

## ZONAL DEFINITIONS

### Descriptions of Middle Latitude Zones

#### PLEISTOCENE

##### BOTRYOSTROBUS AQUILONARIS Zone

(*Eucyrtidium tumidulum* Zone in Hays, 1970; *Artostrobium miralestensis* Zone in Kling, 1973; *Artostrobium tumidulum* in Foreman, 1975)

Defined by the occurrence of *Botryostrobus aquilonaris* (Bailey) subsequent to the extinction of *Stylatractus universus*. This is the uppermost Quaternary Zone in middle latitudes and is equivalent to the Omega Zone in Antarctic sediments (Hays, 1965).

Events included in this zone are:

- Tm *Stylacontarium acquilonium*

The base of the zone is defined by the morphotypic last appearance of *Stylatractus universus* and is coincident with the upper limit of the *Stylatractus universus* Zone.

Reference slides [R 50.1](#), [R 50.2](#) and [R 50.3](#) from Sample 18-173-2-2, 46-49 cm.

## PLEISTOCENE

### STYLATRACTUS UNIVERSUS Zone

(Hays, 1970; *Axoprunum angelinum* in Kling, 1973 and Foreman, 1975)

The top of the zone is defined by the morphotypic last appearance of *Stylatractus universus* and is coincident with the lower limit of the *Botryostrobus aquilonaris* Zone. This zone roughly corresponds to the Psi Zone in Antarctic sediments (Hays, 1965).

Events included in the zone are:

- Tm *Lamprocyrtis neoheteroporos*
- Tm *Theocorythium vetulum* may be coincident with the base of this zone.

The base of the zone is defined by the morphotypic last appearance of *Eucyrtidium matuyamai* and is coincident with the upper limit of the *Eucyrtidium matuyamai* Zone.

Reference slides [R 51.1](#), [R 51.2](#) and [R 51.3](#) from Sample 18-173-4-4, 46-50 cm.

**PLEISTOCENE****EUCYRTIDIUM MATUYAMAI Zone**

(Hays, 1970, *emend.* Foreman, 1975)

The top of the zone is defined by the morphotypic last appearance of *Eucyrtidium matuyamai* and is coincident with the lower limit of the *Stylatractus universus* Zone. The zone corresponds approximately to the Chi Zone in Antarctic sediments (Hays, 1965).

Events included in the zone are:

- Tm *Lamprocyrtis heteroporos*
- Bm *Lamprocyrtis nigrinia*
- Bm *Lamprocyrtis neoheteroporos*
- Tm *Sphaeropyle robusta*

The base of the zone is defined by the evolutionary transition from *Eucyrtidium calvertense* to *Eucyrtidium matuyamai*. The base of the zone approximates the base of the Pleistocene in the North Pacific.

Reference slides [R 52.1](#), [R 52.2](#) and [R 52.3](#) from Sample 18-173-5-CC.

**PLIOCENE****LAMPROCYRTIS HETEROPOROS Zone**

(Hays, 1970, *emend.* Foreman, 1975)

The top of the zone is defined by the evolutionary transition of *Eucyrtidium calvertense* to *Eucyrtidium matuyamai* and is coincident with the lower limit of the *Eucyrtidium matuyamai* Zone. The upper limit of this zone is similar to the upper boundary of the Phi Zone in Antarctic sediments (Hays, 1965). Kling (1973), in North Pacific sediments, used the morphotypic first appearance of *Eucyrtidium matuyamai* as the upper limit of this zone.

The base of the zone is defined by the morphotypic last appearance of *Stichocorys peregrina* and is coincident with the upper limit of the *Sphaeropyle langii* Zone.

Reference slides **R 53.1**, **R 53.2** and **R 53.3** from Sample 18-173-9-3, 24-30 cm.

## PLIOCENE

### SPHAEROPYLE LANGII Zone

(Foreman, 1975)

The top of the zone is defined by the morphotypic last appearance of *Stichocorys peregrina* and is coincident with the lower limit of the *Lamprocyrtis heteroporos* Zone.

Events included in the zone are:

- Bm *Stylacontarium acqilonium*
- Tm *Stichocorys delmontensis*
- Bm *Lamprocyrtis heteroporos*
- Tm *Theocorys redondoensis*

The base of the zone is defined by the morphotypic first appearance of *Sphaeropyle langii* and is coincident with the upper limit of the *Stichocorys peregrina* Zone.

The range of this zone approximates that of the *Spongaster pentas* Zone in the equatorial Pacific.

Subsequent unpublished studies (Kling, pers. comm., 1992) and our own observations suggest that *Sphaeropyle langii* and *Sphaeropyle robusta* are not stratigraphically useful species and that the radiolarian zonation in this part of the time scale will need to be revised.

Reference slides [R 54.1](#), [R 54.2](#) and [R 54.3](#) from Sample 32-310-7-2, 83-90 cm.

