

NORTHERN CALIFORNIA GEOLOGICAL SOCIETY



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FEBRUARY MEETING ANNOUNCEMENT

- DATE:** Wednesday, February 23, 2000
- LOCATION:** Orinda Masonic Center, 9 Altarinda Rd., Orinda
- TIME:** 6:30 p.m. Social; 7:00 p.m. talk (No Dinner)
Cost is \$5.00 per person
- RESERVATIONS:** Leave your name on the recorder at 925-294-7530 anytime before the meeting.



SPEAKER: Warren Nokleber, U.S. Geological Survey, Menlo Park

Dynamic Computer Model for the Phanerozoic Tectonic and Metallogenic Evolution of the Circum-North Pacific

A dynamic computer model, based on a geologic and tectonic analysis of the region, illustrates the complex Phanerozoic tectonic evolution of the Circum-North Pacific. The model, produced by computer morphing of a series of fourteen paleogeographic maps, illustrates the major tectonic and metallogenic events for seven major time intervals. (1) In the Late Proterozoic, and Late Devonian and Early Carboniferous, major periods of rifting, as well as subduction occurred along the margins of Northeast Asia and northwestern part of the North American Cordillera. (2) From about the Late Triassic through the mid-Cretaceous, a succession of offshore island arcs and tectonically paired subduction zones formed near continental margins with subsequent accretion and substantial growth of the North Asian and North American continents. (3) From about mainly the mid-Cretaceous through the Present, a succession of igneous arcs and tectonically paired subduction zones formed along the continental margins. (4) From about the Jurassic to the Present, oblique convergence and rotations caused orogen-parallel sinistral and then dextral displacements within the upper plate margins of Northeast Asia and the North American Cordillera. (5) From the Early Jurassic

Continued on the back page of the newsletter

NCGS Speaker Program: Year 2000

Wednesday, January 26, Masonic Auditorium, Orinda, CA

Paul R. Renne, University of California, Berkeley, and Director, Berkeley Geochronology Center
Continental Flood Basalts and Associated Extraterrestrial Impact and Mass Extinction Phenomena

Wednesday, February 23, Masonic Auditorium, Orinda, CA

Warren Nokleberg, U.S. Geological Survey, Menlo Park, CA
Dynamic Computer Model for the Phanerozoic Tectonic and Metallogenic Evolution of the Circum-North Pacific

Wednesday, March 29, Masonic Auditorium, Orinda, CA

Heidi Stenner, U.S. Geological Survey, Menlo Park, CA
Tectonics of the Anatolian Fault System and Turkish Earthquakes

Special Chevron Overseas Petroleum (COPI)-Hosted Event

Saturday, April 1, 10:00 a.m.-12:00 noon, COPI (Chevron) Virtual Reality Visualization Center, San Ramon, CA
Geology and 3-D Demonstration of Tengiz Oil Field and Absheron Prospect, Caspian Sea (see announcement)
Robert Kieckhefer, COPI, San Ramon, CA and **Frank Picha**, Consultant, Walnut Creek, CA

Wednesday, April 26, Masonic Auditorium, Orinda, CA

Ken Caldiera, Program for Climate Model Diagnosis and Intercomparison, Lawrence Livermore National Laboratory
Carbon Cycles and Paleoclimate Reconstructions

Wednesday, May 24, Masonic Auditorium, Orinda, CA

David Lawler, Far West Geoscience Foundation, Berkeley, and Bureau of Land Management, Sacramento
Paleofluvial Systems and Placer Gold Deposits in the Sierra Nevada Region, California--Sedimentation and Mercury Impacts Associated with Historic Mining Methods

Wednesday, June 28, Masonic Auditorium, Orinda, CA

Keil Albert, Geoconsultants Inc., Sunnyvale
Geologic and Tectonic Significance of the Pleistocene Irvington Gravels, East Bay Area Foothills

Wednesday, September 27, Masonic Auditorium, Orinda, CA

Dr. Eldridge Moores, University of California, Davis, and 1996 President, Geological Society of America
Geology and Society: A Call for Action

Wednesday, October 25, Masonic Auditorium, Orinda, CA

Frank Picha, Consultant, Walnut Creek, CA
Sedimentary Basins and Petroleum Systems in Terms of Global Tectonic Cycles

Wednesday, November 29, Masonic Auditorium, Orinda, CA, or Site TBA NCGS FAMILY NIGHT

Chris McKay, NASA Ames Research Center, Mountain View
Landscape Geomorphology and the Search for Water on Mars: Implications for the Development of Life

AAPG Distinguished Lecturer Program: Year 2000

Wednesday, March 8, Masonic Auditorium, Orinda, CA

Robert C. Balling, Arizona State University, Tempe, AZ
A Climate of Doubt about Global Warming

Wednesday, April 12, COPI Auditorium, Chevron Overseas Petroleum Inc., San Ramon, CA

Mark Cooper, PanCanadian Petroleum, Calgary, Canada
Oil and Gas Fields Associated with Inverted Extensional Faults: A Global Review

AAPG Distinguished Lecturer

Dr. Robert C. Balling, Jr.

