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CARBONATE PETROGRAPHY AND MICROFACIES OF A PORTION OF THE SAMANA SUK FORMATION, KOHAT RANGE, PAKISTAN

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ABSTRACT

Five carbonate microfacies occur in a portion of the Jurassic Samana Suk Formation of the Kohat Range, Pakistan. These microfacies are widespread over the area in the sections measured and indicate carbonate deposition in shoal environments in agitated water, restricted marine shoals and restricted marine shelf lagoons.

The detailed perographic study uncovered a duplication of section which had been caused by faulting and was previously unrecognized.

INTRODUCTION

The purpose of study was to identify and describe the carbonate microfacies from a portion of the Jurassic Samana Suk Formation in the Kohat Range, Pakistan.

Four stratigraphic sections were measured and sampled from a portion of the Saman Suk Formation north of Kohat (fig. 1). Samples were collected at 30 cm intervals or from each individual bed where lithologic changes were noted.

The field work was conducted between December 1980 and May 1981. A profile section was prepared in the field and all samples collected were orientd as to the top of the bed. All field measurements were made with a jacob's staff. The 319 samples were taken to the laboratory and slabs were cut and polished for microscopic examination. Sixty-two thin sections were prepared from representative lithologies and studied with the petrographic microscope. Photomicrographs were taken with a Zeiss 35 mm camera mounted on a petrographic microscope.

Folk's (1962) classification of carbonate rocks was used to describe the carbonate lithologies and Wilson's (1975) Standard Microfacies (SMF) were used for microfacies designation.

SAMANA SUK FORMATION

The name Samana Suk was introduced by Davies (1930) for the Jurassic limestone in the Samana Range. Fatmi (1968) designated a section northeast of Shinawar in the western part of the Samana Range as the type locality. Thickness of the formation ranges from 186 m at the type locality to 366 m at the Bagnotar section.

Several studies have been conducted in the Kohat Range where the Samana Suk Formation has been mapped or referred to in the reports (Khattak and others, 1978; Chaudhri and others, 1978; Tanoli and others, 1978). In all of these studies, the oolitic beds have been placed in the middle part of the Samana Suk Formation. Because of the structural deformation in the present study area, a complete uninterrupted section of the Samana Suk Formation was not available for study. We concentrated our study on the massive oolitic beds and the beds directly above and below the oolitic beds. We have assumed these beds are in the middle part of the formation as reported by the aforementioned authors.

Fatmi (1968, 1972) described a middle Callovian fauna from the Samana Suk Formation in the Surghar Range. The fauna contains brachiopods, pelecypods, ammonoids, gastropods, and crinoids. Shah (1977) concludes that the age of the formation is essentially Middle Jurassic and slightly older than middle Callovian in the Kohat Range.

