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Title of article Sedimentation History and Biostratigraphy of Ophiolite-Related Tertiary Sediments, Luzon, Philippines

Author(s) William J. Schweller, Peter H. Roth, Daniel E. Karig, and Steven B. Bachman

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# SEDIMENTATION HISTORY AND BIOSTRATIGRAPHY OF OPHIOLITE-RELATED TERTIARY SEDIMENTS, LUZON, PHILIPPINES

William J. Schweller[1], Peter H. Roth[2], Daniel E. Karig[3], Steven B. Bachman[4]

ABSTRACT

Pelagic and hemipelagic sediments deposited on the Zambales Ophiolite contain a nearly continuous depositional record of the original setting and emplacement history of this large ophiolite from the late Eocene through the Miocene. Pelagic limestone with thin ash layers (the Aksitero Formation) caps the ophiolite's volcanic complex along its east flank. Calcareous nannofossil biostratigraphy of this limestone gives sedimentation rates of 3-5 m/m.y. from the late Eocene through the early Oligocene. Rates increase to 10 m/m.y. or more in the upper Aksitero Formation when sandy turbidites appear in the middle and upper Oligocene section. Lower Miocene mudstone, sandstone, and conglomerate of the Moriones Formation was deposited at much higher rates; this formation includes channels and debris flow deposits characteristic of deep-sea fans. Oligocene sandstones are predominantly volcaniclastic, whereas sandstones in the lower Miocene section contain serpentine and other components derived from the ultramafic complex of the ophiolite. Sedimentary facies and sandstone composition show that the Zambales was deeply eroded by the early Miocene, and probably first emerged above sea level in the middle or late Oligocene, only 10 to 15 m.y. after it formed as new ocean crust. A comparison of the Aksitero Formation with DSDP sites in the western Pacific suggests that the Zambales Ophiolite was originally part of a marginal basin and not an island arc.

1. Dept. of Geological Sciences, Cornell Univ. Ithaca NY 14853; now at Gulf Research and Devel. Co., P.O. Box 37048, Houston TX 77236
2. Dept. of Geology and Geophysics, Univ. of Utah, Salt Lake City, UT 84112
3. Dept. of Geological Sciences, Cornell Univ., Ithaca NY 14853
4. Dept. of Geological Sciences, Cornell Univ., Ithaca NY 14853; now at Nekton, Inc., 11578 Sorrento Valley Rd., San Diego CA 92121

| Sample | Abundance/ Preservation | Coccolithus eopelagicus | C. pelagicus | Calcidiscus formosus | Cyclicargolithus floridanus | Reticulofenestra bisecta | R. scrippsae | R. umbilicus | Helicosphaera cf. reticulata | Discoaster barbadiensis | D. deflandrei | D. saipanensis | D. cf. tanii | Sphenolithus moriformis | S. predistentus | S. pseudorandians | | | Zone | Age |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A26.9 | R/P | R | R | | R | R | | R | | | | | | R | R | R | | | ret. | E. Oligocene |
| A24.3 | R/P | R | R | R | R | R | | R | R | | R | | | R | | R | | | E. sub-dist. | |
| A22.6 | R/P | R | R | R | R | R | | R | R | | R | | | R | | | | | | |
| A21.8 | F/P | R | R | R | F | R | | R | R | | R | | | F | R | R | | | | |
| A18.0 | R/P | R | R | R | R | R | | R | | R | R | R | | R | R | | | | D. barbadiensis | Late Eocene |
| A15.0 | R/P | R | R | | R | R | | R | | R | R | | | R | | | | | | |
| A14.5 | R/P | R | R | | R | R | | | | R | R | | | R | | | | | | |
| A13.2 | R/P | | | | R | | | | | R | | | | R | | | | | | |
| A11.4 | R/P | | | | R | | | | | R | | | | R | | | | | | |
| A8.9 | B | | | | | | | | | | | | | | | | | | | |
| A6.3 | R/P | R | R | | R | R | R | R | | R | R | | | R | R | | | | | |
| A4.7 | R/P | R | R | | R | | | | | R | R | | | R | | | | | | |
| A4.1 | R/P | | | | R | | | | | | | | | | R | | | | ? | ? |
| A0.2 | R/P | R | | | R | | | | | | | | | | | | | | | |

Appendix A-1: Nannofossil distribution and zonation, section A.

