

## Supplementary Text S1

The main diagnostic characters of the Danian planktic foraminiferal species and genera considered in this paper (Figures A1–A5; Appendix A) are described below. These descriptions are based on our taxonomic, evolutionary and biostratigraphic works (for example, see Arenillas and Arz [42] and Metsana-Oussaid and collaborators [38]).

-*Guembelitra* Cushman, 1933: test triserial; aperture usually umbilical; wall microperforate, pore-mounded, with generally centered pore-mounds.

-*Guembelitra cretacea* Cushman, 1933: test triserial, medium-spined; chamber globular, and moderate rate of chamber size increase; aperture umbilical, wide arch, with lip thin; wall pore-mounded.

-*Guembelitra blowi* Arz, Arenillas & Nájuez, 2010: test triserial, low-spined; chamber globular, and high rate of chamber size increase; aperture umbilical, wide arch, with lip thin; wall pore-mounded.

-*Guembelitra dammula* Voloshina, 1961: test triserial, high-spined; chamber globular, and low rate of chamber size increase; aperture umbilical, wide arch, with lip thin; wall pore-mounded.

-*Chiloguembelitra* Höfker, 1978: test triserial, sometimes mixed triserial-biserial; aperture umbilical-extraumbilical to extraumbilical (lateral); wall microperforate, pore-mounded, pustulate and/or rugose, with generally decentered pore-mounds, perforate and/or imperforate rugosities, and blunt (papilla-type) and/or sharp pustules.

-*Chiloguembelitra hofkeri* Arenillas, Arz & Gilabert, 2017: test triserial, high-spined; chamber globular, and low rate of chamber size increase; aperture umbilical-extraumbilical to extraumbilical, rounded or elongate, with lip thin; wall pore-mounded, pustulate and/or rugose.

-*Chiloguembelitra danica* Höfker, 1978: test triserial, medium-spined; chamber globular, and moderate rate of chamber size increase; aperture umbilical-extraumbilical to extraumbilical, rounded or elongate, with lip thin; wall pore-mounded, pustulate and/or rugose.

-*Chiloguembelitra trilobata* Arenillas, Arz & Gilabert, 2017: test triserial, low-spined; chamber globular, and high rate of chamber size increase; aperture umbilical-extraumbilical to extraumbilical, rounded or elongate, with lip thin; wall pore-mounded, pustulate and/or rugose.

-*Chiloguembelitra irregularis* (Morozova, 1961): test triserial, twisted, high-spined; chamber globular, and low rate of chamber size increase; aperture usually extraumbilical, rounded or elongate, with lip thin; wall pore-mounded, pustulate and/or rugose.

-*Chiloguembelitra biseriata* Arenillas, Arz & Gilabert, 2017: test mixed triserial-biserial; chamber globular, and low rate of chamber size increase; aperture lateral, rounded or elongate, with lip thin; wall pore-mounded, pustulate and/or rugose.

-*Woodringina* Loeblich & Tappan, 1957: test mixed triserial-biserial, usually twisted; wall microperforate, finely pustulate (hispid), with densely distributed small blunt pustules.

-*Woodringina claytonensis* Loeblich & Tappan, 1957: test mixed triserial-biserial (sometimes entirely biserial), medium to high-spired, usually twisted; chamber globular, and moderate to low rate of chamber size increase; aperture lateral, rounded or elongate, with lip thin; wall finely pustulate.

-*Woodringina hornerstownensis* Olsson, 1960: test mixed triserial-biserial (sometimes entirely biserial), usually twisted, high to very high-spired; aperture lateral, rounded or elongate, with lip thin; chamber globular, and low rate of chamber size increase; wall finely pustulate.

-*Chiloguembelina* Loeblich & Tappan, 1956: test biserial, sometimes twisted; wall microperforate, finely to smoothed pustulate (hispid to smooth), with densely distributed small blunt pustules.

