J. Nannoplankton Res. **29** (1), 2007, pp.1-4 © 2007 International Nannoplankton Association
ISSN 1210-8049 Printed by Cambridge University Press, UK

New calcareous nannofossil species from the Cretaceous Budden Canyon Formation, Great Valley Sequence, northern California (USA)

Allan Gil S. Fernando*, Hisatake Okada

Division of Earth and Planetary Sciences, Graduate School of Science, Hokkaido University, N10 W8 Sapporo, 060-0810 Japan. *Present address: National Institute of Geological Sciences, University of the Philippines, Diliman, Quezon City 1101, Philippines; braarudosphaera@yahoo.com

Manuscript received 24th August, 2006; revised manuscript accepted 19th January, 2007

Abstract Two new species of calcareous nannofossil, *Diloma californica* and *Prediscosphaera quasispinosa*, are described from the Budden Canyon Formation of the Great Valley Sequence in northern California (USA). *D. californica* was observed from sediments of Aptian age and has also been observed in rocks of similar age in the Vocontian Basin (SE France), suggesting its potential for wide geographic correlation. *P. quasispinosa*, on the other hand, appears to be restricted to the Cenomanian, and is presently known only from sediments of northern California.

Keywords *Diloma californica*, *Prediscosphaera quasispinosa*, calcareous nannofossils, Cretaceous, Budden Canyon Formation, Great Valley Sequence, California

1. Introduction

Calcareous nannofossil biostratigraphic investigation of sediments from the Budden Canyon Formation of northern California (Fernando, 2006; Fernando *et al*., subm.) has revealed several new taxa, two of which are described in this paper: *Diloma californica* and *Prediscosphaera quasispinosa*. Although both species are rare, the occurrence of *D. californica* in rocks of similar age in the Vocontian Basin (SE France: Fernando, 2006) suggests that this species may be useful for correlation on a broad geographical scale. The samples from California were collected from outcrops along the North Fork Cottonwood Creek in Shasta County (Figure 1; see Fernando *et al*., subm., for further details). The samples from the Vocontian Basin were collected from the Goguel Level ('Niveau Goguel') of Core 2003-GOG1, drilled in Les Sauzeries (~10km north of Barrême), in connection with the Cretaceous Oceanic Anoxic Events Project of the 21st Century Center of Excellence (COE) Program of Hokkaido University.

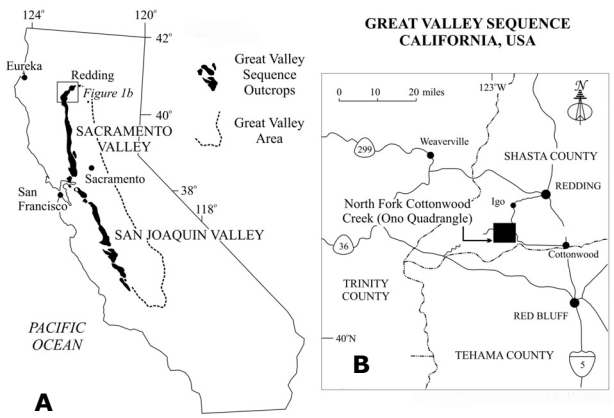


Figure 1: **A**) Map of California and location of study area in the Great Valley Sequence. **B**) Location of North Fork Cottonwood Creek section (solid box), Shasta County, northern California (USA), modified after Murphy & Rodda (1996)

2. Taxonomy

Sediment samples and original digital images of the new taxa are stored at the History of Earth's Environment Research Group Laboratory of Hokkaido University (Sapporo, Japan). Original smear-slides, on the other hand, are stored at the Nannoworks Laboratory of the National Institute of Geological Sciences, University of the Philippines (Quezon City, Philippines).

Family **EIFFELLITHACEAE** Reinhardt, 1965
Genus *Diloma* Wind & Cepek, 1979
Type species *Diloma primitiva* (Worsley, 1971) Wind & Cepek, 1979

Diloma californica sp. nov.