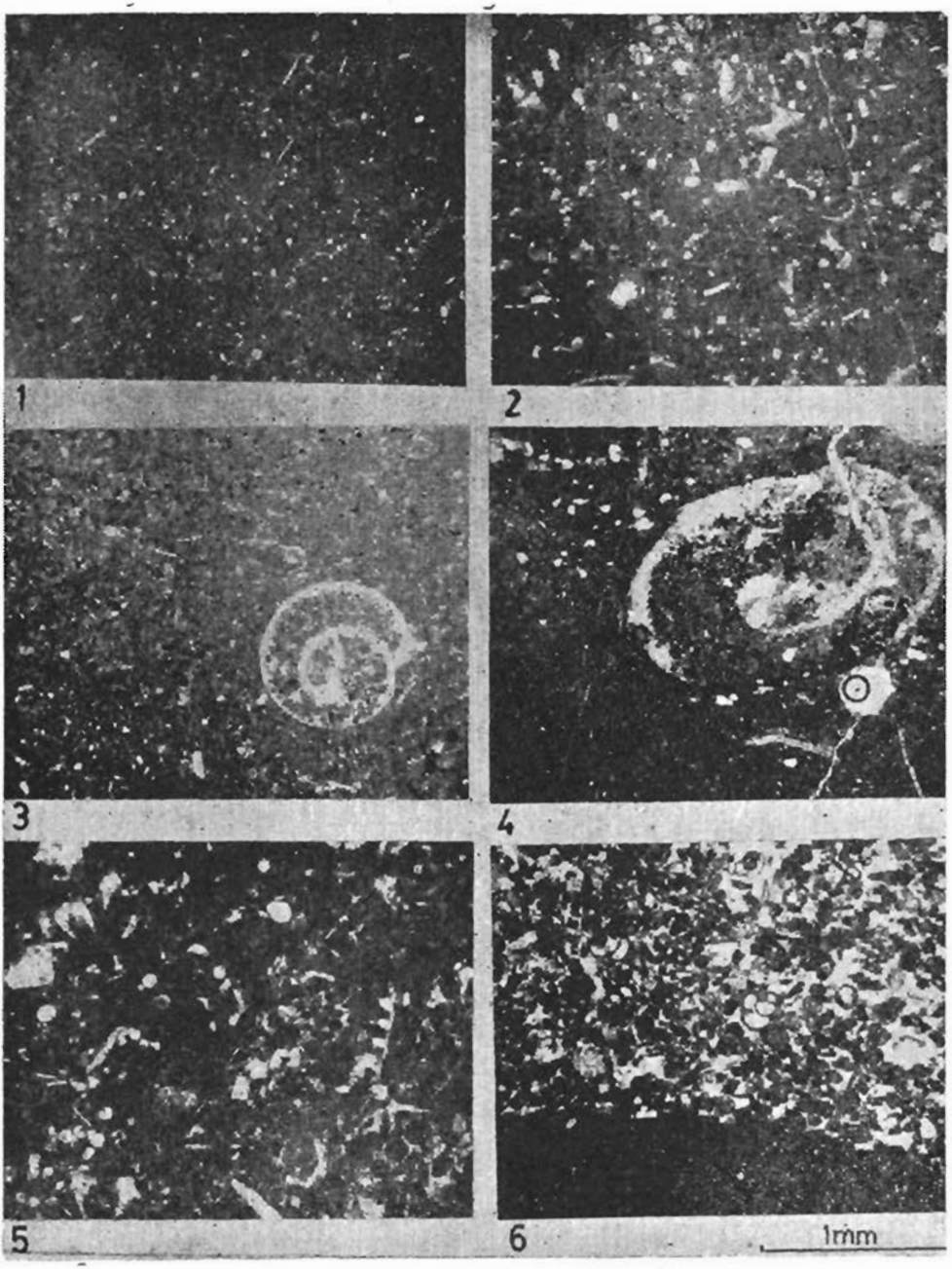
The four measured sections are located on an east-west traverse beginning at a road outcrop on the Peshawar to Kohat Northwest Frontier Road approximately 4.5 km southwest of Kotal Pass. Section one was sampled along the road. Section two is approximately 250 m west of section one (fig. 2) on the highest ridge. Section three is located on a small ridge about 175 m west of section two. Section four is on the east side of the valley approximately 175 m west of section three. Thicknesses of the sections ranges from 26 m (section 4) to 35 m (section 2).

Correlation of the microfacies from section to section is easily done as most of the microfacies are very widespread throughout the study area. Using the massive oosparite microfacies as a marker horizon (fig. 3), the microfacies above and below are eaisly correlated.