-*Chiloguembelina taurica* Morozova, 1961: test biserial, sometimes twisted; chamber subglobular, slightly compressed, and moderate to low rate of chamber size increase; aperture lateral, elongate, with lip thin to thick; wall finely to smoothed pustulate.

-*Chiloguembelina midwayensis* (Cushman, 1940): test biserial, sometimes twisted; chamber ovate, compressed, and high to moderate rate of chamber size increase; aperture lateral, elongate, with lip thin to thick; wall finely to smoothed pustulate.

-*Trochoguembelitra* Arenillas & Arz, 2012: test trochospiral, sometimes mixed triserial-trochospiral; wall microperforate, pore-mounded, pustulate and/or rugose, with generally decentered pore-mounds, perforate and/or imperforate rugosities, and blunt (papilla-type) and/or sharp pustules.

-*Trochoguembelitra alabamensis* (Liu & Olsson, 1992): test trochospiral, sometimes mixed triserial-trochospiral, with moderate to very high spire; chambers globular, 3½ in the last whorl, and low rate of chamber size increase; aperture umbilical, rounded, with lip thin; wall pore-mounded, pustulate and/or rugose.

-*Trochoguembelitra extensa* (Blow, 1979): test trochospiral, with slightly high spire; chambers globular, 3½–4 in the last whorl, and moderate rate of chamber size increase; aperture umbilical to umbilical–extraumbilical, rounded or elongated, with lip thin; wall pore-mounded, pustulate and/or rugose.

-*Trochoguembelitra liuae* Arenillas & Arz, 2016: test trochospiral, with slightly high spire; chambers globular, 4½–5 in the last whorl, and low rate of chamber size increase; aperture umbilical to umbilical–extraumbilical, rounded or elongated, with lip thin; wall pore-mounded, pustulate and/or rugose.

-*Trochoguembelitria olssoni* Arenillas & Arz, 2016: test trochospiral, with low spire; chambers globular, 5–5½ in the last whorl, and low rate of chamber size increase; aperture umbilical–extraumbilical, rounded or elongated, with lip thin; wall pore-mounded, pustulate and/or rugose.

-*Globoconusa* Khalilov, 1956: test trochospiral; wall microperforate, pustulate, with generally sharp pustules.

-*Globoconusa daubjergensis* (Bronnimann, 1979): test trochospiral, slightly high-spined; chambers globular, 3½–4 in the last whorl, and moderate rate of chamber size increase; aperture umbilical to umbilical–extraumbilical, rounded or elongated, with lip thin; wall pustulate.

-*Globoconusa comusa* (Khalilov, 1979): test trochospiral, high-spined; chambers globular, 3½–4 in the last whorl, and moderate to low rate of chamber size increase; aperture umbilical to umbilical–extraumbilical, rounded or elongated, with lip thin; wall pustulate.

-*Globoconusa victori* Koutsoukos, 2014: test trochospiral, low to slightly high-spined; chambers globular, 3–3½ in the last whorl, and high rate of chamber size increase; aperture umbilical to umbilical–extraumbilical, rounded or elongated, with lip thin; wall pustulate.

-*Pseudocaucasina* Arenillas & Arz, 2016: test mixed trochospiral-triserial; wall microperforate, smooth.

-*Pseudocaucasina antecessor* Arenillas & Arz, 2016: test mixed trochospiral-triserial; chambers globular, 3 in the last whorl, and low to moderate rate of chamber size increase; aperture umbilical, high arch, with lip thin; wall smooth.

-*Palaeoglobigerina* Arenillas, Arz & Nández, 2007: test trochospiral; 3–4 chambers in the last whorl; aperture usually umbilical; wall smooth.

-*Palaeoglobigerina alticonusa* (Li, McGowran & Boersma, 1995): test trochospiral, high-spined; chambers globular, 3½–4 in the last whorl, and low rate of chamber size increase; aperture umbilical, usually elongated (high arch), with lip thin; wall smooth.

