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The microstratigraphy of the cretaceous system of Zululand

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2015-03-04
http://hdl.handle.net/10539/17092

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elongated outline, in the oldest chamber being almost completely covered and in their more depressed apertural view.

PREVIOUSLY RECORDED STRATIGRAPHIC DISTRIBUTION

The holotype of Q. stolleyi is from the Upper Cretaceous System, Europe.

FIGURED SPECIMEN: Bh. A., 750'; P. C. Slide No. 63c.

QUINQUELOCULINA sp.

Pl. III Fig. 2

DESCRIPTION

The test is small. The periphery is oval, and rather elongate. In apertural view it appears more decidedly triangular than Q. rotunda, due to the last three chambers being angular, whereas the first two are flattened. The cross-section of the last three chambers is angular. The last chamber is quite strongly protruding at the apertural end. The aperture is rounded and has a bifid tooth. The sutures are slightly depressed. The wall is smooth.

COMPARISON

Quinqueloculina sp. is similar to Q. sawanensis Asano 1951 but it differs from it in being less depressed and in having the fifth chambers, which does not extend past the middle of the test, overlapping onto the fourth (as in Q. sawanensis). It could be a sub-species of Q. sawanensis. Q. sp. differs from Q. rotunda in its more elongated test, in its markedly triangular cross-section, and in the angular cross-section of its chambers.

FIGURED SPECIMEN: Bh. A., 462'; P. C. Slide No. 63b.

Family NODOSARIIDAE

Subfamily NODOSARIINAE

Genus ASTACOLUS de Montfort 1808

ASTACOLUS NUDA (Reuss) 1862

Pl. III Fig. 3

DESCRIPTION

The test is small and not very strongly compressed. The coiled stage is completely enrolled, and formed of four chambers. The axis of the uniserial stage is strongly curved downwards. The periphery is gently lobate in the late stages and there are four chambers in the uniserial stage. The chambers are not very broad but with the axis being curved the last chamber touches the coiled stage. The sutures are not very strongly inclined downwards and become gently depressed. The wall is smooth, and the aperture is at the dorsal angle and not very big.

COMPARISON

This species differs from A. simplex in its smaller size, in the test being less compressed, in the number and shape of its chambers, and in the stronger curvature of its axis.

PREVIOUSLY RECORDED STRATIGRAPHIC DISTRIBUTION

The holotype is from the Cretaceous System, Schreibkreide (Austria).

FIGURED SPECIMEN: Bh. A., 282'; P. C. Slide No. 12c.

ASTACOLUS sp.

Pl. III Fig. 4

DESCRIPTION

The test is very small. The planispiral stage is formed of three chambers not completely enrolled, with thin and flush sutures. The axis of the uniserial stage is almost straight. There are four chambers in the uniserial stage which are low and broad, with the sutures flush and not very strongly inclined downwards. The test is not very strongly depressed, the sides being gently inflated but the cross-section is flattened enough to consider this species as belonging to the genus Astacolus. The aperture is at the dorsal angle, strongly protruding.

FIGURED SPECIMEN: Bh. A., 292'; P. C. Slide No. 12b.

Genus DENTALINA RISSO 1826

DENTALINA MARCKI Reuss 1860

Pl. III Fig. 5

DESCRIPTION

The test is small and formed of six chambers which increase very slowly in size, the last two being considerably higher than the others. The first chamber bears a strong spine at the aboral end and the aperture is protruding but does not have a definite neck. The sutures are flush to very slightly constricted. The delicate costellae which sculpture the early stage become fainter on each successive chamber and on the last chamber they are absent and the wall is flush.

COMPARISON

Dentalina marcki differs from D. admodicostata Belford 1960 in the straight, rather than spiral, costae.

PREVIOUSLY RECORDED STRATIGRAPHIC DISTRIBUTION

Senonian - Lower Paleocene, Germany; Turonian - Lower Paleocene, Sweden (Pozaryska, 1957); Toolonga Calcilutite and Gingin Chalk, Western Australia (Belford, 1960).

FIGURED SPECIMEN: Bh. A., 282'; P. C. Slide No. 3c.

DENTALINA sp. A

Pl. III Fig. 6

DESCRIPTION

The test is large and massive. It is formed of eight chambers which increase slowly in size. The sutures are horizontal and flush, except the last two which are constricted. The first chamber bears a short stout spine at the aboral end. The test is curved with a dorsal concavity. The aperture is eccentric.

FIGURED SPECIMEN: Bh. A., 590'; P. C. Slide No. 3Aa.

