

NOTE

Pyritized ooids from the Arabian Sea Basin

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Abstract—Pyritized ooids in association with turbidites were observed in a box core collected at a depth of 3627 m from the Arabian Sea Basin. Ooids having a shallow water origin were transported to the present depth by turbidity currents or slumping. Occurrence of pyrite at turbidite intervals suggests that pyritization in high organic carbon and H₂S abundant environments was mainly controlled by the supply of reactive iron. From the distribution of pyrite in the core it is inferred that reactive iron necessary for pyritization was transported as colloidal oxyhydroxides from the shelf region along with the ooids.

INTRODUCTION

PYRITE is a widespread authigenic mineral in sedimentary rocks and shallow water marine sediments where organic matter and reactive iron are abundant under sulfate reducing conditions. The distribution, origin and importance of pyrite in defining the environments of deposition are well documented (GOLDHABER and KAPLAN, 1974; GOLDHABER *et al.*, 1977; BERNER, 1982, 1984; RAISWELL, 1982; BERNER and RAISWELL, 1983; RAISWELL and BERNER, 1985).

In the Indian Ocean, MALLIK (1972) reported the presence of pyrite in the shallow marine sediments off Mangalore. In the present study, we report pyrite from a 12 m long box core from the Arabian Sea Basin. This is unique for two reasons, (i) the core is from a deep sea region, and (ii) the sediment consists of calcareous ooze.

CORE DESCRIPTION

A 12 m long (30 × 30 cm) box core was collected during the seventh cruise of O.R.V. *Sagar Kanya* from lat. 16°26'N; long. 69°57'E at a depth of 3627 m (Fig. 1). The coarse fraction (>62 µm) was studied under a binocular microscope. X-ray diffraction analyses were carried out on various fractions from different intervals, before and after treating with dilute acetic acid, with Philips X-ray diffractometer from 8° to 58° 2θ at 2° 2θ min⁻¹ using nickel-filtered Cu Kα radiation.

The core consists of interbedded foraminiferal ooze and turbidites (Fig. 2). Turbidites comprise of shell fragments, shallow water foraminifera, ooids and some detrital material. Laminations are observed throughout the length of the core. At two intervals (600–610, 910–915 cm) bioturbation is also noticed. The top 50 cm of the core exhibits

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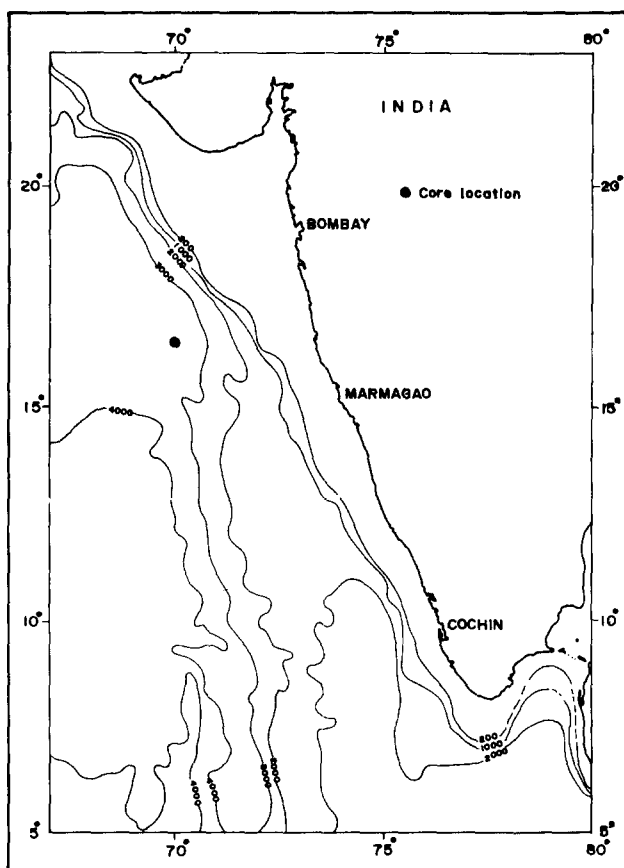


Fig. 1. Map showing core location, western continental margin of India.

low organic carbon (<1%) and CaCO_3 (<50%) contents. Below this level CaCO_3 increases with some fluctuations and reaches a maximum of 80–85% at various levels; organic carbon content also fluctuates and attains a maximum of 4–6% (Fig. 2).

