

Memorial to Milton C. “Clark” Blake Jr. 1932–2017

ROBERT J. MCLAUGHLIN, CARL M. WENTWORTH, AND DAVID S. HARWOOD
*Scientists Emeritus, U.S. Geological Survey, 345 Middlefield Road,
Menlo Park, California 94025, USA*

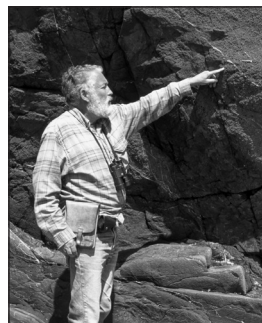
DAVID C. ENGBRETSON
*Professor Emeritus, Western Washington University, 516 High St.,
Bellingham, Washington 98225, USA*

Milton C. Blake Jr., known to all as Clark, died on 5 August 2017, in Bellingham, Washington, at the age of 85. He was born in San Francisco, California, on 20 February 1932, the first son of Milton C. Blake Sr. and Easter Carol Wilson. Clark grew up in San Francisco and the Sonoma Valley, graduating from Sonoma High School in 1949 and attending Santa Rosa Junior College. He joined the U.S. Army in 1952 and was sent to the Army Language School to study Russian. He then spent two years as an interpreter and translator for the Army in Austria and Germany.

Following his U.S. Army service, Clark attended the University of California at Berkeley, where he received his B.S. in geology in 1958. Clark began work with the U.S. Geological Survey while finishing his bachelor's degree, serving over the next few years as a field assistant in California, Nevada, and Alaska with several well-known USGS geologists, notably Porter Irwin and Edgar Bailey (California Klamath Mountains and Coast Ranges), Tom Nolan and Dick Hose (Nevada), and Edward Mackevett (Alaska).

Clark was greatly influenced in this early work with Bailey and his Survey colleagues (particularly Robert Coleman, Porter Irwin, and David Jones) by poorly understood complexities of the Franciscan accretionary assemblage. Much of Clark's long career subsequently concerned the study of the age, field relations, structure, and metamorphic history of these enigmatic rocks. This focus began as a graduate student at Stanford University, where his 1965 Ph.D. dissertation was titled “Structure and petrology of low-grade metamorphic rocks, blueschist facies, Yolla Bolly area, northern California.” This was followed by his classic 1967 paper with USGS colleagues that described inverted metamorphic zonation in Franciscan rocks beneath a regional thrust fault separating Franciscan rocks from oceanic basement of the coeval Great Valley sequence forearc basin section of northern California. This work was followed by other papers coauthored with Edgar Bailey and David Jones describing the ophiolitic basement of the Great Valley sequence and the significance of the fault contact between these rocks and the Franciscan assemblage. The 1960s were an exciting time in earth science, when plate tectonics was emerging as a fundamental driving process at convergent margins, and Clark enthusiastically applied these ideas as a setting for Franciscan accretion, deformation, and metamorphism.

During his research on the accretionary margin of western North America, Clark became involved with projects along other ancient convergent margins, including in New Zealand, Australia, New Caledonia, the western Alps, and the Cyclades Islands of Greece. This resulted in collaborations with numerous geologists in New Zealand, Australia, France, Japan and Italy. Clark received a Fulbright Grant in 1970 to work on tectonic problems associated with ophiolitic



and associated accretionary rocks in New Zealand and New Caledonia, collaborating with C.A. Landis (University of Otago) and R.N. Brothers (University of Auckland) on several important papers (Blake and Landis, 1973; Brothers and Blake, 1973; Blake et al., 1974a). He also spent six months at the University of Paris in 1978 working in the western Alps and in the Greek Cyclades Islands (Blake et al., 1981a).

In the early 1970s, the USGS had become a leader in addressing environmental issues in the urbanized United States through the use of framework geologic mapping and potential-field geophysics to delineate such geologic hazards as earthquakes and landslides. Clark spent two years as a staff geologist for urban studies helping to administer this program in the office of Environmental Geology at USGS headquarters in Washington, D.C., and Reston, Virginia. He then returned to Menlo Park in 1974 as chief of the Branch of Western Environmental Geology.

