UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

PROJECT REPORT
Pakistan Investigations
(IR) PK-36

CRETACEOUS (ALBIAN-CENOMANIAN) PLANKTONIC FORAMINIFERA IN BANGU NALA, QUETTA DIVISION PAKISTAN

by

Edward B. Fritz
U. S. Geological Survey

and

Mujib-ur Khan
Geological Survey of Pakistan

OPEN FILE REPORT

This report is preliminary and has not been edited or reviewed for conformity with Geological Survey standards or nomenclature

Prepared under the auspices of the Government of Pakistan and the Agency for International Development U. S. Department of State

1973

CRETACEOUS (ALBIAN-CENOMANIAN) PLANKTONIC FORAMINIFERA IN BANGU NALA, QUETTA DIVISION, PAKISTAN

By

Edward B. Fritz
U. S. Geological Survey

and

Mujib-ur Khan
Geological Survey of Pakistan

CONTENTS

TABLES

ILLUSTRATIONS

CRETACEOUS (ALBIAN-CENOMANIAN) PLANKTONIC FORAMINIFERA IN BANGU NALA, QUETTA DIVISION, PAKISTAN

by

Edward B. Fritz
U.S. Geological Survey

and

Mujib-ur Khan
Geological Survey of Pakistan

ABSTRACT

Planktonic Foraminifera in rocks exposed along Bangu Nala, 18 miles southeast of Quetta, establish the age of the Cretaceous strata as Albian to Cenomanian. These strata are in the upper part of a sequence that has been known informally as the "Belemnite shale,"** and may be equivalent to rocks that have recently been named the Goru Formation.* Species observed in the collections indicate that the strata were deposited in a deep oceanic shelf environment.

INTRODUCTION

Since the beginning of paleontological investigations in the first half of the 19th century in India and Pakistan, many geological age determinations of Cretaceous and Tertiary formations have been based on the larger Foraminifera found in limestones (Carter, 1853, 1861a, b; Davies, 1940, 1941a, b; Davies and Pinfold, 1937; Nuttall, 1925, 1926, 1927, 1932; Vredenburg (1908).

It has been only since about 1940 that smaller Foraminifera have received attention from workers in the area (Haque, 1956). In recent years, the exploration for petroleum by oil companies has generated renewed interest in defining the stratigraphy of the country, and paleontologists have focused attention not only on larger Foraminifera, but also on planktonic Foraminifera. The use of the planktonic forms in defining the geologic age of formations from the Early Cretaceous to the Holocene in many areas of the world has been of great value to paleontologists and stratigraphers working in Pakistan, because many of the diagnostic forms reported from other areas are also present in the marine formations of Pakistan. The biostratigraphical study of the Cretaceous rocks of Pakistan is particularly important because of their potential as reservoirs of petroleum, their association with deposits of chromite, iron, and laterite, and their importance to the general understanding of the tectonic history of Pakistan.

The study on which this report is based was undertaken to obtain reference collections and information that would contribute to an understanding of the Cretaceous stratigraphy of Pakistan. Rocks cropping out in the Bangu Nala were selected for this study because of the accessibility of the locality and the excellence of the exposure there. The study was an activity of the Mineral Exploration and Development Program, a joint project of the Geological Survey of

Pakistan and the U.S. Geological Survey, undertaken on behalf of the Government of Pakistan and the U.S. Agency for International Development.

Bangu Nala is about 18 miles southeast of the city of Quetta, Pakistan, about 2 miles south of the coal mining community of Daghari (fig. 1). The rocks studied crop out in Bangu Nala canyon, about three-fourths of a mile east of a narrow gorge cut through a hogback of resistant Upper Cretaceous and Paleocene limestone along the northern side of Bangu Peak.

Fieldwork and acknowledgments

Fieldwork done in March 1964 consisted of measuring and sampling a detailed stratigraphic sequence, beginning in rocks of Jurassic age and continuing through the well-exposed rocks of Cretaceous and Paleocene age in Bangu Nala. Samples were collected at 10-foot stratigraphical intervals and examined for microfossil content.

The authors wish to thank J. A. Postuma, Shell Oil Company, for providing reference material on planktonic Foraminifera for identification purposes.