-*Palaeoglobigerina fodina* (Blow, 1979): test trochospiral, slightly high-spined; chambers globular, 3½–4 in the last whorl, and moderate to low rate of chamber size increase; aperture umbilical, rounded or elongated (sometimes high arch), with lip thin; wall smooth.

-*Palaeoglobigerina minutula* (Luterbacher & Premoli Silva, 1964): test trochospiral, low-spined; chambers globular, 3–3½ in the last whorl, and moderate to high rate of chamber size increase; aperture umbilical, rounded or elongated (sometimes high arch), with lip thin; wall smooth.

-*Palaeoglobigerina luterbacheri* Arenillas & Arz, 2007: test trochospiral, low-spined; chambers globular, 4 in the last whorl, and low to moderate rate of chamber size increase; aperture umbilical to umbilical–extraumbilical, rounded or elongated, with lip thin; wall smooth.

-*Parvularugoglobigerina* Hofker, 1978: test trochospiral; 4–8 chambers in the last whorl; aperture usually umbilical–extraumbilical; wall microperforate, smooth.

-*Parvularugoglobigerina perexigua* Li, McGowran & Boersma, 1995: test trochospiral, low-spined; chambers moderately compressed ovate, 4–4½ in the last whorl, and high rate of chamber size increase; aperture umbilical–extraumbilical, high arch, with lip thin; wall smooth.

-*Parvularugoglobigerina umbrica* (Luterbacher & Premoli Silva, 1964): test trochospiral, low-spined; chambers moderately compressed ovate, 6½–9 in the last whorl, and low rate of chamber size increase; aperture umbilical–extraumbilical, high arch, with lip thin; wall smooth.

-*Parvularugoglobigerina longiapertura* (Blow, 1979): test trochospiral, low-spined; chambers globular or slightly compressed ovate (var. *longiapertura*) or moderately compressed ovate (var. *euskalherriensis*), 5–6½ in the last whorl, and moderate to low rate of chamber size increase; aperture umbilical–extraumbilical, high arch, with lip thin; wall smooth.

-*Parvularugoglobigerina eugubina* (Luterbacher & Premoli Silva, 1964): test trochospiral, small, low-spined; chambers globular, 5–6½ in the last whorl, and moderate to low rate of chamber size increase; aperture umbilical–extraumbilical, low arch, with lip thin; wall smooth.

-*Parvularugoglobigerina sabina* (Luterbacher & Premoli Silva, 1964): test trochospiral, small, slightly high-spined; chambers globular, 4½–5 in the last whorl, and moderate rate of chamber size increase; aperture umbilical to somewhat umbilical–extraumbilical, low arch, with lip thin; wall smooth.

-*Eoglobigerina* Morozova, 1959: test trochospiral; 3½–6 chambers in the last whorl; aperture usually umbilical; wall macroperforate, cancellate and spinose.

-*Eoglobigerina simplicissima* Blow, 1979: test trochospiral, low-spined; chambers globular, 3½–4 in the last whorl, and low to moderate rate of chamber size increase; aperture umbilical, with lip moderately thick; wall pitted to cancellate, and spinose.

-*Eoglobigerina eobulloides* Morozova, 1959: test trochospiral, low-spined; chambers globular, 4–4½ in the last whorl, and low rate of chamber size increase; aperture umbilical to somewhat umbilical–extraumbilical, with lip moderately thick; wall cancellate and spinose.

-*Eoglobigerina fringa* (Subbotina, 1950): test trochospiral, low-spined; chambers globular, 4 in the last whorl, and low to moderate rate of chamber size increase; aperture umbilical to somewhat umbilical–extraumbilical, with lip moderately thick; wall cancellate and spinose.

-*Eoglobigerina microcellulosa* (Morozova, 1961): test trochospiral, low-spined; chambers globular, 3½ in the last whorl, and moderate rate of chamber size increase; aperture umbilical to somewhat umbilical–extraumbilical, with lip moderately thick; wall cancellate and spinose.