CARBONATE MICROFACIES

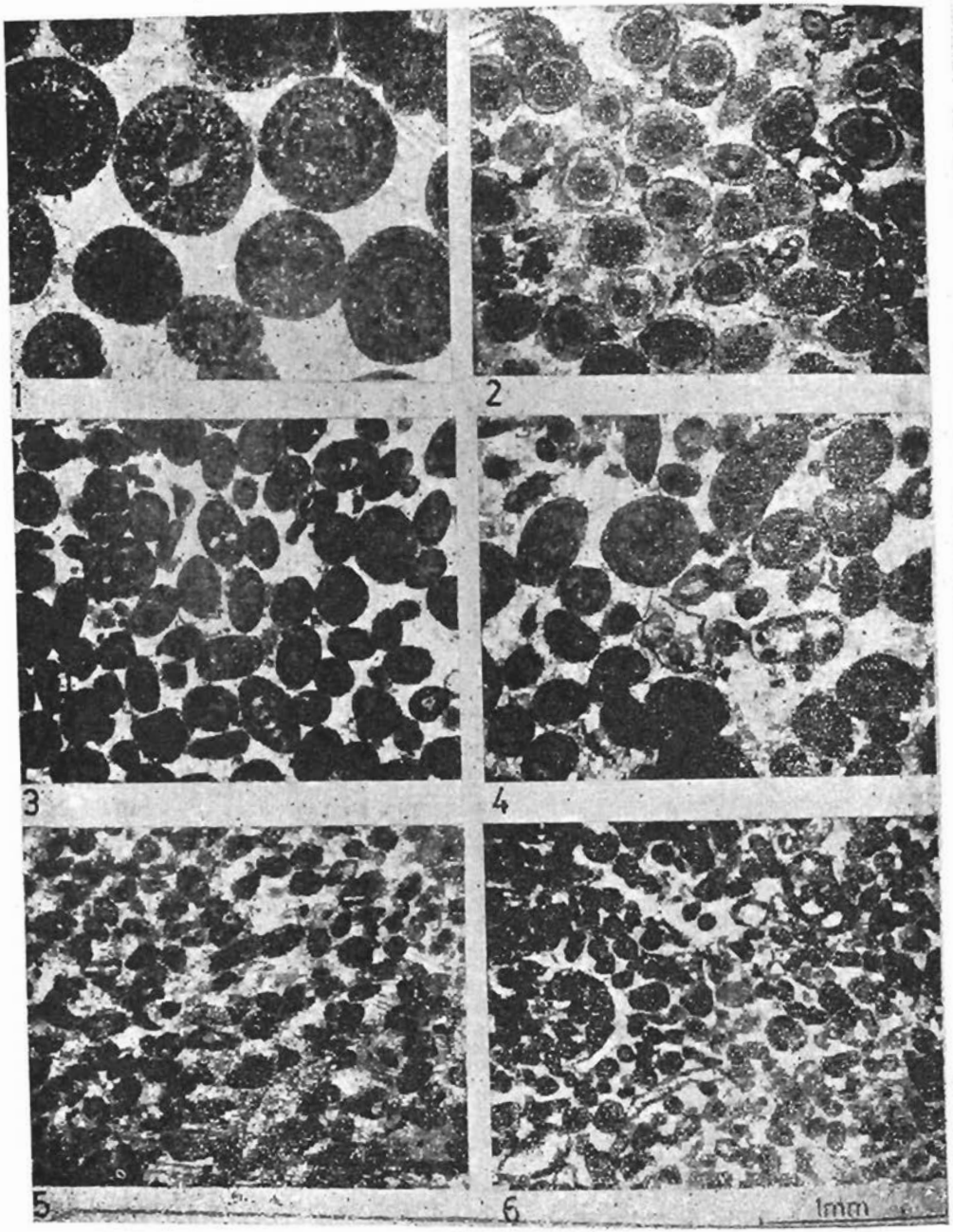
Microfacies identified during this study belong to either the shoal environment in agitated water; restricted marine shoals; or restricted marine shelf lagoons. Organisms representing more normal marine environments such as crinoids, bryozoans, and corals are very rare in the measured sections. The microfacies present throughout the sections appear to be indicative of shallower and more restricted seas than reported for the Arab D cycle (Powers, 1962).