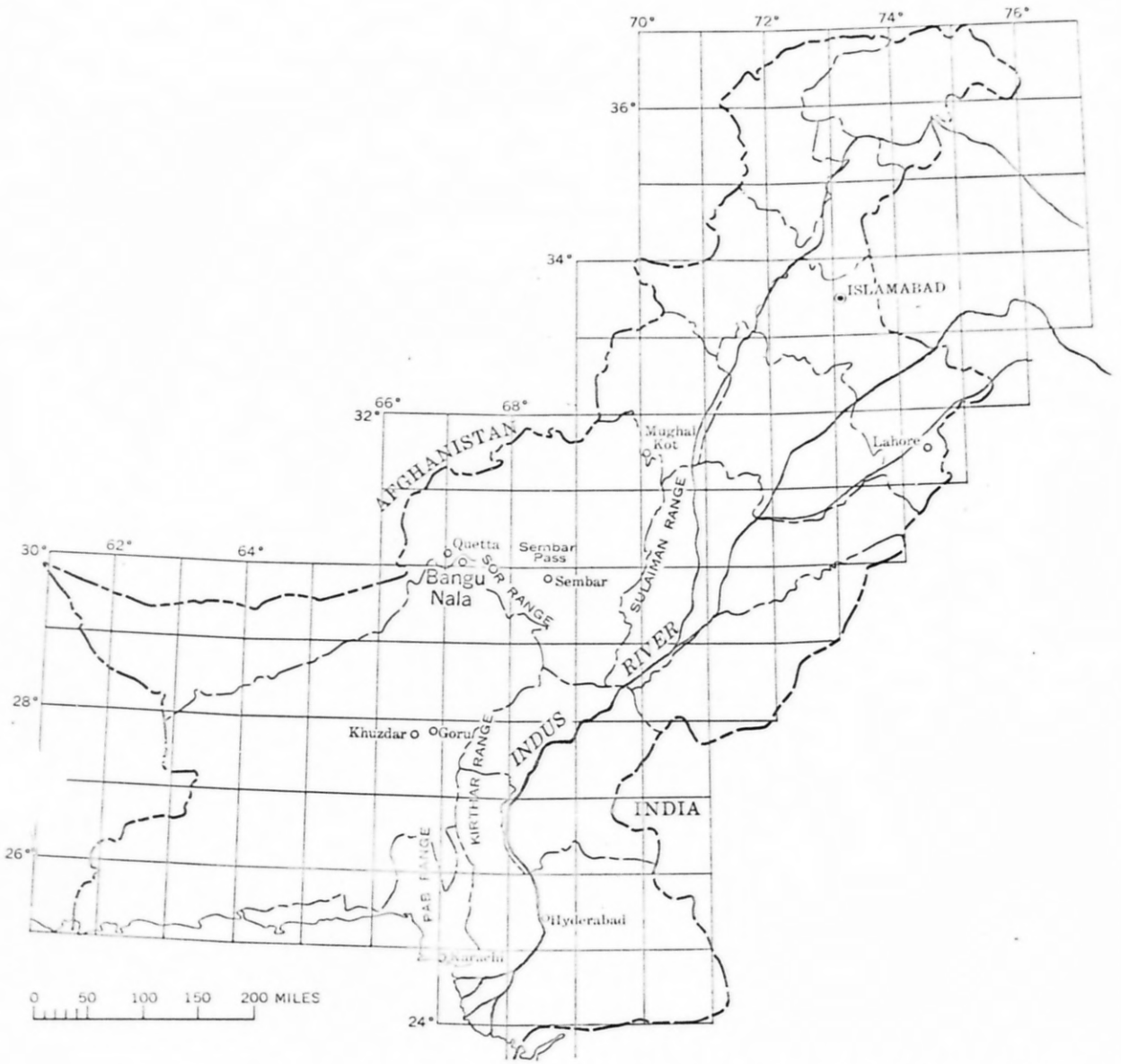

Figure 1.—Index map of Pakistan showing location of Bangu Nala.

GEOLOGIC FORMATIONS

Stratigraphy of the Bangu Nala area

The stratigraphic sequence[1/] (table 1) exposed in Bangu Nala is made up of Jurassic to Paleocene sedimentary rocks. Rocks of Eocene and Oligocene ages are also exposed in the vicinity. The rocks from which Foraminifera were collected are a sequence of interbedded claystone, siltstone, and limestone that has been informally called the "Belemnite shale"** or "Belemnite beds."** This unit underlies a prominent, well bedded, light-gray limestone generally called the Parh Limestone,* and overlies a thick sequence of medium- to dark-gray limestone generally called the Chiltan Limestone* in this region, and may be equivalent to the Goru Formation* of Williams (1959).

