The Dahomey Basin is a combination of inland/coastal/offshore basin that stretches from southeastern Ghana through Togo and the Republic of Benin to southwestern Nigeria. It is separated from the Niger Delta by a subsurface basement high referred to as the Okitipupa Ridge. Its offshore extent is poorly defined. Sediment deposition follows an east-west trend. In the Republic of Benin, the geology is fairly well known (Billman, 1976; De Klasz, 1977). In the onshore, Cretaceous strata are about 200 m thick (Okosun, 1990). A non-fossiliferous basal sequence rests on the Precambrian basement. This is succeeded by coal cycles, clays and marls which contain fossiliferous horizons. Offshore, a 1,000 m thick sequence consisting of sandstones followed by black fossiliferous shales towards the top has been reported. This was dated by Billman (1976) as being pre-Albian to Maastrichtian. The Cretaceous is divisible into two geographic zones, north and south. The sequence in the northern zone consists of a basal sand that progressively grades into clay beds with intercalations of lignite and shales. The uppermost beds of the Maastrichtian are almost entirely argillaceous. The southern zone has a more complicated stratigraphy with limestone and marl beds constituting the major facies.

Sedimentation in the northern zone which is located inland and close to the basin periphery, began during the Maastrichtian when a thin sequence (<200 m) of unconsolidated sands, grits, silts, clays and shales, was deposited. This sequence rests on the basement; the transitional facies is marked by a basal conglomerate or white to grey sandy and kaolinitic clays derived as degradation products from the surrounding Precambrian rocks.

In the southern zone, which is coastal and offshore, the oldest sediments consist mainly of loose sand, grits, sandstones and clay with shale interbeds which progressively grade into shale. They are late Albian and possibly Neocomian in age (Omatsoola and Adegoke, 1981). The basal conglomerates have been reported from outcrops and boreholes (Jones and Hockey, 1964; Omatsoola and Adegoke, 1981). The onshore sequence towards the basin periphery in Nigeria correlates well with the Maastrichtian onshore in the Republics of Benin and Togo. The geology of the Togo sector is very similar to that of Nigerian and Benin sectors. The Cretaceous succession shows marked lithological changes which have been expressed in terms of formal and informal lithostratigraphic nomenclature by previous workers (Fig. 8.1). This can lead to dual or multiple nomenclature and thus confusion.

Okosun (1990) carefully reviewed the stratigraphy of the Dahomey Basin. Little work has been published on the Cretaceous stratigraphy of the Dahomey Embayment. This is due in part to the confidentiality of oil company reports and the absence of readily available deep borehole cores. Jones and Hockey (1964) established the Abeokuta Formation for the Cretaceous sands, grits, clays and shale in the Nigerian sector. Reyment (1965) reported the occurrence of the Ajali Sandstone and the Nsukka Formation close to the basin margin around Ijebu-Ode and Okitipupa. He also reported the occurrence of Nkporo Shale in the subsurface of the basin. Billman (1976), from a study of some offshore sequences in the Republic of Benin, proposed two informal lithostratigraphic units: unnamed Older Folded Sediments and unnamed Albian Sands. The remaining portion of the Cretaceous sequence was referred to as the Abeokuta Formation, and the Awgu and Nkporo Shales. Jan du Chene et al. (1979), from a study of a coastal borehole (Ojo-1), reported the occurrence of strata of Albian to Maastrichtian age. Omatsola and Adegoke (1981)

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<th>Maastrichtian</th>
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<td>Unnamed Albian Sands</td>
<td>Abeokuta Formation</td>
<td>Awgu Shale</td>
<td>Nkporo Shale (Informal)</td>
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<td>Araromi Shale</td>
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**Fig. 8.1** Stratigraphic successions in the Dahomey Basin as variously erected by previous workers. The succession by Okosun (1990) is adopted in this work.
established three new, formal lithostratigraphic units, the Ise, Afowo and Araromi Formations, the first two of which correspond to the unnamed Older Folded Sediments and unnamed Albian Sands, respectively, while the Araromi Formation was considered equivalent to the Nkporo Shale of Billman (op. cit.). The Ise and Afowo Formations were dated as Neocomian (Valanginian) and Albian-Turonian respectively by these workers.

Stratigraphic Nomenclature

There has been a nomenclature problem in the stratigraphy of the Dahomey Basin, as can be seen in Fig. 8.1. Jones and Hockey (1964) established the name Abeokuta Formation for the mainly arenaceous strata with mudstone, silt, clay and shale interbeds that crop out onshore. Billman (1976) subdivided the Abeokuta Formation into three lithostratigraphic units: the “Unnamed Older Folded Sediments”, “Unnamed Albian Sands” and Abeokuta Formation. On the basis of age equivalence he referred the remaining Cretaceous strata to the Awgu and Nkporo Shales. Omatsola and Adegoke (1981) disagreed with this nomenclature on two main grounds. The first of these is that a rule of accepted stratigraphic practice is contravened because when the Abeokuta Formation was subdivided the same name was used for only one part of the succession. The second is that the application of the well-established Anambra Basin names: Nkporo and Awgu Shales to the Dahomey Basin solely on the basis of age is invalid. As a result, they proposed three new lithostratigraphic units, the Ise, Afowo and Araromi Formations, and referred these to the Abeokuta Group. In their classification, the Ise Formation is equivalent to the Unnamed Older Folded Sediments and the Unnamed Albian Sands, the Afowo Formation to the outcropping Abeokuta Formation, and the Araromi Formation to the Awgu and Nkporo Shales.

