (Pandey, Fürsich, 1994; Prasad, 2006).

Hamira Member. This is the basal member of the Jaisalmer Formation, overlying the Lathi Formation (Das Gupta, 1975, p. 79; Pareek, 1984, p. 36). It consists of a more than 2 m thick succession of grayish, brownish yellow to buff low-angle cross-bedded, fine to medium-grained arenaceous limestone/calcareous sandstones, yellow shales, and marly limestones with scattered gastropods, brachiopods and pelecypods. On the basis of fossil records in the overlying Joyan Member, the Hamira Member has been assigned to the interval from Early Jurassic to Bajocian (Pandey *et al.*, 2014).

Joyan Member. The lower part of the member consists predominantly of siliciclastic sediments whereas the upper part is exclusively calcareous. This member consists of light yellow shales, yellow fossiliferous sandstone and hard, buff-colored limestone with corals and pelecypods. Kachara and Jodhawat (1981, p. 242) based on the evidence of the pelecypod assemblage, suggested that the Joyan Member is Bajocian in age.

Fort Member. The Fort Member consists of fine to medium-grained sandstones, oolitic, sandy, bioturbated, fossiliferous limestones, and cross-bedded sandy limestones (Mahendra, Banerji, 1990; Pandey, Dave, 1998; Pandey *et al.*, 2006). On the basis of the interbasinal correlation of marker-beds (Pandey *et al.*, 2009), and the stratigraphic position of this member above the Late Bajocian coral bearing horizon of the Joyan Member and below the Late Bathonian ammonite-bearing Bada Bag Member, the age of the Fort Member can be safely assigned to the Early to Middle Bathonian.

Bada Bag Member. It consists of ferruginous siltstone, ferruginous cross-bedded calcareous sandstone, dolomitized sandy limestone, and buff and golden yellow colored limestone with hardgrounds and intraformational conglomerate (Mahendra, Banerji, 1990; Pandey, Dave, 1998; Pandey *et al.*, 2006, 2014). Fossil cephalopods, brachiopods, pelecypods, corals, ostracods and foraminifers are well preserved in this member. Based on the records of the Late Bathonian ammonites (*Macrocephalites madagascariensis*, *M. triangularis*, and *Sivajiceras congener*), from the upper part of this Member, and Callovian ammonites from overlying Kuldhar Member, a Late Bathonian age has been assigned to the Bada Bag Member.

Kuldhar Member. The member is richly fossiliferous. It comprises golden yellow-brown colored limestones, marls, greenish shales, oolitic limestone beds and cross-bedded sandstones; characterized by the presence of rich fossil assemblages

