

Version 2 / January 1992

SOURCES

- Berggren and others (1985), Barron (1986)
- Theyer and Hammond (1974), LaBrecque and others (1977)
- Berggren and others (1985)
- Blow (1969), Srinivasan and Kennett (1981), Keller (1983)
- Martini (1971)
- Bukry (1973, 1975), Okada and Bukry (1980)
- Nigrini (1971), Riedel and Sanfilippo (1978)
- Barron (1981, 1986)
- Position of benthic foraminiferal stage stratotypes (Kleinpell (1938) relative to planktonic zones as correlated by Poore, Barron, and Addicott (1981) and Miller (1987)
- Stages and zones of Kleinpell (1938, 1980) and Natland (1952); correlated by Blake (1991), Warren (1980), Miller (1987)
- Poore, Barron, and Addicott (1981)
- Woodburne (1987)
- Sarna-Wojcicki and others (1991); Sarna-Wojcicki and Meyer (person. commun., 1990)
- Haq and others (1987), adjusted to fit this time scale

Columns 1 through 8 from Barron (1989)

REFERENCES

- Barron, J.A., 1981, Late Cenozoic diatom biostratigraphy and paleoceanography of the middle-latitude eastern North Pacific, Deep Sea Drilling Project Leg 63, in Yeats, R.L., and Haq, B.U., eds., Initial reports of the Deep Sea Drilling Project: Washington, D.C., U.S. Government Printing Office, v. 63, p. 507-538.
- Barron, J.A., 1986, Updated diatom biostratigraphy for the Monterey Formation of California, in Casey, R.E., and Barron, J.A., eds., Siliceous microfossil and microplankton studies of the Monterey Formation and modern analogs: Los Angeles, Pacific Section, SEPM, v. 45, p. 105-119.
- Barron, J.A., 1989, The late Cenozoic stratigraphic record and hiatuses of the northeast Pacific: results from the Deep Sea Drilling Project [Chap. 15], in Winterer, E.L., Hussong, D.M., and Decker, R.W., eds., The eastern Pacific Ocean and Hawaii: Boulder, Colo., GSA, The Geology of North America, v. N, p. 311-322.
- Berggren, W.A., Kent, D.V., Flynn, J.J., and Van Couvering, J.A., 1985, Cenozoic geochronology: GSA Bull., v. 96, p. 1407-1418.

- Blake, G.H. 1991, Review of the Neogene biostratigraphy and stratigraphy of the Los Angeles basin and implications for basin evolution, in Biddle, K.T., ed., Active margin basins: American Association of Petroleum Geologists Memoir 52, p. 135-184.
- Blow, W.H., 1969, Late middle Eocene to Recent planktonic foraminiferal biostratigraphy, in Bronnimann, R., and Renz, H.H., eds., Proceedings of the First International Conference on Planktonic Microfossils, Geneva, 1967, v. 1, Leiden, The Netherlands, E.J. Brill, p. 199-421.
- Bukry, D., 1973, Low-latitude coccolith biostratigraphic zonation, in Edgar, N.T., and Saunders, J.B., eds., Initial reports of the Deep Sea Drilling Project: Washington, D.C., U.S. Government Printing Office, v. 15, p. 685-703.
- Bukry, D., 1975, Coccolith and silicoflagellate stratigraphy, northwestern Pacific Ocean, Deep Sea Drilling Project Leg 32, in Larson, R.L., and Moberly R., eds., Initial reports of the Deep Sea Drilling Project: Washington, D.C., U.S. Government Printing Office, v. 32, p. 677-701.
- Haq, B.U., Hardenbol, Jan, and Vail, P.R., 1987, The new chronostratigraphic basis of Cenozoic and Mesozoic sea level cycles, in Ross, C.A., and Haman, D., eds., Timing and depositional history of eustatic sequences: constraints on seismic stratigraphy: Cushman Found. Foram. Res., Special Publ. 24, p. 7-13.
- Keller, G., 1983, The Palaeogene/Neogene boundary in the equatorial Pacific Ocean, in Gelati, R., and Steininger, F., eds., In search of the Palaeogene/Neogene boundary stratotype: Revista Italiana de Paleontologia e Stratigraphia, v. 89, pt. 2, no. 4, p. 529-555.
- Kleinpell, R.M., 1938, Miocene stratigraphy of California: Tulsa, Okla., AAPG, 450 p.
- Kleinpell, R.M., 1980, The Miocene stratigraphy of California revisited: AAPG Studies in Geology no. 11, p. 1-182.
- La Brecque, J.L., Kent, D.V., and Cande, S.C., 1977, Revised magnetic polarity time scale for the Late Cretaceous and Cenozoic time: Geology, v. 5, p. 330-335.
- Martini, E., 1971, Standard Tertiary and Quaternary calcareous nannoplankton zonation, in Farinacci, A., ed., Proceedings of the Second Planktonic Conference: Roma, Edizioni Tecnoscienza, p. 739-785.
- Miller, T.L., 1987, Early Neogene coccolith biostratigraphy of R.M. Kleinpell's original stratotype section--Reliz Canyon, Monterey County, California [abs.]: Abstract volume, 4th International Congress on Neogene Stratigraphy, July 29-31, 1987, Berkeley, Calif., p. 77-78.