Microscopic observations reveal that the coarse fraction comprises of mainly foraminifera. Ooids found at six intervals (235–245, 365–375, 535–560, 665–675, 735–740 and 990–1000 cm from top) are elliptical, spherical and discoidal in shape (Fig. 3). They exhibit a highly polished surface with black, grey, white and buff colours.

X-ray diffraction analyses of the bulk samples show that calcite is the prime constituent, whereas aragonite is the dominant mineral in the ooid intervals. Pyrite was not observed in the above analyses. After removing the carbonate by treating with dilute acetic acid, however, pyrite was noticed in the coarse fraction at the turbidite levels (Fig. 4) and not in any other levels.

DISCUSSION

Ooids form under warm water conditions in shallow agitated waters when the waters are supersaturated with CaCO_3 . On the western continental shelf of India, SHETTY (1972)



Fig. 3. Microphotograph showing pyritized ooids.

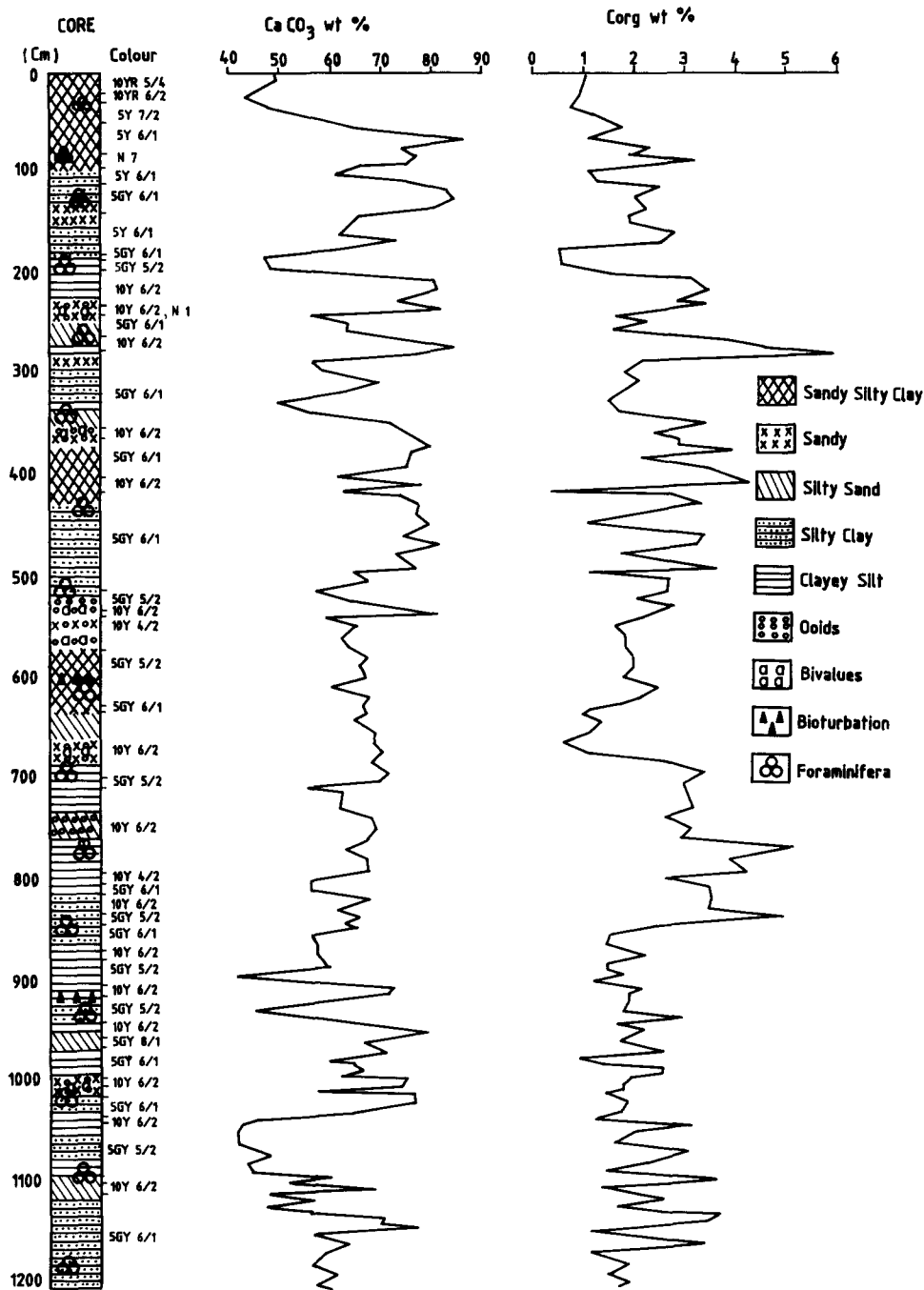


Fig. 2. Down-core variations of lithology, size fractions, calcium carbonate and organic carbon contents.

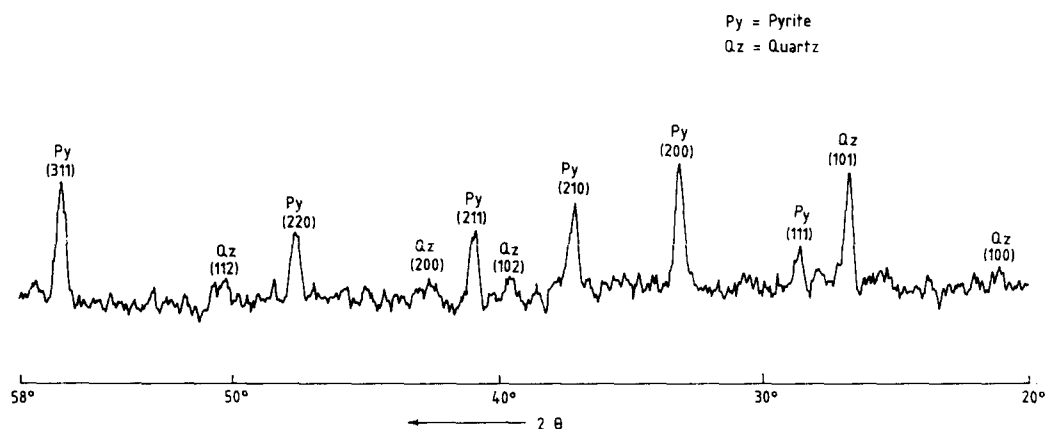


Fig. 4. Slow scan X-ray diffractogram of a sample showing pyrite.

suggested that ooids formed during the late Pleistocene or Holocene period; subsequent radiometric dating confirmed their age as 11,000 y BP (NAIR and HASHIMI, 1980). Therefore it is inferred that the ooids were transported either by slumping due to lowered sea levels or by turbidity currents. The occurrence of turbidites at many intervals along the core indicates that these processes have played an important role in the depositional history of the Arabian Sea.

The presence of pyritized ooids at turbidite intervals and their absence in the shelf region suggest that pyritization took place after their transportation to the present site. Pyrite forms during shallow burial due to reaction of the reactive iron with H_2S , which is produced by the reduction of interstitial dissolved sulfate by bacteria using sedimentary organic matter as reducing agent and energy source (BERNER, 1984). Pyrite is common where the organic matter content is greatest. In the area of high sedimentation and nutrient-rich waters production, deposition and burial of organic matter is higher and increasingly available for sulfate reduction, resulting in more H_2S and more pyrite formation (WESTRICH and BERNER, 1984). The availability of reactive iron minerals also controls the pyrite formation. In terrigenous marine sediments, iron minerals are abundant and readily available for reaction. In the case of highly calcareous sediments as encountered in the present core, free iron is insufficient as calcareous skeletal debris contains much less iron. The iron content in the carbonate phase of the sediments of the western continental margin of India is less than 0.048% (RAO, 1983). Therefore it appears that iron in the form of colloids of oxyhydroxides have been transported along with the ooids to the present depth and consequently reacted with the readily available H_2S to form appreciable quantities of pyrite. At other levels pyrite, not noticed due to low concentrations, may be below the detection limit of the X-ray diffractometer.

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