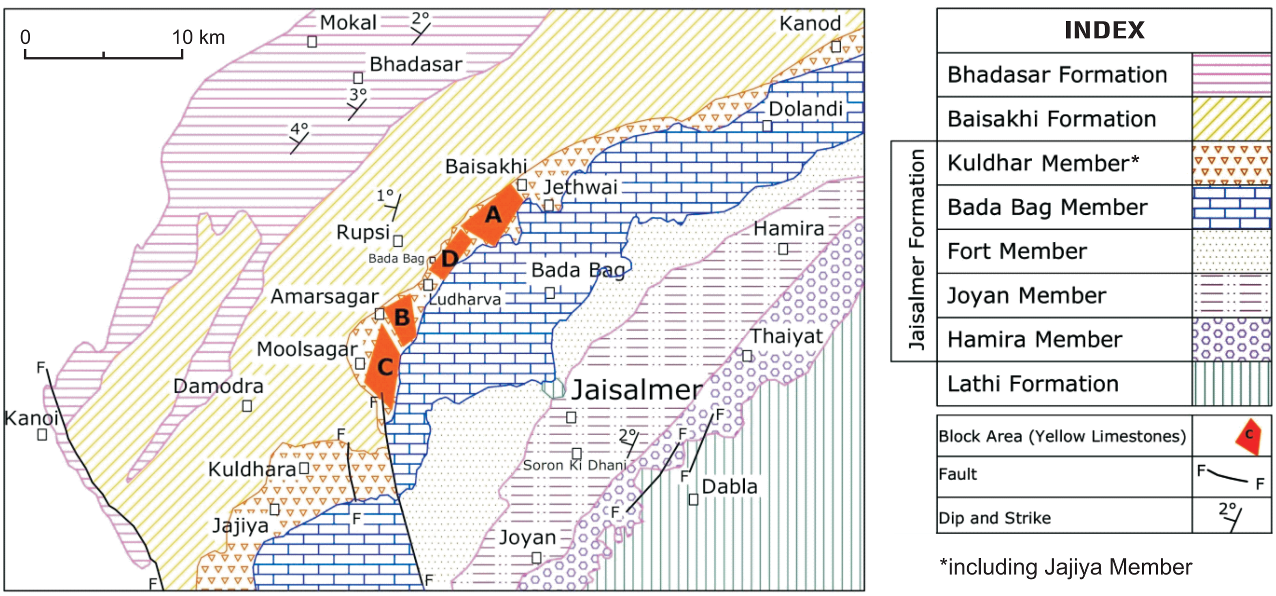

Fig. 1. Jurassic stratigraphy of the Jaisalmer Basin of Rajasthan showing block areas of Yellow Limestone (modified after Dave, Chatterjee, 1996; Roy, Jakhar, 2002)

similar to those of the underlying member. Based on the ammonite assemblages, the lower part of the Kuldhar Member has been correlated with the Chari Formation of the neighboring Kachchh Basin (Krishna, 1987; Pandey *et al.*, 2009) and has been assigned to the Callovian Stage.

Jajiya Member. This is the topmost member of the Jaisalmer Formation according to Kachhara and Jodhawat (1981) who placed this member above the Kuldhar Member. The member originally formed part of the Kuldhar Member. It was separated owing to its distinctive lithology and age. It consists of oolitic, bioturbated and cross-bedded limestone and sandstone. This member is also richly fossiliferous. The age of Jajiya Member is from Early to Late Oxfordian.

Yellow Limestone occurs mainly in the Kuldhar Member (Fig. 1), but locally also some deposits of Bada Bag and Jajiya members of the Jaisalmer Formation may be recognized as the local varieties of the Yellow Limestone. Yellow limestone includes thus the variety of fine-grained massive sandy limestones, sometimes also calacareous sandstones, sometimes with shelly limestone intercalations, everywhere showing the dominating yellow (but locally also brown) colours. It is also termed as yellow marble as it takes reasonably good polish. The main area of occurrence of the yellow limestone in the Jaisalmer Basin was divided into four blocks (A–D, see Fig. 1) out of which 3 blocks have been completely investigated, geologically mapped and the reserves estimated.