PLATE I



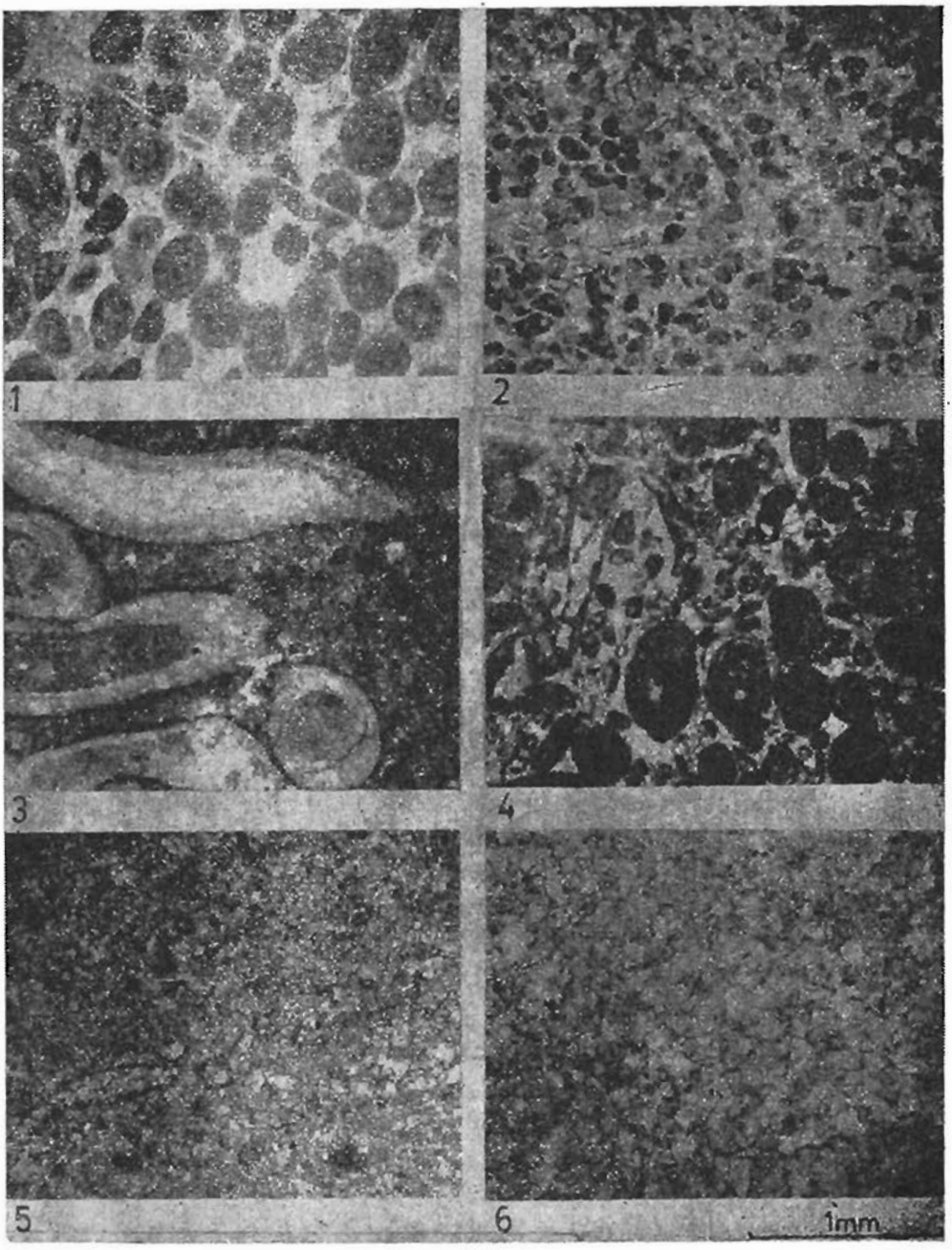
(For description of Plate I, see page 78)

PLATE II



(For description of Plate II, see page 78)

PLATE III



(For description of Plate III, see page 78)

PLATE I

Fig. 1. Fossiliferous micrite: few octracods and sponge spicules.

Fig. 2. Ostracodal biomicrite: ostracods, sponge spicules, and terrigenous grains.

Fig. 3. Gastropodal–ostracodal biomicrite: ostracods, gastropods, sponge spicules, and terrigenous grains.

Fig. 4. Gastropodal biomicrite: gastropods and terrigenous grains.

Fig. 5. Gastropodal–algal–foraminiferal biomicrite: abundant foraminifers, green algae, and gastropods.