1/ The stratigraphic nomenclature in Pakistan is being reviewed by the Stratigraphic Committee of Pakistan for conformity with the new Stratigraphic Code (1962). Most stratigraphic names used in this report have not yet been reviewed and therefore do not have the same status under the Code. Present status of these names is indicated as follows:

no asterisk — Name formally accepted under the Code.

* — Name not formally accepted, but believed to meet the requirements of the Code.

** — Name does not meet the requirements of the Code, but has been used in previous published or unpublished reports.

Table 1. Sequence of rocks exposed in the Bangu Nala area

System and Series			Stage	Formation	Thickness (in feet)	Description
Tertiary	Oligocene					
	Eocene	Upper		Kirthar Formation	Unknown	Limestone, gray to light gray, dense, hard.
		Middle				
		Lower		Ghazij Shale	6000+	Shale, olive green to gray, to medium gray, hard.
	Paleocene			Dunghan Formation	491	Limestone gray to bluish gray, yellow to brown, dense, hard.
Cretaceous	Upper		Maestrichtian	Parh Limestone*	225	Limestone, light grayish green or light gray, white or pink dense, sublithographic.
			Campanian, Santonian Coniacian, and Turonian			
			Cenomanian	Goru Formation*	340	Thin limestone layers interbedded with siltstone, gray to dark gray and claystone, maroon at base.
	Lower		Albian			
			Aptian ?	Covered Interval	100	
Jurassic				Chiltan Limestone*	Unknown	Limestone, dark gray to gray, dense, hard.

Classification and correlation of the strata

Oldham (1892, p. 19) introduced the name "Belemnites beds,"** for strata in Sembar Pass, near Sembar and about 90 miles east of Quetta, believed to be equivalent to those studied in this report. He described this sequence as follows:

> "The massive Cretaceous limestones are overlain with perfect conformity by a series of beds which, in the Sembar pass, attains a thickness of at least 1,000 feet, but is usually much thinner, the difference being apparently due principally to a squeezing out of the lower shaly beds by compression. In the Sembar pass the lower half of the group is composed of black shales with some sandy and calcareous beds and, near their base, the shales contain an admixture of volcanic ash. The upper half of the group consists of distinctly bedded green and purple indurated marls and limestone, capped by about 250 feet of compact white limestone."

Vredenburg (1907) used the term Belemnite shale** for the sequence above the "massive Cretaceous limestones" of Oldham, and Gee (1944, table 1) used Belemnite beds.**

The "massive Cretaceous limestones" of Oldham were subsequently determined to be Jurassic (Williams, 1959), and these rocks are now called the Chiltan Limestone.* In the same report (p. 384), Williams called the lower half of the sequence overlying the Jurassic limestone in Sembar Pass the Sembar Formation;* the upper part, consisting of

distinctly bedded green and purple marls and limestones he named the Goru Formation* (p. 385); and the 250 feet of compact white limestone he states (1959, p. 384) is Parh Limestone*.

Outcrop at Bangu Nala

The outcrop at Bangu Nala from which Foraminifera were collected consists of hard limestone layers alternating with siltstone and claystone. The limestone is fine grained, light yellow to medium gray, and forms layers 2 to 8 inches thick. The limestone beds constitute about 50 percent of the basal part of the exposed section, but decrease to less than 20 percent in the upper half of the exposure. The siltstone is maroon at the base, but changes to grayish-green above. In the upper 150 feet, the color becomes gray or very dark gray. The maroon rocks weather to a deep red, but the grayish-green, gray, and dark-gray rocks weather to bluish green. In general, the siltstone and claystone are hard, blocky, and become very thin bedded toward the top.

The authors believe that the siltstone and claystone with limestone beds exposed in Bangu Nala are probably the equivalent of the Goru Formation* as defined by Williams because of their lithologic similarities to the type section and their stratigraphic position immediately below the Parh Limestone*. The contact between the Parh Limestone* and the probable Goru Formation* is shown in figure 2. The Sembar Formation may be present in a 100-foot covered interval,

Figure 2. Contact between the Parh Limestone (above) and the probable Goru Formation (below)

stratigraphically below the rocks that are exposed. However, our present knowledge of the lithologic variations, faunal content, and distribution of both the Goru* and Sembar* does not permit positive identification of the strata at Bangu Nala.