Pl.1, figs 1-16. **Derivation of name**: Named after the state of California (USA), where the species was first observed. **Diagnosis**: Medium-sized, (narrowly) elliptical coccolith, surrounded by a relatively narrow (<1μm) rim. A plate (?) occupies the central area and has a prominent median suture, parallel to the long axis of the coccolith. The element construction of the rim and the central plate are not visible under the light-microscope, although, in several specimens, the rim appears to be constructed of (short) overlapping elements (Pl.1, fig.16). Moderately-preserved specimens (SE France samples) display rims with a beaded appearance (Pl.1, figs 10-15). Under crossed-polars (XPL), with the main axes of the coccolith parallel to the polarising direction of the microscope, both the rim and the central area exhibit low to moderate birefringence, and the longitudinal suture is visible (Pl.1, figs 1, 10). At ~45˚, the central area appears brighter than the rim and the suture may or may not be visible (Pl.1, figs 7, 8, 12). At certain angles, the central area appears to be divided into four quadrants, the boundaries of which correspond to the axes of the ellipse, and with each diagonally opposite quadrant exhibiting similar properties in XPL

(Pl.1, figs 5, 6, 11, 14, 15). **Remarks**: Wind & Cepek (1979, pp.248-249, pl.8, figs 8-17) illustrated a specimen (*Diloma* sp.) similar to *D. californica*. Similarities include the bright central area under XPL and the four quadrants comprising the central area. However, several of their specimens of *Diloma* sp. are divided into six sections, two of which are small triangular segments, situated along the short axis (Wind & Cepek, 1979, pl.8, figs 12-15). This habit was not observed in specimens of *D. californica* from either California or the Vocontian Basin. Additionally, the size of *D. californica* is smaller than *Diloma* sp. (7.5-9.0μm) and *Diloma* sp. has a geological range within the Hauterivian, in contrast to *D. californica,* which is presently restricted to the Early Aptian. Wind & Cepek (1979) suggested the possibility that specimens of *Diloma* sp. could represent overgrown specimens of *D. placinum*, which also occurs within the Hauterivian. Most specimens of *D. californica* exhibit moderate preservation, where both etching and overgrowth (as suggested by the beaded appearance of the rim in some *D. californica* specimens) are possible. However, as the diagnostic features for the well- and moderately-preserved specimens are similar, it is unlikely that *D. californica* could represent overgrown specimens of *Diloma* sp. **Dimensions**: Length = 5-6μm; width = 3-4μm. **Holotype**: Pl.1, figs 1-9, Sample US-040 (northern California). **Paratypes**: Pl.1, figs 10-13, Sample GO-013, Section 17-4, Core 2003-GOG1, Les Sauzeries, Vocontian Basin, SE France; Pl.1, figs 14-16, Sample GO-015, Section 17-4, Core 2003-GOG1, Les Sauzeries, Vocontian Basin, SE France. **Type locality**: Ono, North Fork Cottonwood Creek section, Ono Quadrangle, Shasta County, northern California (Great Valley Sequence), USA. Sec.12 of T.30N., R.7W. (Murphy *et al*., 1969). **Type Level**: Lower Aptian, Sample US-040, base of upper Chickabally Member, Budden Canyon Formation (nannofossil zone BC19 of Bown *et al*., 1998). **Occurrence**: BC19-BC20 in California (Fernando, 2006; Fernando *et al*., subm.); CC7a (of Sissingh, 1977, as modified by Perch-Nielsen, 1985) and NC6A-NC7A (of Roth, 1978, as modified by Bralower *et al*., 1995) in the Le Sauzeries section, Vocontian Basin, SE France (Fernando, 2006).

Family **PREDISCOSPHAERACEAE** Rood *et al*., 1971

Genus *Prediscosphaera* Vekshina, 1959

Type species *P. cretacea* (Arkhangelsky, 1912) Gartner, 1968

Prediscosphaera quasispinosa sp. nov.