Fig. 6. Foraminiferal biopelsparite overlying fossiliferous micrite: abundant foraminifers and peloids in a spar cement in sharp contact with a dense fossiliferous micrite.

PLATE II

Fig. 1. Oosparite: ooids showing concentric and radial structure.

Fig. 2. Oosparite: ooids and superficial ooids with few foraminifers.

Fig. 3. Dolomitized oosparite: dolomitized ooids and superficial ooids with few foraminifers.

Fig. 4. Dolomitized oosparite: dolomitized ooids and superficial ooids with bioclasts of algae and molluscs.

Fig. 5. Pelsparite: peloids and bioclasts in a spar cement.

Fig. 6. Foraminiferal biopelsparite: peloids and foraminiferal tests with some algal plates in a spar cement.

PLATE III

Fig. 1. Foraminiferal oosparite: ooids with few foraminiferal tests in spar cement.

Fig. 2. Biopelsparite: peloids and bioclasts in a spar cement.

Fig. 3. Algal (?) thalli in a biomicrite: algal (?) thalli with ostracods and sponge spicules in a micrite matrix.

Fig. 4. Algal–foraminiferal biosparite: abundant bioclasts with algal coated grains in a spar cement.

Fig. 5. Dolomite: few ghosts of bioclasts in a fine–grained dolomite.

Fig. 6. Dolomite: coarse–grained dolomite.

Oosparite Microfacies (SMF—15)

The dominant microfacies is the oosparite microfacies (Plate II, figs. 1—4; Plate III, fig. 1). Thickness ranges from 10.7 m to 11.9 m. Medium-scale festoon cross bedding is common in the microfacies. A radiating rill weathering pattern characterizes the surface of these beds.

Petrographically, the dominant allochems are ooids and superficial ooids. These ooids have been both radial and concentric structure around nuclei consisting of peloids, foraminifers, and other bioclastic fragments. Size of ooids ranges from 0.2 mm to 0.9 mm. Rounded foraminifers, algal plates, and peloids occur with the ooids. The cement is spar.

A subtype of this microfacies contains intraclasts composed of ooids, peloids, and biomicrite. These intraclasts occur in the upper half of the oosparite microfacies. They form four distinct intervals that are useful for local correlation between sections. Because the intraclasts are widespread laterally, we have interpreted them as representing a period of turbulence where partly consolidated sediments were torn up and deposited widely over the area.

Pelsparite Microfacies (SMF—16)

The principal microfacies in the lower one-third of the measured sections is a pelsparite microfacies (Plate II, fig. 5; Plate III, fig. 2). Peloids ranging from 0.02 mm up to 0.15 mm comprise more than 33 percent of the microfacies. The peloids appear as dark grains without any internal structure. Bioclasts make up from 10 to 20 per cent of the pelsparite microfacies. Principal bioclasts are ostracods, foraminifers, sponge spicules, and green algae plates. Echinoid spines and molluscs are also present. Intraclasts are present at one interval. Terrigenous material comprises less than 2 percent of the microfacies.

Foraminiferal Biopelsparite Microfacies (SMF—18)

Foraminiferal tests are the most abundant type of bioclstic allochems in the biopelsparite microfacies Plate I, fig. 6; Plate II, fig. 6). These tests are so abundant the rock is properly classified as a biopelsparite. Peloids range from 0.02 mm to 0.18 mm and foraminifers range from 0.08 mm to 0.4 mm. The cementing material is spar.

Gastropodal Biomicrite—Biosparite Microfacies (SMF—19)

The gastropodal biomicrite–biosparite microfacies occurs below and above the oosparite microfacies. These microfacies consist of bioclastic allochems in a micrite matrix (Plate I, figs. 1–5). Common bioclasts are gastropods, foraminifers, ostracods, sponge spicules, and green algae plates. Terrigenous grains are also present. Bioturbation has resulted in a thorough mixing of the sediment in these microfacies.

Additional detailed studies of the Jurassic, Cretaceous, and Tertiary stratigraphic sections are necessary for interpreting the general stratigraphy and structure of the complex area.