- Natland, M.L., 1952, Pleistocene and Pliocene stratigraphy of southern California: Los Angeles, Calif., Univ. of California, PhD thesis, 165 p.
- Nigrini, C., 1971, Radiolarian zones in the Quaternary of the equatorial Pacific Ocean, in Funnell, B.M., and Riedel, W.R., eds., Micropaleontology of oceans: Cambridge, Cambridge Univ. Press, p. 443-461.
- Okada, H., and Bukry, D., 1980, Supplementary modification and introduction of code numbers to the low-latitude coccolith biostratigraphic zonation [Bukry, 1973, 1975]: Marine Micropaleontology, v. 5, p. 321-325.
- Poore, R.Z., Barron, J.A., and Addicott, W.O., 1981, Biochronology of the northern Pacific Miocene: Proceedings of IGCP 114 International Workshop on Pacific Neogene Biostratigraphy, 6th International Working Group Meeting, November 25-29, 1981, Osaka, Osaka Museum of Natural History, p. 91-98.
- Riedel, W.R., and Sanfilippo, A., 1978, Stratigraphy and evolution of tropical Cenozoic radiolarians: Micropaleontology, v. 24, no. 1, p. 61-96.
- Sarna-Wojcicki, A.M., Lajole, K.R., Meyer, C.E., Adam, D.P., Rieck, H.J., 1991, Tephrochronologic correlation of upper Neogene sediments along the Pacific margin, conterminous United States, in Morrison, R.B., ed., Quaternary of the unglaciated United States: Boulder, Colo., GSA, The Geology of North America, v. K-2, p. 117-140.
- Srinivasan, M.S., and Kennett, J.P., 1981, Neogene planktonic foraminiferal biostratigraphy and evolution, equatorial to subarctic South Pacific: Marine Micropaleontology, v. 6, p. 499-533.
- Theyer, F., and Hammond, S.R., 1974, Paleomagnetic polarity sequence and radiolarian zones, Brunhes to Epoch 20: Earth and Planetary Science Letters, v. 22, p. 307-319.
- Warren, A.D., 1980, Calcareous nannoplankton biostratigraphy of Cenozoic marine stages in California, in Kleinpell, R.M., The Miocene stratigraphy of California revisited: AAPG Studies in Geology, no. 11, p. 60-69.
- Weaver, C.E., and others, 1944, Correlation of the marine Cenozoic formations of western North America: GSA Bull., v. 55, p. 569-598.
- Woodburne, M.O., 1987, A prospectus of the North American mammal ages, in Woodburne, M.O., ed., Cenozoic mammals of North America: Berkeley, Univ. of Calif. Press, p. 285-290.