The view that Anambra Basin lithostratigraphic names should not be used in the Dahomey Basin solely on the basis of age was supported by Okosun (1990). Furthermore, it is inappropriate to use the same names for lithostratigraphic units situated in different basins which are both widely separated from each other and have had different geologic history. This is also true if material for comparison of complex lithologic sequences is only present in deep well cores that are not readily available for study. Thus the strata previously referred to as the Nkporo Shale were renamed Araromi Formation by Okosun (1990). The lithology of Ise and Afowo formations as defined by Omatsola and Adegoke (1981) show a high degree of similarity. Both are essentially sands and sandstones, but the latter contains thick interbeds of shale. This difference is not sufficient to warrant the establishment of separate lithostratigraphic units. The two formations were considered synonymous by Okosun (1990). In that study, it was observed that the Ise, Afowo and Abeokuta formations have similar lithologic and electric log characters. The uppermost beds of Abeokuta Formation which crop out in the Ijebu-Ode area and in the shallow boreholes, at Itori, Wasimi and Ishaga onshore, consist mainly of fine- to
coarse-grained sand and interbeds of shale, mudstone, limestone and silt. These lithofacies correlate well with the upper portion of the neostratotype in the Ojo-1 Borehole, studied by Okosun (1990). Although the Afowo Formation contains shale interbeds, Okosun (1990) emphasized that its essentially sandy character qualifies it along with the arenaceous Ise Formation, for inclusion in the Abeokuta Formation which also contains shale interbeds as demonstrated in the neostratotype described by him and as seen also in many surface outcrops. The use of the names Ise and Afowo.

Formations was therefore discontinued and replaced by the Abeokuta Formation which has priority of publication and a wider accepted usage. The Abeokuta Formation was defined by Jones and Hockey (1964) to consist of grits, loose sand, sandstone, kaolinitic clay and shale. It was further characterized as usually having a basal conglomerate or a basal ferruginised sandstone.

Litho-Biostratigraphy

Two lithostratigraphic units, the Abeokuta and Araromi Formations, have been recognized in the Cretaceous of the eastern Dahomey Embayment. Further surface and subsurface data are necessary to confirm the occurrence of strata with lithologic similarity to Ajali Sandstone and Nsukka Formation which were reported to occur in the embayment by Reyment (1965). An account of the stratigraphic units as described by Okosun (1990) is given below.

The Abeokuta Formation

The Abeokuta Formation in surface outcrops comprises mainly sand with sandstone, siltstone, silt, clay, mudstone and shale interbeds. It usually has a basal conglomerate which may measure about 1 m in thickness and generally consists of poorly rounded quartz pebbles with a silicified and ferruginous sandstone matrix or a soft gritty white clay matrix. In outcrops where there is no conglomerate, a coarse, poorly sorted pebbly sandstone with abundant white clay constitutes the basal bed. The overlying sands are coarse grained, clayey, micaceous and poorly sorted, and indicative of short distances of transportation or short duration of weathering and possible derivation from the granitic rocks located to the north. Higher up stratigraphically at outcrop the shale content of the formation progressively increases. At some levels, particularly around Ijebu-Ode close to the eastern margin of the embayment, thin beds of lignite are present together with a high impregnation of bitumen in the sands and clays (Okosun, 1990). These occurrences are very strongly manifested in most of the eastern part of the basin where they are locally referred to as tar sands. The upper horizons of the basal beds were found in some outcrops to contain thin beds of oolitic ironstone.