At the very top of the studied sections, a special type of this microfacies is present which consists of a dasycladacean (?) algae in a micritic matrix. These algal(?) thalli appear as interwoven tubes in discrete clusters. The diameter of the algal (?) thalli is 0.4 mm to 0.6 mm and the length is 4.0 mm to 5.5 mm. The diameter of the clusters ranges up to 1.3 cm.

Fossiliferous micrite (SMF–19) is a subtype of the gastropodal biomicrite. The fossiliferous micrite forms a prominent zone three to four meters thick directly on top of the oosparite microfacies. In this microfacies, the bioclasts comprise less than 10 per cent of the rock and consist primarily of ostracods and sponge spicules.

Algal Foraminiferal Biosparite (SMF—11)

Green algae plates, foraminifers, and algal coated grains make up most of the allochems in the algal-foraminiferal biosparite (Plate III, fig. 4). The microfacies occurs in the lower part of the section in only a few locations. Most of the allochems are rounded, poorly sorted, and in a spar cement.

DOLOMITE

Beds of dolomite are present in several parts of the studied section. These dolomite beds are very continuous and can be traced from section to section. The dolomite beds overlie the gastropodal biomicrite and fossiliferous micrite microfacies.

The dolomite occurs as fine to coarsely crystalline, anhedral mosaic crystals (Plate III, figs. 5, 6) very similar to those described by Powers (1962, p. 142–143).

STRUCTURAL INTERPRETATIONS

Detailed studies of the carbonate microfacies can aid in the understanding of the structurally complex Kohat Range. Recognition of sequences of microfacies and microfacies with widespread distribution are especially useful in discerning structurally repeated stratigraphic sections or incomplete sections caused by faulting.

Although the stratigraphic section in the study area appears to be a normal sequence, in fact, it has been duplicated by faulting (fig. 3). The detailed study of the carbonate microfacies disclosed an exact duplication of the section and led to the recognition of the fault.

CONCLUSIONS

Five microfacies are present in the study area. They are oosparite (SMF–15), pelsparite (SMF–16), foraminiferal biopelsparite (SMF–18), gastropodal biomicrite–biosparite (SMF–19), and algal–foraminiferal biosparite (SMF–11). Extensive dolomite beds are also present.

All of these microfacies indicate carbonate deposition in a shallow and restricted sea.

Detailed petrographic study of the carbonate microfacies aided in the structural interpretation of the study area.

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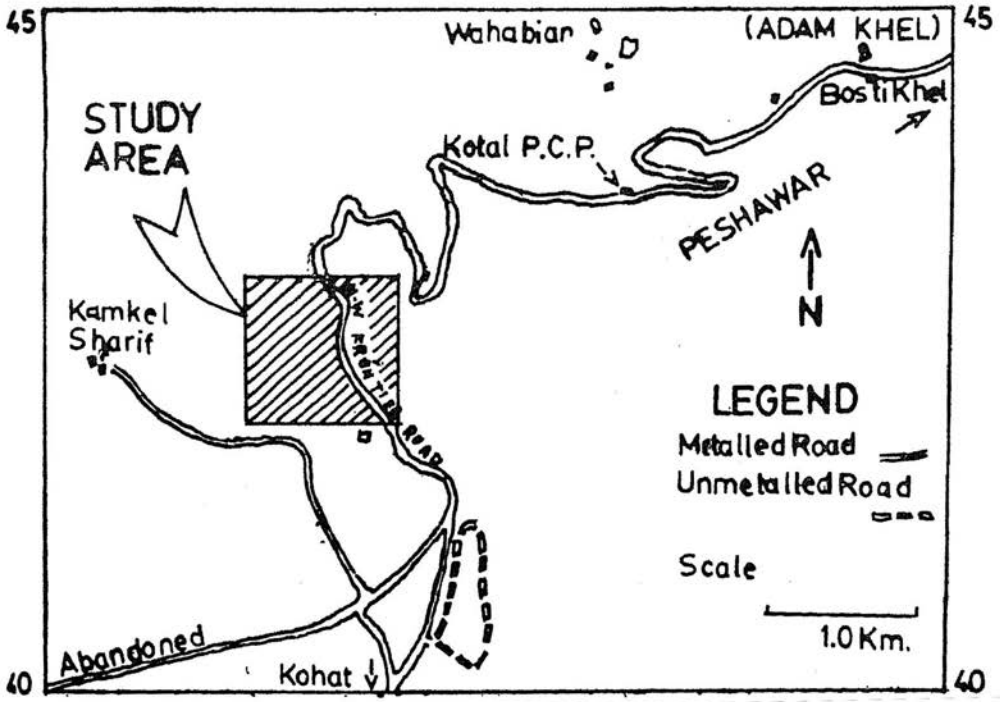