## LATE MIOCENE

### STICHOCORYS PEREGRINA Zone

(Riedel and Sanfilippo, 1970, *emend.* Foreman, 1975)

The top of the zone is defined by the morphotypic first appearance of *Sphaeropyle langii* and is coincident with the lower limit of the *Sphaeropyle langii* Zone. The top of the zone is redefined by Foreman (1975) for the North Pacific where the tropical *Spongaster pentas* Zone cannot be recognized.

The base of the zone is defined by the earliest evolutionary appearance of *Stichocorys peregrina* and is coincident with the upper limit of the *Didymocyrtis penultima* Zone.

Subsequent unpublished studies (Kling, pers. comm., 1992) and our own observations suggest that *Sphaeropyle langii* and *Sphaeropyle robusta* are not stratigraphically useful species and that the radiolarian zonation in this part of the time scale will need to be revised.

Although equivalent to the low-latitude zone of the same name, the aspect of the fauna in middle latitudes is often different and important marker species are frequently missing.

Reference slides [R 55.1](#), [R 55.2](#) and [R 55.3](#) from Sample 32-310-7-5, 63-70 cm.

**LATE MIOCENE****DIDYMOCYRTIS PENULTIMA Zone**

(Riedel and Sanfilippo, 1970)

The top of the zone is defined by the earliest evolutionary appearance of *Stichocorys peregrina* and is coincident with the lower limit of the *Stichocorys peregrina* Zone.

The base of the zone is defined by the earliest evolutionary appearance of *Didymocyrtis penultima* and is coincident with the upper limit of the *Didymocyrtis antepenultima* Zone.

Although equivalent to the low-latitude zone of the same name, the aspect of the fauna in middle latitudes is often different and important marker species are frequently missing.

Reference slides [R 56.1](#), [R 56.2](#) and [R 56.3](#) from Sample 32-310-8-5, 136-146 cm.

**LATE MIOCENE****DIDYMOCYRTIS ANTEPENULTIMA Zone**

(Riedel and Sanfilippo, 1970)

The top of the zone is defined by the earliest evolutionary appearance of *Didymocyrtis penultima* and is coincident with the lower limit of the *Didymocyrtis penultima* Zone.

The base of the zone is defined by the first evolutionary appearance of *Didymocyrtis antepenultima* and is coincident with the upper limit of the *Diartus petterssoni* Zone.

Although equivalent to the low-latitude zone of the same name, the aspect of the fauna in middle latitudes is often different and important marker species are frequently missing.

Reference slides [R 57.1](#), [R 57.2](#) and [R 57.3](#) from Sample 18-173-18-35, 35-40 cm.



## MIDDLE MIOCENE

### DIARTUS PETTERSSONI Zone

(Riedel and Sanfilippo, 1970)

The top of the zone is defined by the evolutionary transition from *Diartus petterssoni* to *Diartus hughesi* and is coincident with the lower limit of the *Didymocyrtis antepenultima* Zone.

Events included in the zone are:

- Tm *Eucyrtidium inflatum*

The base of the zone is defined by the morphotypic first appearance of *Diartus petterssoni* and is coincident with the upper limit of the *Dorcadospyris alata* Zone.

Although equivalent to the low-latitude zone of the same name, the aspect of the fauna in middle latitudes is often different and important marker species are frequently missing.

Reference slides [R 58.1](#), [R 58.2](#) and [R 58.3](#) from Sample 18-173-22-4, 18-24 cm.

**MIDDLE MIOCENE****DORCADOSPYRIS ALATA Interval-Chronozone**

(Riedel and Sanfilippo, 1970, *emend.* 1971)

The top of the zone is defined by the morphotypic first appearance of *Diartus petterssoni* and is coincident with the lower limit of the *Diartus petterssoni* Zone.

The base of the zone is defined by the evolutionary transition from *Dorcadospyris dentata* to *Dorcadospyris alata* and is coincident with the upper limit of the *Calocyclella costata* Zone.

Although equivalent to the low-latitude zone of the same name, the aspect of the fauna in middle latitudes is often different and important marker species are frequently missing.

Reference slides [R 59.1](#), [R 59.2](#) and [R 59.3](#) from Sample 18-173-26-3, 37-43 cm.

**EARLY MIOCENE****CALOCYCLETТА COSTATA Interval-Chronozone**

(Riedel and Sanfilippo, 1970)

The top of the zone is defined by the evolutionary transition from *Dorcadospyris dentata* to *Dorcadospyris alata* and is coincident with the lower limit of the *Dorcadospyris alata* Zone.

The base of the zone is defined by the morphotypic first appearance of *Calocycletta costata* and is coincident with the upper limit of the *Stichocorys wolffii* Zone.

Although equivalent to the low-latitude zone of the same name, the aspect of the fauna in middle latitudes is often different and important marker species are frequently missing.

Reference slides **R 60.1**, **R 60.2** and **R 60.3** from Sample 18-173-29-2, 126-132 cm.