Pl.1, fig.17. **Derivation of name**: From the Latin *quasi*, meaning 'having similarities to', referring to its resemblance in appearance to *P. spinosa*. **Diagnosis**: A small, (normally) elliptical species of *Prediscosphaera*, which has a thick inner-cycle and a thick, subaxial central cross, occupying most of the central area. **Remarks**: *P. quasispinosa* most closely resembles *P. spinosa* with regards to basic morphology. They are similar in that the cross-bars of *P. spinosa* could either be axial or not perfectly aligned with the major and minor axes of the ellipse (Gartner, 1968; Bukry, 1969). However, the general outline of the two taxa is different (*i.e*. *P. spinosa* is rectangular in outline), and the cross-bars and inner cycle of *P. spinosa* are narrower than those of *P. quasispinosa* (see Pl.1, fig.18 for comparison). *P. cretacea*, another elliptical form, has cross-bars that are not aligned with the major and minor axes of the ellipse (Pl.1, fig.19). The recorded distribution of *P. quasispinosa* is, at present, restricted to northern California, although J. Self-Trail (pers. comm., 2007) has also observed *P. quasispinosa* from sediments of Cenomanian age of the Atlantic Coastal Plain. **Dimensions**: Length = 5μm; width = 4μm. **Holotype**: Pl.1, fig.17, Sample US-062 (northern California). **Type locality**: North Fork Cottonwood Creek section, Ono Quadrangle, Shasta County, northern California (Great Valley Sequence), USA. Sec.21 of T.30N., R.6W. (Murphy *et al*., 1969). **Type level**: Upper Cenomanian, Sample US-062, Gas Point Member, Budden Canyon Formation (nannofossil subzone UC3e of Burnett, 1998). **Occurrence**: UC3e-UC5c in California (Fernando, 2006; Fernando *et al*., subm.).

Acknowledgements

The authors would like to thank Drs Jackie Lees and Jean Self-Trail for reviewing the initial draft and for their helpful comments and suggestions. AGSF would also like to thank Dr. Lees for the encouragement to write this taxonomic paper. This paper would not have been possible without the following people who collected the samples in California and SE France: Drs Kazushige Tanabe, Michael Murphy, Hiroshi Nishi, Kazuto Kodama, Reishi Takashima, Ken Sawada, Kazuyoshi Moriya, Yasuhiro Iba and Koichi Iijima. This paper is supported by the 21st Century COE Program 'The Neoscience of Natural History' of the Hokkaido University.

References

Bown, P.R., Rutledge, D.C., Crux, J.A. & Gallagher, L.T. 1998. Lower Cretaceous. *In*: P.R. Bown (Ed.). *Calcareous Nannofossil Biostratigraphy*. British Micropalaeontological Society Series. Chapman & Hall/Kluwer Academic Press, London: 86-131.

Bralower, T.J., Leckie, R.M., Sliter, W.V. & Thierstein, H.R. 1995. An Integrated Cretaceous Microfossil Biostratigraphy. *In*: W.A. Berggren, D.V. Kent, M.-P. Aubry & J. Hardenbol (Eds). *Geochronology, Time Scales and Global Stratigraphic Correlation*. *SEPM Special Publication*, **54**: 65-79.

Bukry, D. 1969. Upper Cretaceous coccoliths from Texas and Europe. *The University of Kansas Paleontological Contributions*, **Article 51** (Protista 2): 1-79.

Burnett, J.A. with contributions from Gallagher, L.T. & Hampton, M.J. 1998. Upper Cretaceous. *In*: P.R. Bown (Ed.). *Calcareous Nannofossil Biostratigraphy*. British Micropalaeontological Society Series. Chapman & Hall/Kluwer Academic Press: 132-199.

Fernando, A.G.S. 2006. *Calcareous Nannofossil Biostratigraphy and Assemblages of the Mid-Cretaceous*

(Barremian-Turonian) Budden Canyon Formation (northern California, USA) and Oceanic Anoxic Event (OAE) 1a in SE France and OAE2 in the Tethyan and Pacific Regions. Unpublished PhD thesis, Hokkaido University, Sapporo, Japan: 199pp.

Fernando, A.G.S., Nishi, H., Tanabe, K., Moriya, K., Iba, Y., Kodama, K., Murphy, M.A. & Okada, H. Submitted. Calcareous Nannofossil Biostratigraphy and Nannofloral Composition of the Cretaceous Budden Canyon Formation in Northern California. *Geological Society of America Bulletin*.