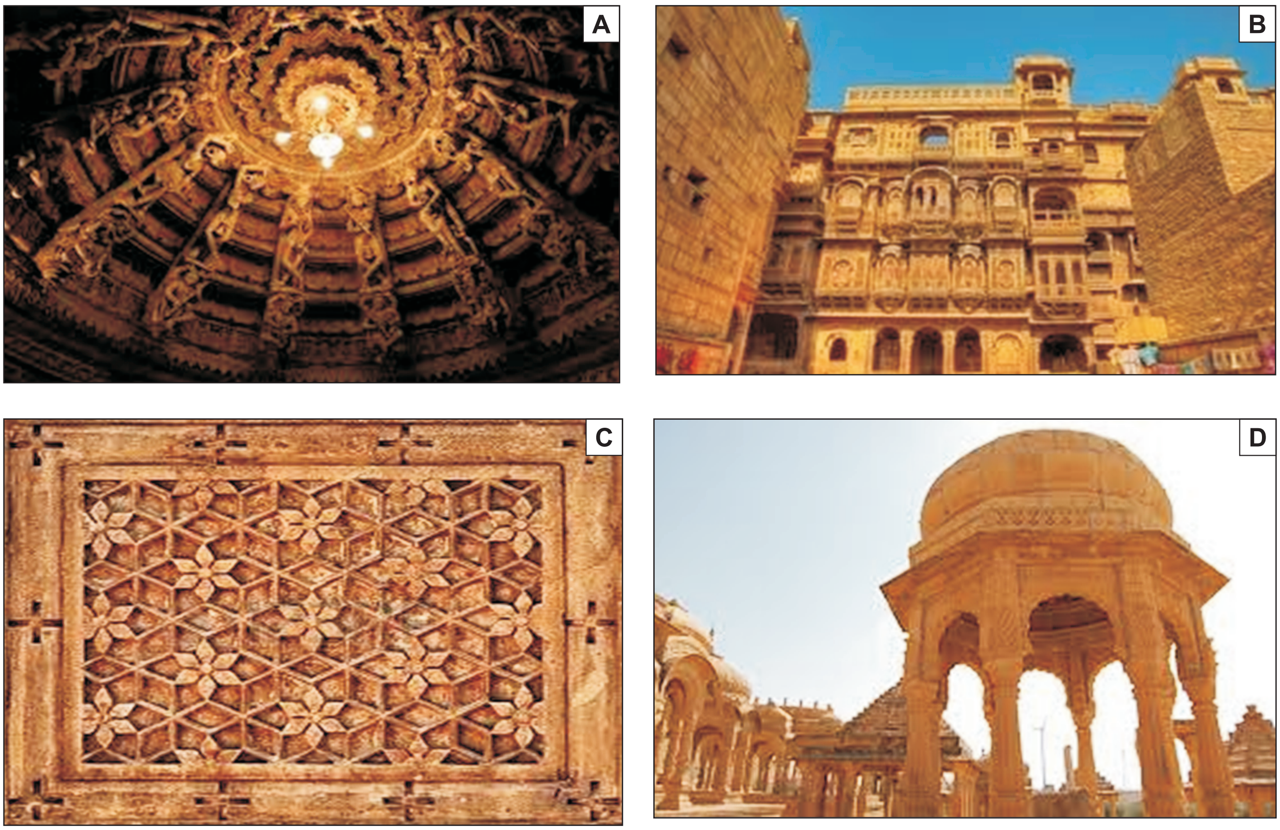

Fig. 2. A–C. Architecture inside the Jaisalmer Fort. D. The Bada Bag Cenotaphs: burial monuments ("chhatries") of the Maharawals of Jaisalmer and their families

ECONOMICS AND FUTURE OF THE YELLOW LIMESTONE

The limestone has an attractive appearance due to its bright yellow color. It is fine grained and takes a good polish and can be carved nicely. It can be used for manufacturing chips and tiles and as ornamental and decorative stone (Fig. 2). Since Jaisalmer has been linked by railway line and as a terminus on Jodhpur–Jaisalmer branch of the Northern Railway, there are good chances for its utilization as ornamental stone along with other marbles. It can very well fetch a good market in the marble industry all over India and may also earn foreign exchange if exported. This Yellow Limestone can be sawn into tiles of even 1.5 cm thickness. Polished tiles of this limestone can fetch about Rs.150 per sq. ft. Crude blocks can be sawn into thin tiles and slabs can fetch Rs.20 per cubic ft. The “Khandas” (small pieces of blocks) masonry stone fetches Rs.240 per ton in Jaisalmer. There are several factories established within 10 km distance from Jaisalmer on the Jaisalmer- Sam road which produces chips and tiles. There are chances for new more factories to open up in Jaisalmer which can produce tiles and chips of Yellow Limestone from the Jaisalmer area “Department of Mines & Geology”, 2004; Indian Bureau of Mines, 2011).

The demand for artifacts, especially carved work (Fig. 2) is on the rise the world over. India with its rich tradition of craftsmanship and trained artisans can embark upon the world scene. Improved quarrying, finishing and hauling technology, the availability of a greater variety of stones, and the rising cost of alternative construction materials, are among the factors that suggest a continuing increase in demand for dimension stones in future.

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REFERENCES

AGARWAL S.C., BHATNAGAR P., KHABYA N., 1988 — Limestone deposit of Rajasthan: 12–47. Publication of Department of Mines and Geology, Udaipur.