In the mid-1970s and early 1980s, paleomagnetism emerged as another tool for studying structurally complex accretionary rocks. When integrated with biostratigraphic data, paleomagnetic studies showed that many accreted bodies of rock along continental margins had undergone large translation parallel to the margin. This led to rapid application of the new concept of tectonostratigraphic terranes, which Clark adopted as a powerful means of subdividing the Franciscan. In the mid-1980s, influenced by the paleomagnetic revelations, Clark, together with David Jones and other USGS colleagues, proposed a new model for assembly of the Mesozoic to Cenozoic accretionary margin of western North America that integrated plate tectonic evolution of the oceanic crust with the sedimentary history of the continental margin. Based on relations documented by geologic mapping in Mesozoic and Tertiary Franciscan rocks of the San Francisco Bay region of California and in a transect across northern California from Cape Mendocino to the northern Great Valley, Clark and David Jones proposed that the margin consists of a series of composite oceanic and continent-derived tectonostratigraphic terranes. They proposed that these terranes were accreted as the result of both convergent and translational processes. This model, though still controversial and debated today, is widely used globally as a basic framework for accretion along subduction margins. Clark was recognized by the Geological Society of America for his work on accretionary terranes in 1972 when he was elected to GSA Fellowship. In the late 1970s and 1980s Clark also participated with New Zealand colleagues in the early application of the terrane concept to accretionary rocks in New Zealand. Subsequently, in 1987, Clark and Charles Landis were joint recipients of the Geological Society of New Zealand's most prestigious McKay Hammer Award for their "most meritorious published contributions to New Zealand geology."

In 1988, Clark continued his work in the Alps of France and Italy under a G.K. Gilbert Fellowship and also worked at the New South Wales Geological Survey mapping accretionary and ophiolitic rocks in Australia.

Clark retired from the USGS in 1993 and moved to Bellingham, Washington, where he continued his research on accretionary rocks of the Washington margin as a research associate, advising and teaching at Western Washington University. He collaborated with his WWU colleagues and, under a National Science Foundation grant, participated in the study of the geology and tectonic history of the San Juan Islands. Until his death, Clark also continued geologic mapping studies of the accretionary margin of California as a USGS emeritus scientist, having major influence on 3-dimensional modeling of crustal structure in northern California, collaborating with other emeriti colleagues and acting as mentor to a younger generation of USGS scientists.

Clark's passion for geology was equaled by his desire to live his life to the fullest, surpassed only by his love of family and friends. He was an avid naturalist and an accomplished field ornithologist (Blake, 2004; Blake and Engebretson, 2007; Blake and Wentworth, 2007;

Marshall and Blake, 2009), over the years acting as a compiler during annual Christmas bird counts with the Audubon Society both in California (Santa Clara County chapter) and Arizona (Tucson and Sonoran–Glendale chapters). He was also an avid collector of antique bottles and memorabilia and, with his father and daughter Emma, did extensive genealogical research on the Blake and related families. He loved good wine and food and enjoyed countless memorable gatherings with friends and family, and with colleagues on field trips and at professional meetings. His colleagues and friends enjoyed his lively and friendly discussions of geology and subjects ranging from music and travel to wine and food. Students and younger geologists further remember Clark for his generosity and endless willingness to discuss and explain complex geologic relations on field trips and for pointing them to places to see field relations that helped them in their own research. Clark's unique influence in the geologic community and on his colleagues and friends will be long lasting.

Acknowledgments: We thank Clark's wife Patty and his daughter Emma C. Blake for providing us with details of Clark's life and career. We also thank Russell F. Burmester, Western Washington University, for providing the photo of Clark pointing to a belemnite in greywacke of the Lopez structural zone on Lopez Island, Washington, in May 1997.