-*Eoglobigerina* cf. *trivialis* (Subbotina, 1953): test trochospiral, lightly high-spined; chambers globular,  $3\frac{1}{2}$ –4 in the last whorl, and low to moderate rate of chamber size increase; aperture umbilical, with lip moderately thick; wall cancellate and spinose.

-*Eoglobigerina tetragona* Morozova, 1961: test trochospiral, high-spined; chambers globular,  $3\frac{1}{2}$ –4 in the last whorl, and low rate of chamber size increase; aperture umbilical, with lip moderately thick; wall cancellate and spinose.

-*Eoglobigerina praeedita* Blow, 1979: test trochospiral, low-spined; chambers globular,  $4\frac{1}{2}$ –5 in the last whorl, and low rate of chamber size increase; aperture umbilical to somewhat umbilical–extraumbilical, with lip moderately thick; wall cancellate and spinose.

-*Eoglobigerina edita* (Subbotina, 1953): test trochospiral, slightly high-spined; chambers globular,  $4\frac{1}{2}$ –5 in the last whorl, and low rate of chamber size increase; aperture umbilical to somewhat umbilical–extraumbilical, with lip moderately thick; wall cancellate and spinose.

-*Eoglobigerina pentagona* Morozova, 1961: test trochospiral, high-spined; chambers globular,  $4\frac{1}{2}$ –5 in the last whorl, and low rate of chamber size increase; aperture umbilical, with lip moderately thick; wall cancellate and spinose.

-*Eoglobigerina polycamera* (Khalilov, 1956): test trochospiral, slightly high-spined; chambers globular,  $5\frac{1}{2}$ –6 in the last whorl, and low rate of chamber size increase; aperture umbilical to somewhat umbilical–extraumbilical, with lip moderately thick; wall cancellate and spinose.

-*Parasubbotina* Olsson, Hemleben, Berggren & Liu, 1992: test trochospiral; 4–5 chambers in the last whorl; aperture usually umbilical–extraumbilical; wall macroperforate, cancellate and spinose.

-*Parasubbotina moskvini* (Shutskaya, 1953): test trochospiral, low-spined; chambers globular, 4 in the last spiral whorl, moderate rate of chamber size increase, aperture umbilical–extraumbilical, lip moderately thick; wall cancellate and spinose.

-*Parasubbotina varianta* (Subbotina, 1953): test trochospiral, low-spined; chambers globular, 4 in the last spiral whorl, high rate of chamber size increase, aperture umbilical–extraumbilical, lip moderately thick; wall cancellate and spinose.

-*Parasubbotina pseudobulloides* (Plummer, 1927): test trochospiral, low-spined; chambers globular,  $4\frac{1}{2}$ –5 in the last spiral whorl, moderate rate of chamber size increase, aperture umbilical–extraumbilical, lip moderately thick; wall cancellate and spinose.

-*Subbotina* Brotzen & Pozaryska, 1961: test trochospiral; 3– $3\frac{1}{2}$  chambers in the last whorl; aperture usually umbilical; wall macroperforate, cancellate and spinose.

-*Subbotina triloculinoides* (Plummer, 1927): test trochospiral, low-spined; chambers globular, 3–3½ in the last whorl, and high rate of chamber size increase; aperture umbilical to umbilical-extraumbilical, with lip thick; wall cancellate and spinose.

-*Subbotina triangularis* (White, 1928): test trochospiral, low-spined; chambers globular, 3½ in the last whorl, and moderate to high rate of chamber size increase; aperture umbilical to somewhat umbilical-extraumbilical, with lip thick; wall cancellate and spinose.

-*Globanomalina* Haque, 1956: test trochospiral; axial periphery usually with imperforate band; wall macroperforate, smooth to pitted (non-spinose).