FORAMINIFERA

The Foraminifera in the rocks believed to be Goru* in Bangu Nala consist of mixed planktonic and benthonic forms, the planktonic forms are dominant (table 2). The latter are very abundant and well preserved, permitting accurate determination of the geologic age to be made.

The contact between the Lower and Upper Cretaceous (Albian-Cenomanian) beds is 280 feet below the base of the Parh Limestone*. The base of the Cenomanian sequence was determined on the basis of the first stratigraphic appearance of Globigerinelloides breggiensis (Gandolfi) which is not known to be present in Lower Cretaceous (Albian) strata. The lowermost appearance of the following two forms was 10 feet above the Albian-Cenomanian boundary: Rotalipora ticinesis (Gandolfi), and Planomalina buxtorfi (Gandolfi).

Other diagnostic Cenomanian forms are listed below, in order of the lowermost stratigraphic appearance of each:

1. Rotalipora appennenica (Renz)
2. Globigerinelloides caseyi (Bolli, Loeblich, and Tappan)
3. Praeglobotruncana stephani (Gandolfi)
4. Rotalipora brotzeni (Sigal)
5. Rotalipora reicheli (Mornod)
6. Praeglobotruncana stephani (Gandolfi) var. turbinata Reichel

Table 2.—Foraminiferal range chart for the Albian-Cenomanian in the Bangu Nala section, Quetta Division, Pakistan.

Period	Cretaceous																																							
Epoch	Early						Late																																		
Formation	Goru																																						Parh Ls	
Stage	Albian						Cenomanian																																	
Sample number	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140			
Globigerinelloides algeriana (Cushman and ten Dam)																																								
Ticinella roberti (Gandolfi)																																								
Gavelinella lorneiana (d' Orbigny)																																								
Globigerinelloides breggiensis (Gandolfi)																																								
Rotalipora ticinensis (Gandolfi)																																								
Planomalina buxtorfi (Gandolfi)																																								
Rotalipora appennenica (Renz)																																								
Globigerinelloides caseyi (Bolli, Loeblich, and Tappan)																																								
Praeglobotruncana stephani (Gandolfi)																																								
Rotalipora brotzeni (Sigal)																																								
Rotalipora reicheli (Mornod)																																								
Praeglobotruncana stephani (Gandolfi) var turbinata Reichel																																								

No Turonian forms were found, although the presence of Rotalipora reicheli Mornod suggests that the Cenomanian-Turonian contact is nearby. This confirms the belief that the base of the Parh Limestone* is of late Cenomanian age, at least in the Dangu Nala area (see table 1).

The presence of Globigerinelloides algeriana Cushman and ten Dam in the lowest sample stratigraphically (sample no. 104, table 2) suggests that the Albian-Aptian contact may be nearby, and that some of the covered interval may be as old as Aptian. Because the Albian and Cenomanian sequences are well developed, it is improbable that the balance of the Lower Cretaceous (Aptian and Neocomian) sequences could be present in the 100 feet of covered interval between the Jurassic and Cretaceous rocks. There is no evidence that any section is missing owing to faulting. Therefore, an unconformity may be present between the Jurassic and the Cretaceous rocks.

The Foraminifera found in the Goru Formation* indicate that the unit was deposited in a marine environment, open to the ocean currents, in the deeper waters of the continental shelf.

SUMMARY

The study of rich foraminiferal assemblages from an outcrop in the Bangu Nala definitely establishes the geologic age of the formation, which may be the equivalent of the Coru Formation* of Williams, as Albian to Cenomanian, and shows that the Lower Cretaceous-Upper Cretaceous boundary is present in the outcrop. The interval from the base of the exposure to the underlying Jurassic rocks does not seem thick enough to accommodate a complete Lower Cretaceous sequence, which could mean there was an hiatus and that most Lower Cretaceous (Neocomian) rocks are missing.

The rich planktonic and benthonic foraminiferal fauna indicates that the formation was deposited in warm, clear waters of the open ocean on the continental shelf.