SELECTED BIBLIOGRAPHY OF M. CLARK BLAKE JR.

- 1965 Structure and petrology of low-grade metamorphic rocks, blueschist facies, Yolla Bolly area, northern California [unpublished Ph.D. thesis]: Stanford University, map scale 1:20,000.
- 1967 (with Irwin, W.P., and Coleman, R.G.) Upside-down metamorphic zonation, blueschist facies, along a regional thrust in California and Oregon, *in* Geological Survey Research, Chapter C: U.S. Geological Survey Professional Paper 575C, p. C1–C9.
- 1969 (with Irwin, W.P., and Coleman, R.G.) Blueschist-facies metamorphism related to regional thrust faulting: *Tectonophysics*, v. 8, no. 3, p. 237–246, [https://doi.org/10.1016/0040-1951\(69\)90100-0](https://doi.org/10.1016/0040-1951(69)90100-0).
- 1970 (with Hose, R.K.) Geologic map of White Pine County, Nevada: U.S. Geological Survey Open-File Report 70-166, scale 1:150,000.
- 1970 (with Bailey, E.H., and Jones, D.L.) On-Land Mesozoic oceanic crust in California Coast Ranges: U.S. Geological Survey Professional Paper 700-C, p. C70–C81.
- 1971 (with Smith, J.T., Wentworth, C.M., and Wright, R.H.) Preliminary geologic map of western Sonoma County and northernmost Marin County, California: U.S. Geological Survey Open-File Map 71-44, scale 1:62,500.
- 1973 (with Landis, C.A.) The Dun Mountain ultramafic belt—Permian oceanic crust and upper mantle in New Zealand: U.S. Geological Survey *Journal of Research*, v. 1, p. 529–534.
- 1973 (with Brothers, R.N.) Tertiary plate tectonics and high-pressure metamorphism in New Caledonia: *Tectonophysics*, v. 17, no. 4, p. 337–358, [https://doi.org/10.1016/0040-1951\(73\)90046-2](https://doi.org/10.1016/0040-1951(73)90046-2).
- 1974 (with Bailey, E.H.) Major chemical characteristics of Mesozoic Coast Range ophiolite in California: U.S. Geological Survey, *Journal of Research*, v. 2, p. 637–656.
- 1974 (with Jones, D.L.) Origin of Franciscan mélanges in northern California, *in* Dott, R.H., Jr., and Shaver, R.H., eds., *Modern and ancient geosynclinal sedimentation*: Society of Economic Paleontologists and Mineralogists, Special Publication 19, p. 345–357, <https://doi.org/10.2110/pec.74.19.0345>.