-*Globanomalina archeocompressa* (Blow, 1979): test trochospiral, low-spined; chambers globular to ovate, 5-6½ in the last whorl, and low rate of chamber size increase; aperture umbilical-extraumbilical, low arch, with lip moderately thick; wall smooth to pitted.

-*Globanomalina imitata* (Subbotina, 1953): test trochospiral, low-spined; chambers globular to hemispherical, 4-4½ in the last whorl, and moderate rate of chamber size increase; aperture umbilical-extraumbilical, low arch, with lip moderately thick; wall smooth to pitted.

-*Globanomalina planocompressa* (Shutsкая 1965): test trochospiral, flat-spined; chambers ovate to hemispherical, 4½-5 in the last whorl, and low to moderate rate of chamber size increase; aperture umbilical-extraumbilical, low arch, with lip moderately thick; wall smooth to pitted.

-*Globanomalina compressa* (Plummer, 1927): test trochospiral, biconvex; chambers slightly to moderately compressed ovate, 4½–5½ in the last whorl, and low to moderate rate of chamber size increase; axial periphery slightly to moderately angular, with imperforate band usually little developed or absent; aperture umbilical-extraumbilical, with lip thick; wall pitted.

-*Globanomalina haunsbergensis* (Gohrbandt, 1963): test trochospiral, biconvex; chambers moderately to strongly compressed ovate, 4½–6 in the last whorl, and low to moderate rate of chamber size increase; axial periphery moderately to strongly angular, with imperforate band well developed; aperture umbilical-extraumbilical, with lip thick; wall pitted.

-*Luterbacheria* Canudo, 1994: test trochospiral; axial periphery with carina; wall macroperforate, smooth to pitted (non-spinose).

-*Luterbacheria ehrenbergi* (Bolli 1957): test trochospiral, compressed biconvex; chambers strongly compressed ovate, 5–6 in the last whorl, and low to moderate rate of chamber size increase; axial periphery moderately to strongly angular, with carina partially or poorly developed; aperture umbilical-extraumbilical, with lip thick; wall macroperforate, pitted.

-*Praemurica* Olsson, Hemleben, Berggren & Liu, 1992: test trochospiral; wall macroperforate, cancellate (non-spinose).

-*Praemurica taurica* (Morozova, 1961): test trochospiral, low to flat-spined; chambers globular, 5½–7 in the last whorl, and low rate of chamber size increase; sutures straight on the spiral side; aperture umbilical-extraumbilical, with lip thick; wall cancellate.

-*Praemurica pseudoinconstans* (Blow, 1979): test trochospiral, low to flat-spined; chambers globular (last chambers axially widened on axial side), 5–5½ in the last whorl, and initially with low rate of chamber size increase and finally moderate to high rate; sutures straight or slightly curved on the spiral side; aperture umbilical-extraumbilical, with lip thick; wall cancellate.

-*Praemurica inconstans* (Subbotina, 1953): test trochospiral, low to flat-spined; chambers inflated globular (axially widened on axial side), 5–6½ in the last whorl, and moderate rate of chamber size increase; sutures slightly curved on the spiral side; aperture umbilical-extraumbilical, with lip thick; wall cancellate.

-*Acarinina* Subbotina, 1953: test trochospiral; wall macroporulate, muricate.

-*Acarinina trinidadensis* (Bolli, 1957): test trochospiral, low-spined; chambers initially hemispherical and finally globular, 5–7 in the last whorl, and low to moderate rate of chamber size increase; sutures initially curved and finally slightly curved; aperture umbilical-extraumbilical, with lip moderately thick; wall muricate or partially muricate (cancellate in the last chambers).

-*Acarinina uncinata* (Bolli, 1957): test trochospiral, low-spined; chambers hemispherical, 5–6½ in the last whorl, and low to moderate rate of chamber size increase; sutures curved (or slightly curved in the last chambers); aperture umbilical-extraumbilical, with lip moderately thick; wall muricate.