Fig. 1. Index map showing location of study area.

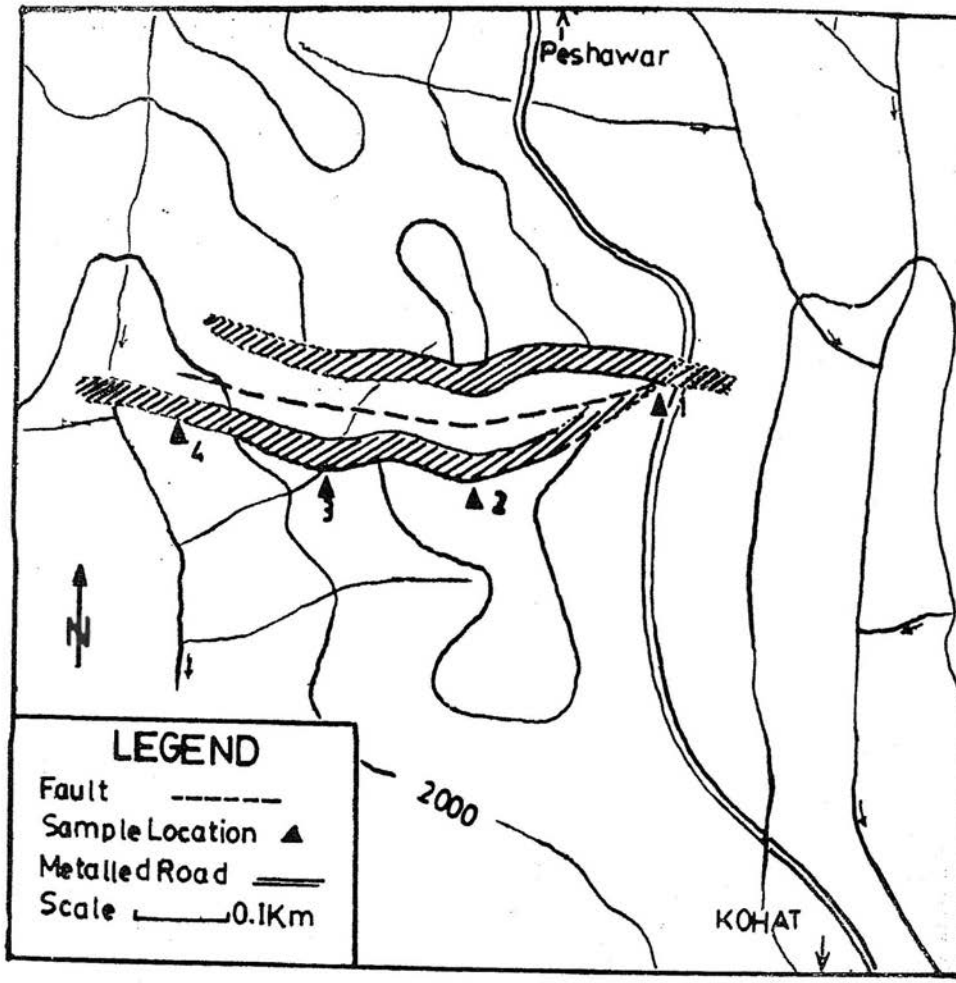

Fig. 2. Map showing outcrop of studied portion of Samana Suk Formation (shaded bands) and location of measured section.