- 1974a (with Jones, D.L., and Landis, C.A.) Active continental margins: contrasts between California and New Zealand, *in* Burk, C.A., and Drake, C.L., eds., *The Geology of Continental Margins*: Berlin Heidelberg, Springer, p. 853–872, https://doi.org/10.1007/978-3-662-01141-6_63.
- 1974b (with Bartow, J.A., Frizzell, V.A., Schlocker, J., Sorg, D., Wentworth, C.M., and Wright, R.H.) Preliminary geologic map of Marin and San Francisco Counties and parts of Alameda, Contra Costa, and Sonoma Counties, California: U.S. Geological Survey Miscellaneous Field Studies Map MF-574, scale 1:62,500.
- 1974c (with Irwin, W.P., Wolfe, E.W., and Cunningham, C.G., Jr.) Geologic map of the Pickett Peak quadrangle, Trinity County, California: U.S. Geological Survey, Geological Quadrangle Map GQ IIII, scale 1:62,500.
- 1974d (with Nolan, T.B., and Merriam, C.W.) Geologic map of the Pinto Summit quadrangle, Eureka and White Pine Counties, Nevada: U.S. Geological Survey Miscellaneous Investigations Map I-793, scale, 1:31,680.
- 1975 (with McKee, E.H., Marvin, R.F., Silberman, M.L., and Nolan, T.B.) The Oligocene volcanic center at Eureka, Nevada: U.S. Geological Survey *Journal of Research*, v. 3, no. 5, p. 605–612.
- 1976 (with Jones, D.L., and Rangin, C.) The four Jurassic belts of northern California and their significance to the geology of the southern California borderland, *in* Howell, D.G., ed., *Aspects of the Geologic History of the California Continental Borderland*: American Association of Petroleum Geologists, Pacific Section, Miscellaneous Publication 24, p. 343–362.
- 1978 (with Lanphere, M.A., and Irwin, W.P.) Early Cretaceous metamorphic age of the South Fork Mountain schist in the northern Coast Ranges of California: *American Journal of Science*, v. 278, no. 6, p. 798–815, <https://doi.org/10.2475/ajs.278.6.798>.
- 1978 (with Zietz, I., and Daniels, D.L.) Aeromagnetic and generalized geologic map of parts of central California: U.S. Geological Survey Geophysical Investigations Map GP-918, scale 1:1,000,000.
- 1981 (with Jones, D.L.) The Franciscan Assemblage and related rocks in northern California: a reinterpretation, *in* Ernst, W.G., ed., *The Geotectonic Development of California (Rubey Volume I)*: Englewood Cliffs, New Jersey, Prentice-Hall, p. 306–328.
- 1981a (with Bonneau, M., Geyssant, J., Kienast, J.R., Lepvrier, C., Maluski, H., and Papanikolaou, D.) A geologic reconnaissance of the Cycladic blueschist belt, Greece: *Geological Society of America Bulletin*, v. 92, no. 5, p. 247–254, [https://doi.org/10.1130/0016-7606\(1981\)92<247:AGROTC>2.0.CO;2](https://doi.org/10.1130/0016-7606(1981)92<247:AGROTC>2.0.CO;2).
- 1981b (with Jayko, A.S., and Howell, D.G.) Geology of a subduction complex in the Franciscan assemblage of northern California: *Oceanologica Acta*, v. 12, p. 267–272.
- 1982 (with Howell, D.G., and Jones, D.L.) Preliminary tectonostratigraphic terrane map of California: U.S. Geological Survey Open-File Report 82-593, scale 1: 750,000, 3 sheets, 10 p. text.
- 1983 (with Jayko, A.S.) Preliminary geologic map of the Yolla Bolly–Middle Eel Wilderness and adjacent roadless areas, northern California: U.S. Geological Survey Miscellaneous Field Studies Map MF 1595-A.
- 1984 *Franciscan Geology of Northern California*: Pacific Section, Society of Economic Paleontologists and Mineralogists, v. 43, p. 185–201.
- 1984 (with Jayko, A.S.) Geologic map of part of the Orleans Mountain Roadless Area, Siskiyou and Trinity Counties, California: U.S. Geological Survey Miscellaneous Field Studies Map MF-1600-A.