DENTALINA cf. D. ANNULATA Reuss 1845

Pl. III Fig. 7

DESCRIPTION

Only fragments have been found and these are of approximately the same size as the holotype. The difference lies in the sutures, which are always constricted and always inclined.

PREVIOUSLY RECORDED STRATIGRAPHIC DISTRIBUTION

Rare in Poland, from the Turonian to the Maestrichtian. (Pozaryska, 1957).

FIGURED SPECIMEN: Bh. A., 772'; P. C. Slide No. $3Aa_2$.

DENTALINA FILIFORMIS Reuss 1845

Pl. III fig. 8

DESCRIPTION

Only fragments of this species were found. It was probably very big and formed of strongly elongated chambers which have constricted sutures. The aperture is eccentric. The test is circular in cross-section. The wall is smooth.

PREVIOUSLY RECORDED STRATIGRAPHIC DISTRIBUTION

Cretaceous of Trinidad and Gulf Coastal Plain (Cushman and Jarvis, 1932).

FIGURED SPECIMEN: Bh. A., 590'; P. C. Slide No. 3Ac.

DENTALINA cf. D. BASIPLANATA Cushman 1938

Pl. III Fig. 9

DESCRIPTION

The test is small and slender and in the specimens examined it is always damaged, so that six to seven chambers and the proloculum are left in the holotype. The proloculum is rounded and the following chambers are short, but quickly become elongated. The sutures are flush to gently constricted and vary from perpendicular to the axis to slightly inclined. The tests are gently curved and

their section elliptical. The aperture is eccentric, the wall is smooth.

COMPARISON

The Zululand specimens differ from the typical form in the very high late chambers. However, they are very close to the ones figured by Olsson (1960).

PREVIOUSLY RECORDED STRATIGRAPHIC DISTRIBUTION

Dentalina basiplanata is known from strata equivalent to the Campanian and Maestrichtian from the Gulf Coast (Cushman, 1946) and New Jersey (Olsson, 1960); from Upper Campanian - Danian in Europe (Pozaryska, 1957); from Maestrichtian strata in Egypt (Said and Kenawy, 1956); and it is reported as rare in the Santonian, but common in the Campanian of Western Australia (Belford, 1960).

FIGURED SPECIMEN: Bh. A., 282'; P. C. Slide No. 3Ae.

DENTALINA sp. aff. CATENULA Reuss 1860

Pl. III Fig. 10

DESCRIPTION

Unfortunately the test of the type of this specimen was damaged after its description and drawings were made. The test is very small and delicate, and formed of four elongated chambers which increase very rapidly in size and have strongly constricted sutures. The test is strongly curved. The cross-section is circular. The aperture is slightly eccentric.

COMPARISON

The Zululand specimens differ from the typical form in having more

constricted sutures and a much stronger growth rate. Only one, well preserved, specimen was found, therefore it is impossible to create a new species.

PREVIOUSLY RECORDED STRATIGRAPHIC DISTRIBUTION

Cushman (1946) records D. catenula from the Upper Taylor of the Gulf Coast, Said and Kenawy (1956) from the Upper Maestrichtian of Egypt, Pozaryska (1957) from the Upper Cretaceous of Central Europe and Belford (1960) from the Toolonga Calcilutite of Western Australia.

FIGURED SPECIMEN: Bh. A., 292'; P. C. Slide No. 3Ag.

DENTALINA (NODOSARIA) CORSICANANA (Cushman) 1938

Pl. III Fig. 11

DESCRIPTION

The material consists merely of a fragment of four elongated chambers, disposed on a slightly curved axis. The sutures are slightly constricted and inclined and the test is sculptured with strong continuous longitudinal ribs of clear calcite. The test is sub-circular in cross-section. This fragment must have belonged to a slender and delicate test.

COMPARISON

This type corresponds exactly to Cushman's description (1946). His specimens are also slightly arenate with aperture at apical angle (loc. cit., pl. 26, fig. 19, 22) therefore they are probably better placed under Dentalina than under Nodosaria as is in the original description.

PREVIOUSLY RECORDED STRATIGRAPHIC DISTRIBUTION

The holotype is from the Coreicana Marl, Navarro Group, of the Gulf Coast.

FIGURED SPECIMEN: Bh. A., 412'; P. C. Slide No. 3Ah.

DENTALINA ANNLOOMISAE McLean 1951

Pl. III Fig. 12

DESCRIPTION

The test is long and slender and formed of 12 chambers. The chambers are very low and broad and increase slowly in size. Later they have a greater increase rate. The sutures are flush, very thick and very slightly inclined. The transversal section of the test is elliptical. The wall is sculptured with faint longitudinal ribs. At the aboral end is a very strong blunt spine of clear calcite. The first four chambers have a thickening of clear calcite on the dirsal side.