SELECTED REFERENCES

Blanford, W. T., 1880, The Geology of Western Sind: India Geol. Survey Mem., v. 17, p. 1-210.

Carter, H. J., 1853, Descriptions of some of the larger forms of fossilized Foraminifera in Science; with observations on their internal structure: Annales Mag. Nat. History, ser. 2, v. xi, p. 161-177.

_____, 1861a, On Contributions to the Geology of Western India including Sind and Baluchistan: Asiatic Society of Bombay Journal, v. 6, p. 161-206.

_____, 1861b, On the Fossil Foraminifera of Scinde: Annales Mag. Nat. History, ser. 3, v. viii, p. 366-382, 446-470.

Davies, L. M., 1940, The upper Khirthar beds of north-west India: Geol. Soc. London Quart. Jour. v. 96, p. 199-230.

_____, 1941a, Correlation of Laki Beds: Geol. Mag., v. 78, p. 151-152.

_____, 1941b, The "Dunghan" limestone and Ranikot beds in Baluchistan: Geol. Mag. v. 78, p. 316-317.

Davies, L. M., and Pinfold, E. S., 1937, The Eocene beds of the Punjab Salt Range: India Geol. Survey Mem., Paleont, Indica, new ser., v. 24, no. 1, p. 1-79.

Day, A. E., and others, 1962, Stratigraphic code of Pakistan: Pakistan Geol. Survey Mem., v. 4, pt. 1, 8 p.

Gee, E. R., 1945, The age of the Saline series of the Punjab and Kohat: India Natl. Acad. Sci., Sec. B., Proc., v. 14, pt. 6, p. 269-311.

Gignon, W. O., 1962, Upper Cretaceous stratigraphy of the well Ciandari 1 and its correlation with the Sulaiman and Kirthar Ranges, West Pakistan: United Nations Economic Commission for Asia and the Far East, Second Petroleum Symposium, Tehran, September 1962.

Haque, A.F.M.M., 1956, The Foraminifera of the Ranikot and Laki of the Namal Gorge, Salt Range: Pakistan Geol. Sur. Mem., Palaeontolgia Pakistanica, v. 1, p. 1-228.

Hunting Survey Corp., Ltd., 1960, Reconnaissance geology of part of West Pakistan: Toronto, 550 p. (A report prepared for the Covt. of Pakistan by the Govt. of Canada).

Loeblich, A. R., Jr., and Tappan, H., 1964, Treatise on invertebrate paleontology, Part C, v. 1, 510 p.: The Geological Society of America and the University of Kansas Press.

Nagappa, Y., 1959, Foraminiferal biostratigraphy of the Cretaceous-Eocene succession in the India-Pakistan-Burma region: Am. Mus. Nat. Hist., Micropaleontology, v. 5, no. 2, p. 145-177.

Nuttall, W.L.F., 1925, Stratigraphy of the Laki Series (lower Eocene) of parts of Sind and Baluchistan (India); with a description of the larger Foraminifera contained in those beds: Geol. Soc. London Quart. Jour. v. 81, p. 417-453.

Nuttall, W.L.F., 1926, The zonal distribution of the larger Foraminifera of the Eocene of western India: Geol. Mag. v. 63, p. 495-504.

_____, 1927, The zonal distribution and description of the larger Foraminifera of the middle and lower Khirthar series of parts of Western India: India Geol. Survey Recs., v. 59, p. 115-164.

Nuttall, W.L.F., 1932, The stratigraphy of the upper Ranikot series (lower Eocene) of Sind, India: India Geol. Survey Rec., v. 65, p. 306-313.

Oldham, R. D., 1892, Report on the geology of Thai Chotiali and part of the Mari country: India Geol. Survey Rec., v. 25, pt. 1, p. 18-29.

Vredenburg, E. W., 1907, Note on the occurrence of Physa prinsepii in the Maestrichtian strata of Baluchistan: India Geol. Survey Recs., v. 35, pt. 2, p. 114-118.

_____, 1908, The Cretaceous Orbitoides of India: India Geol. Survey Recs. v. 36, p. 171-213.

Williams, M.D., 1959, Stratigraphy of the lower Indus Basin, West Pakistan: World Petroleum Cong., 5th, New York, Proc. Sec. 1, paper 19, p. 377-390.