- 1984 (with Howell, D.G., and Jayko, A.S.) Tectonostratigraphic terranes of the San Francisco Bay Region, *in* Blake, M.C., Jr., ed., *Franciscan Geology of Northern California*: Society of Economic Paleontologists and Mineralogists, Pacific Section, v. 43, p. 5–22.
- 1984 (with Jayko, A.S., Moore, T.E., Chavez, V., Saleeby, J.B., and Seel, K.) Tectonostratigraphic terranes of Magdalena Island, Baja California Sur, *in* Frizzell, V.A., Jr., *Geology of the Baja California Peninsula*: Society of Economic Paleontologists and Mineralogists, Pacific Section, v. 39, p. 183–191.
- 1985 (with Engebretson, D.E., Jayko, A.S., and Jones, D.L.) Tectonostratigraphic terranes in southwest Oregon, *in* Howell, D.G., ed., *Tectonostratigraphic Terranes of the Circum-Pacific Region*: Earth Science Series, v. 1, Circum-Pacific Council for Energy and Mineral Resources, p. 147–157.
- 1985 (with Jayko, A.S., and McLaughlin, R.J.) Tectonostratigraphic terranes of northern California, *in* Howell, D.G., ed., *Tectonostratigraphic Terranes of the Circum-Pacific Region*: Earth Science Series, v. 1, Circum-Pacific Council for Energy and Mineral Resources, p. 159–171.
- 1986 (with Jayko, A.S.) Significance of Klamath rocks between the Franciscan Complex and Coast Range ophiolite, northern California: *Tectonics*, v. 5, p. 1055–1071, <https://doi.org/10.1029/TC005i007p01055>.
- 1986 (with Jayko, A.S., and Brothers, R.N.) Blueschist metamorphism of the Eastern Franciscan belt, northern California, *in* Evans, B.W., and Brown, E.H., eds., *Blueschists and Eclogites*: Geological Society of America Memoir 164, p. 107–123, <https://doi.org/10.1130/MEM164-p107>.
- 1987 (with Brown, E.H.) Correlation of early Cretaceous blueschists in Washington, Oregon and northern California: *Tectonics*, v. 6, no. 6, p. 795–806, <https://doi.org/10.1029/TC006i006p00795>.
- 1987 (with Jayko, A.S., and Harms, T.) Attenuation of the Coast Range ophiolite by extensional faulting and nature of the Coast Range “thrust,” California: *Tectonics*, v. 6, p. 475–488, <https://doi.org/10.1029/TC006i004p00475>.
- 1987 (with Landis, C.A.) Tectonostratigraphic terranes of the Croissilles Harbour region, South Island, New Zealand, *in* Leitch, E.C., and Scheibner, E., eds., *Terrane Accretion and Orogenic Belts*: American Geophysical Union, Geodynamics Series, v. 19, p. 179–198.
- 1988 (with Aitchison, J.C., Flood, P.G., and Murchey, B.L.) New and revised lithostratigraphic units from the southwestern New England Fold Belt: NSW Geological Survey, Q Notes, v. 72, p. 10–16.
- 1988 (with Jayko, A.S., McLaughlin, R.J., and Underwood, M.B.) Metamorphic and tectonic evolution of the Franciscan Complex, northern California, *in* Ernst, W.G., ed., *Metamorphism and Crustal Evolution of the Western United States* (Rubey Volume VII, Chapter 38): Englewood Cliffs, New Jersey, Prentice-Hall, p. 1035–1060.
- 1988 (with Murchey, B.) A California model for the New England fold belt, *in* Kleeman, J.D., ed., *New England Orogen Tectonics and Metallogeneses*: University of New England, Symposium Proceedings, Armidale, New South Wales, Australia, November 1988, p. 20–31.
- 1989 (with Jayko, A.S.) Deformation of the eastern Franciscan belt, northern California: *Journal of Structural Geology*, v. 11, no. 4, p. 375–390.
- 1989 (with Jayko, A.S., McLaughlin, R.J., Ohlin, H.N., and Kelsey, H.) Reconnaissance geologic map of the Covelo 30' × 60' quadrangle, northern California: U.S. Geological Survey Miscellaneous Field Studies Map MF-2001, scale 1:100,000.