COMPARISON

The Zululand specimens differ from the holotype only in their smaller size.

PREVIOUSLY RECORDED STRATIGRAPHIC DISTRIBUTION

Pozaryska (1957) places D. annloomisae in the Danian of Poland.

FIGURED SPECIMEN: Bh. A., 590'; P. C. Slide No. 3Al.

DENTALINA sp. B

Pl. III Fig. 13

DESCRIPTION

The test is straight and has only been found as fragments. The chambers are low and broad and increase slowly in size except for the last four which show no increase in width. The sutures are flush and thickened and the aperture is eccentric. The test is depressed in transversal section. The wall is smooth.

COMPARISON

The peculiarity of these specimens, which probably represent a new species, is the irregular mode of growth of the last few chambers. This makes the sides of the test gently flaring at first and then parallel.

FIGURED SPECIMEN: Bh. A., 590'; P. C. Slide No. 3Ab.

Genus FRONDICULARIA Defrance in d'Orbigny 1826

FRONDICULARIA STRIATULA Reuss 1844

Pl. III Fig. 14

DESCRIPTION

The test is big and lanceolate, with a rectangular cross-section, and sutures merging at the edges to form four ridges at the four corners. A spherical proloculum is followed by chambers which overlap quite strongly but do not reach the base. They are strongly arched in the middle and increase quite rapidly in size. The sutures are thickened and elevated. The wall is sculptured by six strong ribs and discontinuous costellae. The aperture is terminal and radiate.

FIGURED SPECIMEN: Bh. A., 1161'; P. C. Slide No. 8a.

VARIATIONS

Variation A_2.

Pl. III Fig. 15

DESCRIPTION

This variation differs from the typical form in its much smaller size, being formed only of two chambers, and by having fainter sculpture on the chambers and stronger sculpture on the proloculum. As the proloculum is approximately the same size as the proloculum in the typical form, but the test is much smaller, this variation could be the megalospheric form of the species.

FIGURED SPECIMEN: Bh. A., 292'; P. C. Slide No. 8a2.

PREVIOUSLY RECORDED STRATIGRAPHIC DISTRIBUTION

Recorded by Cushman (1946) from the Taylor and Austin formation of the Gulf Coast; by Pozaryska (1957) from the Turonian - Campanian of Poland; by McGugan (1957) from the Campanian Maestrichtian of Ireland; by Takayanagi (1960) Upper Usobushinae formation of Japan.

FRONDICULARIA MUCRONATA Reuss 1845

Pl. IV Fig. 1

DESCRIPTION

The test is broad, depressed and palmate. The periphery is angled and the cross-section is an elongated octagon. The

elongated, elevated proloculum bears a blunt spine at the aboral end, and is followed by four - nine equitant, strongly overlapping chambers, all but the last of which extend to the base. The sutures are thick and depressed, curved and sharply angled in the middle of test. The wall is smooth, and the aperture is terminal and radiate.

COMPARISON

The Zululand specimens are usually wider than the typical form. Strong size variations were noticed.

PREVIOUSLY RECORDED STRATIGRAPHIC DISTRIBUTION

Cushman (1946) reports F. mucronata from the Gober Tongue of the Austin Chalk and from the Taylor marl, Texas; Pozaryska (1957) from the Turonian-Maestrichtian of Poland; Belford (1960) from the Toolonga Calcilutite of North-west Australia.

FIGURED SPECIMEN: Bh. A., 772'; P. C. Slide No. 8b.

FRONDICULARIA sp. C

Pl. IV Fig. 2

DESCRIPTION

The test is lanceolate. The last chamber has the long sides flattened, so that when looked at in cross-section it is rectangular. Before the last chamber the periphery is roundly angled and bears a single keel. The globular proloculum bears a short, stout spine at the aboral end, and is followed by nine equitant chambers that do not reach the base of the test and increase slowly in size. The sutures are thin and flush and sharply angled in the middle. The wall is smooth. The aperture is

terminal and radiate.

COMPARISON

This species is similar to F. verneuiliana in general characteristics but it differs from it in that the periphery is single keeled instead of doubly angled.

FIGURED SPECIMEN: Bh. A., 892'; P. C. Slide No. 8c.