Subsurface data on the Abeokuta Formation was obtained from Ise-2, Afowo-1, Orimedu-1, Bodashe-1, Ileppaw, Ojo-1 and Itori Boreholes by Okosun (1990).
The formation has a thickness of 849, 898, 624, 54.4 and 888 m in Ise-2, Afowo-1, Ileppaw, Itori and Ojo-1 Boreholes respectively. In the Ise-2 Borehole, the essentially arenaceous sequence between 1261.5 and 2142.1 m, which consists of sand, grits, sandstone, siltstone, clay and shale, constitutes the formation. The interval 1,076–1,907 m, which is made up of very coarse loose sand with sporadic thin intercalations of multicoloured shale and limestone, represents the formation in Ojo-1 Borehole. The strata from 44 to 98.4 m in the Itori Borehole, which consists of coarse-, fine- and medium-grained sand, silt and sandy clay horizons, constitutes the upper portion of the formation. The Ise-2 Borehole also penetrated a basal conglomerate. The ages of the lower and upper limits of the formation in the neostratotype described by Okosun (1990) are late Albian and late Senonian. This stratigraphic dating was obtained from the results of palynological studies by Jan du Chene et al. (1978) who recorded the pollen and spores *Reticulatasporites jardinus*, *Cicatricosisporites potomacensis*, *Reticulatasporites* sp., *Cingulatisporites* sp., *Lycopodium* sp., *Corrugatisporites ivoirensis*, *Pelleteria minutaestriata*, *Classopollis* sp., *Araucariacites* sp., *Trifossapollenites* group and *Deltoidospora* sp from 1,984 to 1,900 m in the basal sequence, which was taken to indicate a late Albian-early Cenomanian age. Close to the top of the formation, at 1,154 m, *Foveotricolpites giganteus* was recorded. This is a characteristic species for the late Turonian-early Senonian of the Ivory Coast and was reported from the Coniacian-Campanian of Gabon by Boltenhagen (in Archibong, 1978). The occurrence of this pollen therefore suggests a late Senonian age for the upper strata of the Abeokuta Formation. Between the lowest and highest levels of the neostratotype *Droseridites senonicus*, *Triorites* sp. and *Classopollis* were recorded from 1,647 m to 1,834–1,988 m respectively. These palynomorphs indicate an early Senonian age. According to Okosun (1990), the Neocomian (Valanginian) age proposed for the lower sediments referable to the Abeokuta Formation in Ise-2 Borehole by Omatsola and Adegoke (1981) required further studies and clarification.

**The Araromi Formation**

This formation was defined by Omatsola and Adegoke (1981) as comprising a fine to medium-grained basal sand overlain by shale and siltstones with thin intercalations of marl and limestone. The shale is grey to black and has a high organic content; thin beds of lignite are frequent. The formation is very similar in composition to the Nkporo Shale, but as mentioned earlier, their occurrence in separate basins with different geologic histories and the lack of adequate outcrop sections necessitate a separate nomenclature. The formation according to Okosun (1990) is equivalent to the “Araromi Shale” of Reyment (1965), and the Awgu Formation and Nkporo Shale of Billman (1976). Observations made by Okosun (1990) support the inclusion of thin interbeds of sandstone, shelly limestone and shale in the definition of the formation. The lithostratigraphic unit does not occur in outcrops. It was encountered in drillholes at Araromi, the type locality, at 446–583 m, and also in Ojo-1,
Gbekebo-1, Ise-2 and Afowo-1 at depths 756–1,075, 880–1,039, 1,834–2,000 and 969–1,230 m respectively. The ages of the lower and upper limits are Campanian and late Paleocene. In the Araromi Borehole the formation is present between 446 and 583 m.

The foraminifera *Rugoglobigerina rugosa* (Plummer), *Hedbergella monmouthensis* (Olsson), *Bolivina afra* (Reyment) and *Heterohelix* sp. were recovered from the interval 510–582 m. These indicate a Campanian-Maastrichtian age. The occurrence of *Globorotalia pseudobulloides* (Plummer), *Globorotalia compressa* (Plummer) and *Globorotalia deubjergensis* Bronnimann in the interval 446–510 m supports an early Paleocene age for the upper beds. Thus in the holostratotype (Okosun, 1990), the age of the formation is Campanian-early Paleocene. In the Ojo-1 Borehole, the interval 756–1,075 m which represents the Araromi Formation is Maastrichtian-late Paleocene. The occurrence of *Bolivina afra*, *Buliminella quadrilobata*, *Gabonita spinosa*, *Rugoglobigerina* sp., and *Heterohelix* sp. in the basal sequence of 771–1,075 m indicates a range from the Senonian to early Maastrichtian, as in Gabon. The regular occurrence of *Foveotriletes margaritae* pollen and the dinoflagellate *Svalbardella* sp. together with these foraminifera provided sufficient evidence from which to infer a Maastrichtian age (Okosun, 1990). The reported occurrence of the foraminifera *Eponides pseudoelevatus* Graham et al., *Globorotalia velascoensis* Cushman and *Globigerina triloculinoides* Plummer in the upper part of the formation from 753 to 771 m indicates a late Paleocene age. Thus the data available from both the Ojo-1 and Araromi-1 Boreholes indicate that the age of the formation is Campanian to late Paleocene.

In summary therefore the stratigraphic nomenclature of Cretaceous sediments in eastern Dahomey Basin has been revised and two lithostratigraphic units, the Abeokuta and Araromi Formations are recognized. The former comprises predominantly unconsolidated sands with intercalations of grey shale, mudstone, silt and clay while the latter consists of dark grey and black shales with interbeds of sandstone, limestone, marl, and silty and glauconitic shale. The detailed description of the holostratotype and the establishment of a hypostratotype for the Araromi Formation (Okosun, 1990) became necessary for the proper definition and recognition of the formation. The neostratotype proposed for the Abeokuta Formation replaced the holostratotype which has been invalidated. The age of Araromi Formation is based on microfossils from the holo- and hypostratotype sections described by Okosun (1990) which indicate Campanian-late Paleocene while those in the Abeokuta Formation gave ages of late Albian-late Senonian.