DAS GUPTA S.K., 1975 — A revision of the Mesozoic–Tertiary Stratigraphy of the Jaisalmer Basin, Rajasthan. *Indian Journal of Earth Sciences*, **2**, 1: 77–94.

DASHORA R.S., BHARGAVA K.D., 1971 — Investigation of Yellow Limestone and other economic minerals in Jaisalmer area. Report of field season 1970–71: 5–31. Department of Mines and Geology, Udaipur.

DAVE A., CHATTERJEE T.K., 1996 — Integrated foraminiferal and ammonoid biostratigraphy of Jurassic sediments in Jaisalmer Basin, Rajasthan. *Journal of the Geological Society of India*, **47**, 4: 477–490.

DEPARTMENT OF MINES & GEOLOGY., 2004 — Mineral directory of Rajasthan: 4–66. Publication of Department of Mines and Geology, Udaipur.

INDIAN BUREAU OF MINES., 2011 — Limestone and other calcareous materials, Indian Mineral Yearbook: 3–24. Publication of Indian Bureau of Mines, Nagpur.

KACHHARA R.P., JODHAWAT R.L., 1981 — On the age of Jaisalmer Formation, Rajasthan, India. Proceedings of IX Indian Colloquium on Micropalaeontology and Stratigraphy: 235–247. Udaipur.

KRISHNA J., 1987 — An overview of the Mesozoic stratigraphy of Kachchh and Jaisalmer basins. *Journal of the Palaeontological Society of India*, **32**: 136–149.

MAHENDRA K., BANERJI R.K., 1990 — Petrography, diagenesis and depositional environment of Middle Jurassic Jaisalmer Carbonates, Rajasthan, India. *Indian Journal of Earth Sciences*, **17**, 3/4: 194–207.

NARAYANAN K., SUBRAHMANYAN M., SRINIVASAN S., 1961 — Geology of Jaisalmer. Unpublished report O.N.G.C. Dehradun, India.

PANDEY D.K., FÜRSICH F. T., 1994 — Bajocian (Middle Jurassic) age of the Lower Jaisalmer Formation of Rajasthan, western India. *Newsletters on Stratigraphy*, **30**: 75–81.

PANDEY D.K., FÜRSICH F. T., SHA J., 2009 — Inter-basinal marker intervals – A case study from the Jurassic basins of Kachchh and Jaisalmer, western India. *Science China Series D Earth Sciences*, **52**, 12: 1924–1931.

PANDEY D.K., FÜRSICH F.T., ALBERTI M., 2014 — Stratigraphy and palaeoenvironments of the Jurassic rocks of the Jaisalmer Basin – Field Guide. *Beringeria*, Special Issue **9**: 1–111.

PANDEY D.K., SHA J., CHOUDHARY S., 2006 — Depositional environment of Bathonian sediments of the Jaisalmer Basin, Rajasthan, western India. *Progress in Natural Science* (Special issue of IGCP 506 on the Jurassic Boundary Events), **16**: 163–175; Beijing.

PANDEY J., DAVE A., 1998 — Stratigraphy of Indian Petroliferous Basins. *In*: Proceedings of XVI Indian Colloquium on Micropalaeontology and Stratigraphy: 1–248; Dehradun.

PAREEK H.S., 1984 — Pre-Quaternary geology and mineral resources of northwestern Rajasthan. *Memoirs Geological Survey of India*, **115**: 99

PRASAD S., 2006 — Ammonite biostratigraphy of Middle to Late Jurassic rocks of Jaisalmer Basin, Rajasthan, India. *Memoirs of the Geological Survey of India*, **52**: 1–146.

ROY A.B., JAKHAR S.R., 2002 — Geology of Rajasthan (North-west India) Precambrian to Recent. Scientific Publishers (India), Jodhpur: 421p.

SWAMINATHAN J., KRISHNAMURTHY J.G., VERMA K.K., CHANDIAK G.J., 1959 — General geology of Jaisalmer area, Rajasthan. Proceedings of the Symposium of Development in Petroleum Resources of Asia and the Far East. Mineral Resources Development Series, 10. Bangkok (ECAFE, UN).