FRONDICULARIA GLABRANS Cushman 1931

Pl. IV Fig. 3

DESCRIPTION

The test is big, wide and palmate. The periphery is angled and the cross-section is rectangular. A rounded, globular proloculum is followed by nine equitant, strongly overlapping chambers that reach the base of the test. The sutures are slightly depressed, thin on the sides and become thicker as they approach the aperture. They are bluntly angled in the middle and quite strongly curved. The aperture is terminal, radiate.

COMPARISON

F. glabrans is very similar to F. mucronata to which it was at first thought to be related. The globular proloculum and rectangular cross section are the discriminating characteristics.

PREVIOUSLY RECORDED STRATIGRAPHIC DISTRIBUTION

Cushman (1946) reports F. glabrans from the Middle Navarro Group of the Gulf Coast series.

FIGURED SPECIMEN: Bh. A., 2014'; P. C. Slide No. 8d.

FRONDICULARIA cf. FRANKEI Cushman 1936

Pl. IV Fig. 4

DESCRIPTION

The material consists of a fragment of which only the last seven chambers are preserved. It is lanceolate and it has a rectangular cross-section with four very strong keels. The chambers are equitant and short and do not reach the base. The maximum width is attained at the base of the last chamber. The sutures are thickened, elevated and rope-like. Between the sutural elevations, grooves are developed, which are narrower than the sutures. A median groove is also developed and this joins all the apertures.

COMPARISON

Only a fragment was found. It resembles closely Cushman's definition in the truncate periphery and general characters.

PREVIOUSLY RECORDED STRATIGRAPHIC DISTRIBUTION

F. frankei is restricted to the Upper Middle Taylor to Lower Navarro of the Gulf Coast according to Cushman (1946). Pozaryska regards it as Turonian - Maestrichtian in range.

FIGURED SPECIMEN: Bh. A., 1695'; P. C. Slide No. 8f.

FRONDICULARIA ALTHI Karrer 1870

Pl. IV Fig. 5

DESCRIPTION

The test is slightly damaged but whole. It is palmate and rectangular in cross-section and doubly keeled. Five very strongly overlapping chambers follow a globular proloculum which bears a

blunt spine. The chambers start further away from the base as they are added and their aboral corners are disposed on two lines converging at the proloculum, in an acute angle. The sutures are thickened and elevated, straight and acutely angled at the centre of the test. The proloculum bears six strong ribs that converge in the aboral spine. Four of the prolocular ribs form the beginning of the keels and two are centrally positioned in correspondence with the flat faces of the test.

COMPARISON

The Zululand specimens differ from the holotype of F. althi in having completely straight sutures rather than gently arched ones. Although this species presents strong similarities with F. verneuiliana in its type of proloculum and cross-section, it differs from it in shape and mode of overlap of the chambers.

PREVIOUSLY RECORDED STRATIGRAPHIC DISTRIBUTION

The holotype is from the Upper Cretaceous.

FIGURED SPECIMEN: Bh. A., 336'; P. C. Slide No. 8g.

FRONDICULARIA cf. VERNEUILIANA d'Orbigny 1840

Pl. IV Fig. 6

DESCRIPTION

The material consists only of a very big, lanceolate fragment. Nine chambers are detectable, and these are equitant and short, and do not reach the base of the test. The periphery is doubly-angled to rounded and the sutures are very slightly elevated, and sharply angled in the centre. The wall is smooth.

PREVIOUSLY RECORDED STRATIGRAPHIC DISTRIBUTION

Pozaryska reports F. verneuiliana from the Campanian - Maestrichtian of Poland.

FIGURED SPECIMEN: Bh. A., 444'; P. C. Slide No. 8e.

FRONDICULARIA LINGUIFORMIS Marsson 1878

Pl. IV Fig. 7

DESCRIPTION

This is a fragment that suggests a very large-sized long, slender type in which five chambers are preserved. The periphery is rounded and the sutures are flush, straight and sharply angled. The wall is sculptured with numerous fine, continuous, longitudinal costellae.

PREVIOUSLY RECORDED STRATIGRAPHIC DISTRIBUTION

F. linguiformis is reported by Cushman (1946) from the Taylor formation of the Gulf Coast; by Pozaryska (1957) from the Upper Campanian - Maestrichtian of Poland.

FIGURED SPECIMEN: Bh. A., 444'; P. C. Slide No. $8e_2$.

Genus LAGENA Walker & Jacob in Kanmacher 1798

LAGENA SIMPLEX Reuss 1851

Pl. IV Fig. 8

DESCRIPTION

The test is pyriform, the wall smooth, the aperture radiate.

Author De Gasparis M L
Name of thesis The Microstratigraphy of the cretaceous system of Zululand 1968

PUBLISHER:
University of the Witwatersrand, Johannesburg
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