Gartner, S. 1968. Coccoliths and related calcareous nannofossils from Upper Cretaceous deposits of Texas and Arkansas. *The University of Kansas Paleontological Contributions*, **Article 48** (Protista 1): 1-56.

Murphy, M.A. & Rodda, P.U. 1996. The Albian-Cenomanian boundary in northern California. *Geological Society of America Bulletin*, **108**(2): 235-250.

Murphy, M.A., Rodda, P.U. & Morton, D.M. 1969. Geology of the Ono Quadrangle, Shasta and Tehama Counties, California. *California Division of Mines and Geology Bulletin*, **192**: 1-28.

Perch-Nielsen, K. 1985. Mesozoic calcareous nannofossils. *In*: H.M. Bolli, J.B. Saunders & K. Perch-Nielsen (Eds). *Plankton Stratigraphy*. Cambridge University Press, Cambridge: 329-426.

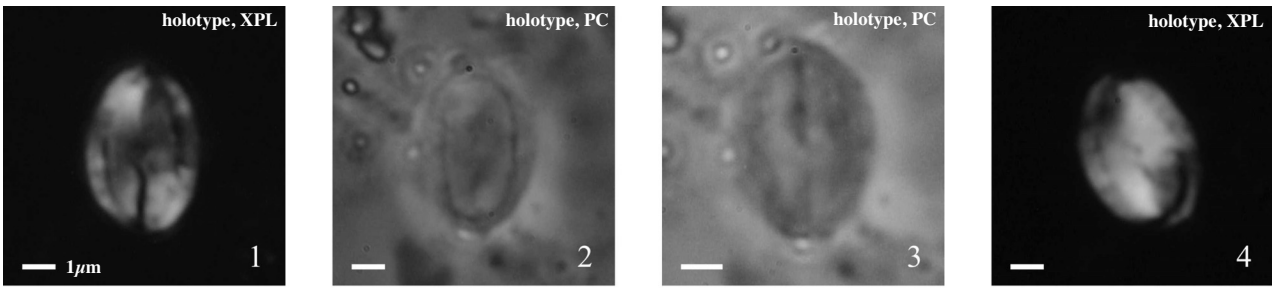
Roth, P.H. 1978. Cretaceous nannoplankton biostratigraphy and oceanography of the northwestern Atlantic Ocean. *Initial Reports of the DSDP*, **44**: 731-760.

Sissingh, W. 1977. Biostratigraphy of Cretaceous calcareous nannoplankton. *Geologie en Mijnbouw*, **56**: 37-65.

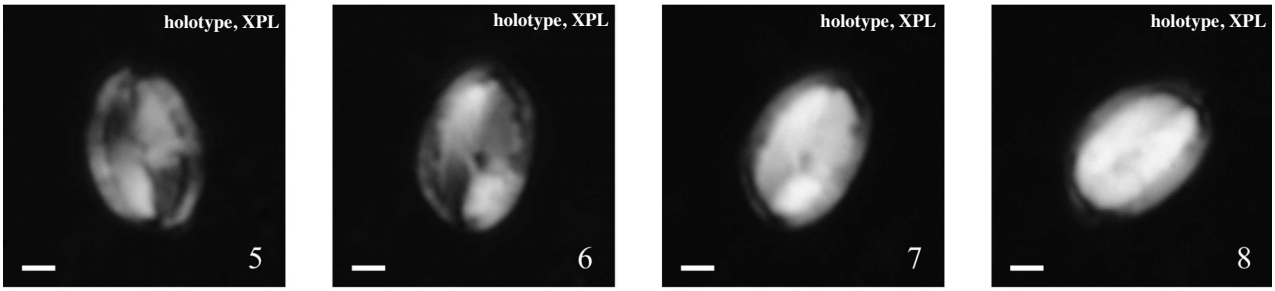
Wind, F.H. & Cepek, P. 1979. Lower Cretaceous Calcareous Nannoplankton from DSDP Hole 397A (Northwest African Margin). *Initial Reports of the DSDP*, **47A**: 221-235.