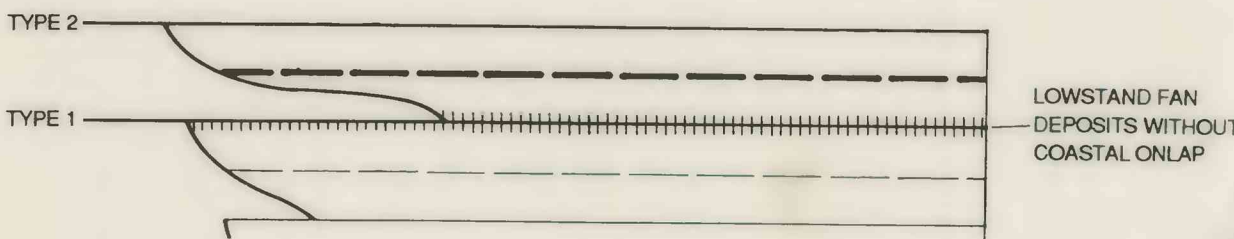
**Note:** This chart was designed to aid inter-basin correlation of Neogene strata for a current large-scale geologic mapping effort in southern California. It was assembled from published information and is, of course, subject to change as new information becomes available. **This version of the Neogene chart is a revision of an earlier version published as U.S. Geological Survey Open-File Report 90-636A.**

The standard tropical plankton zones are tied to the magnetostratigraphy (Barron, 1989). The benthic foraminiferal stages and the North American Mammal Ages are tied to the isotopic time scale; California molluscan stages are tied to the benthic foraminiferal stages. The planktonic zonation of columns 3, 4, and 5 are tropical zones that are not generally recognized in California. They are included here to provide a standard for reference. The sequence stratigraphy of Haq and others (1987) may have no applicability to the Neogene of tectonically active southern California, but it was included for possible correlation with passive-margin Neogene sequences.

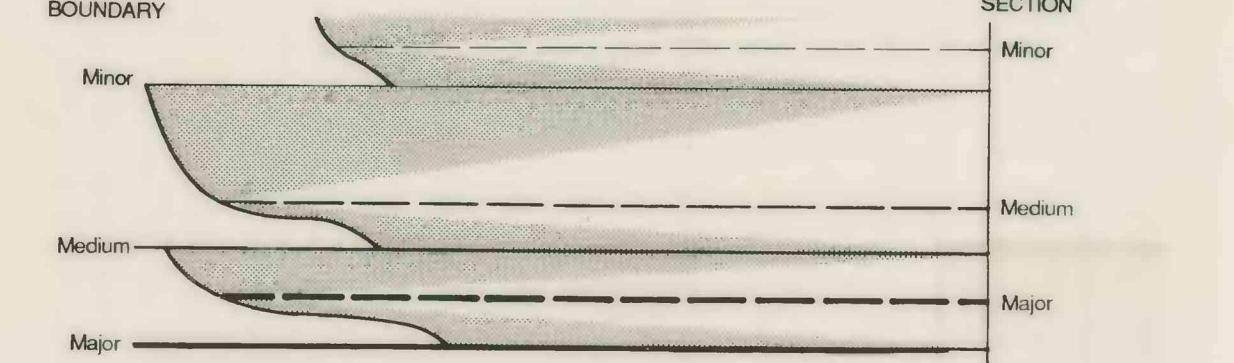
The use of quotation marks follows the practice of Weaver and others (1944) in flagging problems in the definitions of California formations, stages, and zones. Dashed and queried lines express difficulties in correlating these units. Many of these difficulties are explained by Kleinpell (1980, p. 4-53).

EXPLANATION

SEQUENCE BOUNDARY TYPES



KEY TO RELATIVE MAGNITUDE



NEOGENE TIME SCALE FOR SOUTHERN CALIFORNIA

Compiled by J.A. Bartow

1992

This report is preliminary and has not been edited or reviewed for conformity with U.S. Geological Survey editorial standards or with the North American Stratigraphic Code. Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.