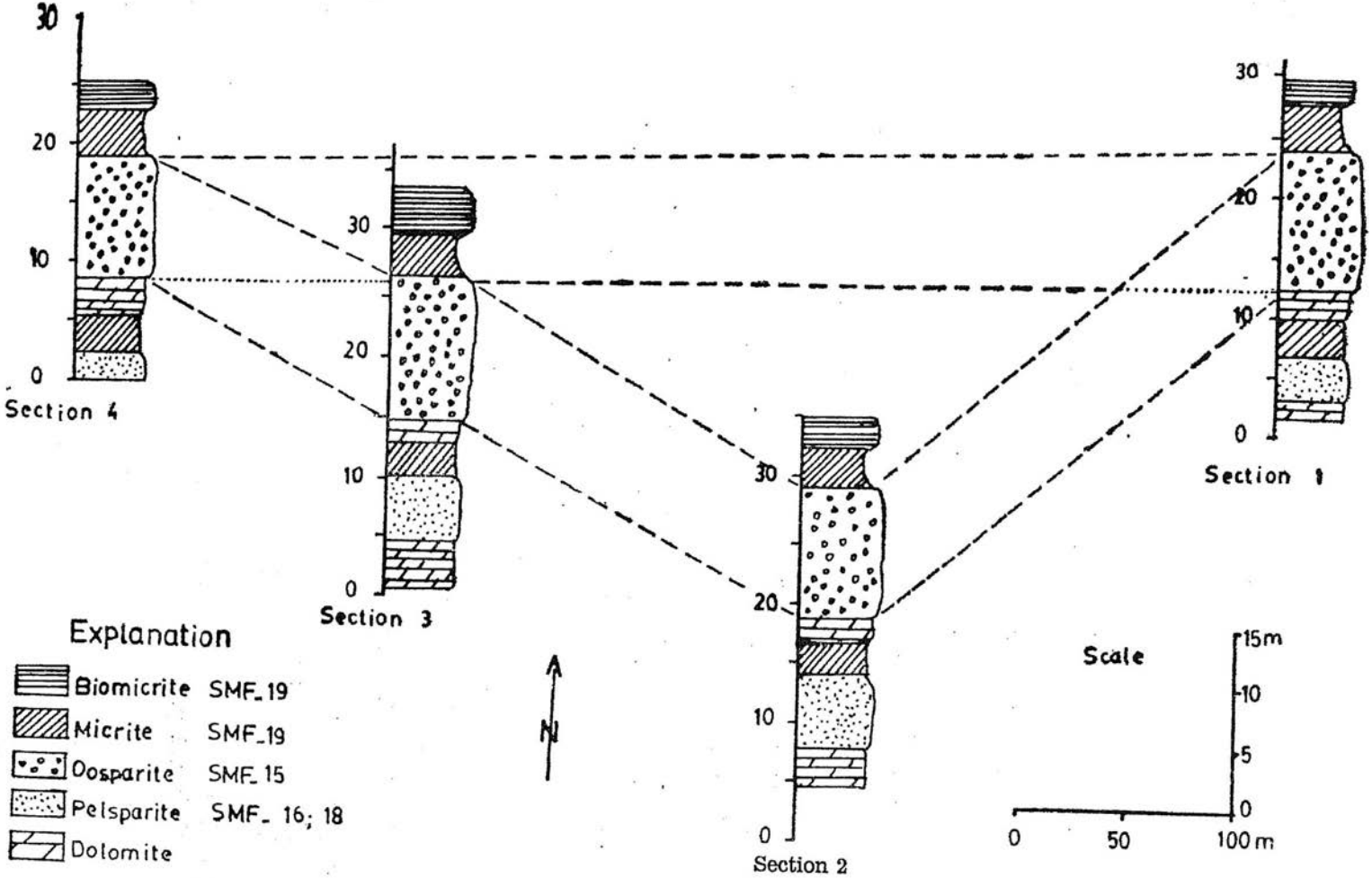

Fig. 3. Generalized sections showing standard microfacies and correlation of oosparite microfacies (SMF–19) between the four measured sections.

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