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| Sample | Abundance/Preservation | Coccolithus copelagicus | C. pelagicus | Cyclicargolithus floridanus | Reticulofenestra bisecta | Discoaster barbadiensis | D. deflandrei | D. saipanensis | Sphenolithus moriformis | S. predistentus | S. radians | | Zone | Age |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| B20.3 | C/P | R | R | C | R | | R | | C | R | | | S.pre-disten. | M. Oligoc. |
| B20.2 | R/P | R | R | C | R | | R | | C | R | | | | |
| B13.7 | R/P | | | R | R | | | | | | | | | |
| B10.2 | R/P | | | R | R | R | R | | R | | | | D. barbadiensis | Late Eocene |
| B8.0 | R/P | R | R | R | R | R | | | R | | | | | |
| B5.0 | F/P | R | R | R | R | R | | R | F | R | | | | |
| B4.2 | R/P | | | R | | R | | | R | | | | | |
| B3.1 | R/P | | | R | R | | | | R | | | | | |
| B2.5 | R/P | R | R | R | | | | | R | | | | | |
| B1.4 | F/P | R | R | F | R | R | | | R | R | R | | | |

Appendix A-2: Nannofossil distribution and zonation, section B.

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| Section | Sample | Abundance/Preservation | Coccolithus eopelagicus | C. pelagicus | Calcidiscus formosus | Cyclicargolithus floridanus | Reticulofenestra bisecta | R. cf. reticulata | R. umbilicus | Discoaster barbadiensis | D. deflandrei | D. saipanensis | D. cf. tanii | Sphenolithus moriformis | S. predistentus | S. pseudoradians | | Zone | Age |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | AK80-5 | R/P | R | R | | R | R | | | | R | | | | R | | | S. predis. | M.Olig. |
| | AK-D | F/P | R | R | R | F | F | | | | R | | R | F | | | | E.subd. | E.Olig. |
| | AK-E1 | R/P | R | R | | R | R | R | | | | | | R | | | | ? | ? |
| | AK-E2 | R/P | R | R | R | R | R | R | | R | | | | R | | R | R | D. barba-diensis | L. Eocene |
| | AK-G1 | R/P | R | | | R | R | | | R | | R | | | | | | | |
| | AK-F1 | R/P | R | | | R | R | | | R | | | | R | R | | | | |
| | AK-H | R/P | | | | R | R | | | | | | | | | | | | |
| | AK-NB | R/P | R | R | | R | R | | | R | R | R | R | R | | R | | | |
| Moriones River | 80-2-70 | B | | | | | | | | | | | | | | | | | |
| | MSU | B | | | | | | | | | | | | | | | | | |
| | M6.0 | R/P | R | R | | R | R | | | R | | | | R | R | | | D.barba-diensis | L. Eocene |
| | M4.0 | R/P | R | R | | R | R | | | R | | | | R | | | | | |
| | M0.1 | R/P | R | R | | R | R | | | R | | | | R | | | | | |
| Mayantoc | My-C2 | F/P | R | R | | R | R | | R | R | | | | R | | | | D. barba-diensis | L. Eocene |
| | My-C1 | F/P | R | R | | R | R | | R | R | R | | | R | R | | | | |
| Suaco | S-7.5 | C/P | R | R | | C | F | | R | | R | | | C | R | | | H. reti-culata | E. Oligo-cene |
| | S-1.5 | F/P | R | R | | R | F | | R | | R | | | R | R | | | | |

Appendix A-3: Nannofossil distribution and biostratigraphy in various short sections and isolated samples (AK, Moriones River, Mayantoc Suaco). Please note that no stratigraphic continuity between these sections is implied.

| Sample | Abundance/Preservation | Coccolithus eopelagicus | Cyclicargolithus floridanus | Reticulotenestra abisecta | R. bisecta | Discoaster deflandres | Sphenolithus distentus | S. moriformis | | Zone | Age |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Barlo 79 | F/P | R | R | R | R | R | R | R | | S. distentus | M.Olig. |
| N | R/P | R | R | | | | | | | ? | ? |
| L | B | | | | | | | | | | |
| K | B | | | | | | | | | | |

Appendix A-4: Nannofossil distribution and biostratigraphy, Barlo section, a possible stratigraphic outlier of the Aksitero Formation.