- 1992 (with Helley, E.J., Jayko, A.S., Jones, D.L., and Ohlin, H.N.) Geologic map of the Willows 1:100,000 quadrangle, California: U.S. Geological Survey Open-File Report 92-271.
- 1993 (with Jayko, A.S.) Northward displacements of forearc slivers in the Coast Ranges of California and southwest Oregon during the late Mesozoic and early Cenozoic, *in* Dunn, G., and McDougall, K., eds., *Mesozoic Paleogeography of the Western United States—II*: (SEPM) Society for Sedimentary Geology, Pacific Section, Book 71, p. 19–36.
- 1994 (with Aitchison, J.C., Flood, P.G. and Jayko, A.S.) Paleozoic ophiolitic assemblages within the southern New England Orogen of eastern Australia: implications for growth of the Gondwana margin: *Tectonics*, v. 13. no. 5, p. 1135–1149, <https://doi.org/10.1029/93TC03550>.
- 1994 (with Isozaki, Y.) Biostratigraphic constraints on formation and timing of accretion in a subduction complex: an example from the Franciscan Complex of northern California: *Journal of Geology*, v. 102, p. 283–296, <https://doi.org/10.1086/629671>.
- 1995 (with Moore, D.E., and Jayko, A.S.) The role of serpentinite mélanges in the unroofing of ultrahigh-pressure metamorphic rocks: an example from the western Alps, *in* Coleman, R.G., and Wang, X. eds., *Ultrahigh-Pressure Metamorphism*: Cambridge University Press, New York, p. 182–205, <https://doi.org/10.1017/CBO9780511573088.007>.
- 1999 (with Wentworth, C.M.) Structure and metamorphism of the Franciscan Complex, Mt. Hamilton area, northern California: *International Geology Review*, v. 41, p. 417–424, <https://doi.org/10.1080/00206819909465150>. [Republished in 2000 in *Geological Society of America, International Book Series*, v. 3, p. 295–302.]
- 1999 (with Wentworth, C.M., McLaughlin, R.J., and Graymer, R.W.) Preliminary geologic map of the San Jose 30 × 60 minute quadrangle, California: U.S. Geological Survey Open-File Report 98-795, scale 1:100,000.
- 1999 (with Harwood, D.S., Helley, E.J., Irwin, W.P., Jayko, A.S., and Jones, D.L.) Geologic map of the Red Bluff 30' × 60' quadrangle, California: U.S. Geological Survey Geologic Investigations Map I-2542, 1 sheet, scale 1:100,000, 15 p. pamphlet, and database, available at <https://pubs.usgs.gov/imap/2542/>.
- 2000 (with Graymer, R.W., and Jones, D.L.) Geologic map and map database of parts of Marin, San Francisco, Alameda, Contra Costa, and Sonoma Counties, California: U.S. Geological Survey Miscellaneous Field Studies MF-2337, scale 1:75,000.
- 2000 (with McLaughlin, R.J., Ellen, S.D., Jayko, A.S., Irwin, W.P., Aalto, K.R., Carver, G.A., Clarke, S.H., Barnes, J.B., Cecil, J.D., and Cyr, K.A.) Geology of the Cape Mendocino, Eureka, Garberville, and southwestern part of the Hayfork 30 × 60 minute quadrangles and adjacent offshore area, northern California, with digital database: U.S. Geological Survey Miscellaneous Field Studies Map MF-2336, scale 1:137,000.
- 2002 (with Graymer, R.W., and Stamski, R.E.) Geologic map and map database of western Sonoma, northernmost Marin, and southernmost Mendocino Counties, California: U.S. Geological Survey Miscellaneous Field Studies Map MF-2402, scale: 1:62,500.
- 2004 Tucson Audubon Society's finding birds in southeast Arizona: Tucson, Arizona, Tucson Audubon Society, 329 p. ISBN-13:9780964503137.
- 2007 (with Engebretson, D.) Murrelets and molasse in the eastern San Juan Islands, *in* Stelling, P., and Tucker, D.S., eds., *Floods, Faults, and Fire: Geological Field Trips in Washington State and Southwest British Columbia*: Geological Society of America Field Guide 9, p. 137–142, [https://doi.org/10.1130/2007.fld009\(07\)](https://doi.org/10.1130/2007.fld009(07)).

- 2007 (with Wentworth, C.M.) The geology and tectonic history of Santa Clara County, *in* Bouseman, W.G., ed., *Breeding bird atlas of Santa Clara County, California*: Santa Clara Valley Audubon Society, Cupertino, California, p. 14–21.
- 2009 (with Marshall, L.G.) *Land of black volcanoes and white sands: the Pinacate and Gran Desierto de Altar Biosphere Reserve*: Tucson, Arizona, Environmental Education Exchange, 129 p., ISBN 978-0-615-28064-6.