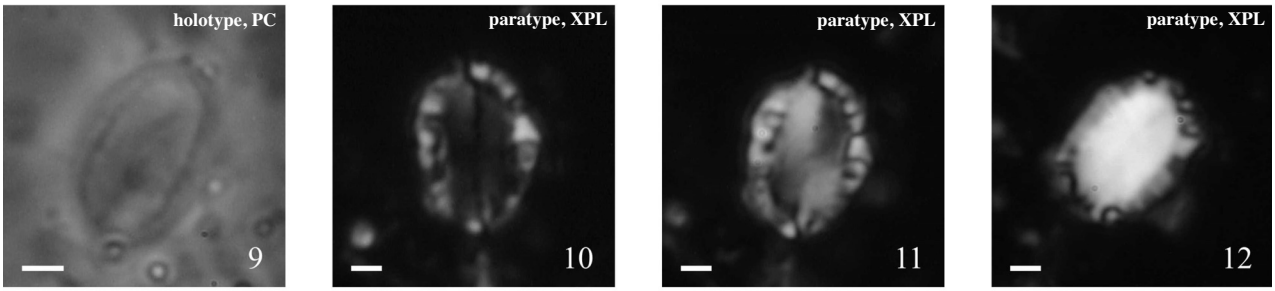
Plate 1

XPL = cross-polarised light; PC = phase-contrast; BF = bright-field

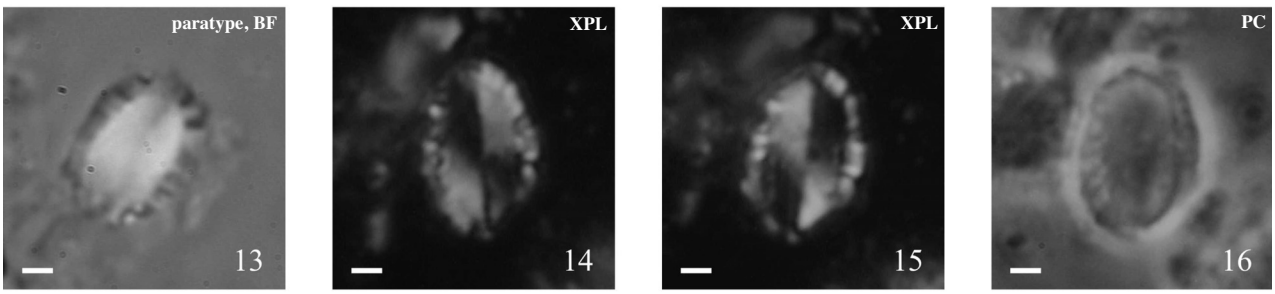


Diloma californica Sample US-040, upper Chickabally Member, Budden Canyon Formation, Great Valley Sequence (GVS), California

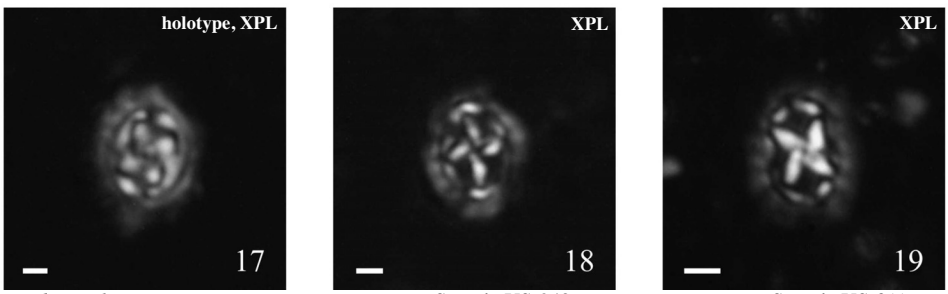




D. californica Sample GO-013, Section 17-4, Core 2003-GOG1, Les Sauzeries, Vocontian Basin, SE France



D. californica Sample GO-015, Section 17-4, Core 2003-GOG1, Les Sauzeries, Vocontian Basin, SE France



Prediscosphaera quasispinosa Sample US-062, Gas Point Member, Budden Canyon Formation, GVS, California

P. spinosa Sample US-049, GVS, California

P. cretacea Sample US-311, GVS, California