Director, Office of Climatology, Arizona State University, Tempe, AZ

Sponsored by the American Association of Petroleum Geologists and the NCGS

Wednesday, March 8, 2000

7:00 p.m. at the Masonic Center, Orinda, CA (see map for February 23rd meeting)

6:30-7:00 p.m. Social with refreshments

Cost is \$5.00 per person

A Climate of Doubt About Global Warming

Over the past decade, global warming has become a front-page environmental issue capturing the attention of thousands of scientists and policy makers worldwide. According to numerical models of climate, the continued buildup of greenhouse gases will lead to a substantial rise in planetary temperature, melting icecaps and alpine glaciers, rising sea levels, changes in regional climate patterns, and an increase in extreme weather events. Empiricists have noted that the planetary temperature, as measured from thermometers throughout the globe, has increased over the past century thereby providing support for the theoretical predictions of the models. Many nations have called for action to combat the threat of global warming, and the Kyoto Protocol represents a major first step in the policy arena.

However, many of the most fundamental global warming issues remain in a state of considerable debate in the scientific community. For example, in the most recent half decade, the atmospheric concentration of many greenhouse gases has slowed or even stabilized. The numerical models of the climate continue to have serious weaknesses including their representation of cloud processes and the coupling of the atmosphere and ocean. Thermometer records may show warming, but serious concerns remain about the true

representativeness of their readings. In addition, increased output of the sun, lack of recent volcanism, and trends in El Nino/Southern Oscillation have certainly contributed to any observed warming. The entire issue is further complicated by the fact that satellite-based and balloon-based measurements of lower atmospheric temperatures show no warming whatsoever over the past few decades. Furthermore, there appears to be no increase in tropical cyclone activity, severe weather events, or variability of climate.

We now fully realize that the future climate will be impacted by many changes in atmospheric composition, including the buildup of greenhouse gases. Increasing levels of sulfate and mineral aerosols and the depletion of stratospheric ozone all have a known cooling effect that may completely cancel any projected warming. Finally, the evidence is overwhelming that the climate impact of a fully-implemented Kyoto Protocol will be trivial over the next fifty years.

Dr. Robert C. Balling received his B.A. degree in 1974 from Wittenberg University, his M.A. from Bowling Green State University in 1975, and his Ph.D. from the University of Oklahoma in 1979. He has been Director of the Office of Climatology, and Professor in the Department of Geography at Arizona State University, Tempe, since 1998. In 1991 he was Contributing Author to the United Nations Intergovernmental Panel on Climate Change, from 1993 to 1996 he was Member of the United Nations International Panel of Experts on Desertification, and in 1999 he served as Senior Climate Consultant for National Geographic Society's 7th Edition Atlas of the World. Dr. Balling is author of the book *The Heated Debate: Greenhouse Predictions Versus Climate Reality*, San Francisco, California: Pacific Research Institute for Public Policy, 195 pp. (1992) and co-authored with Martin A.J. Williams *Interactions of Desertification and Climate*, London, England: Edward Arnold Press, 270 pp. (1996).

His recent (1998-1999) scientific publications include nine articles featured in the professional journals *Climate Research*, *Nature*, *Physical Geography*, *Climatic Change*, *Environmental and Experimental Biology*, and *Geophysical Research Letters*. These articles cover studies of winter and summer warming rates in gridded temperature time series, analyses of trends in the variability of daily and monthly historical temperature measurements, short term cycles of air pollutants and weather conditions in the coastal NW Atlantic region, impacts of land degradation on historical temperature records from the Sonoran (Arizona) desert, analyses of long-term European temperature records, studies of relationships between near surface air temperatures over land and the atmosphere's seasonal CO₂ cycle, and lunar influences on the diurnal temperature range.



Geology and 3-D Demonstration of Tengiz Oil Field and Absheron Prospect, Caspian Sea

Hosted by **Chevron Overseas Petroleum Inc.**
Virtual Reality Visualization Center, San Ramon, CA.

Saturday, April 1, 2000

10:00 a.m. to 12:00 noon

No cost; please register before March 30th (see below)

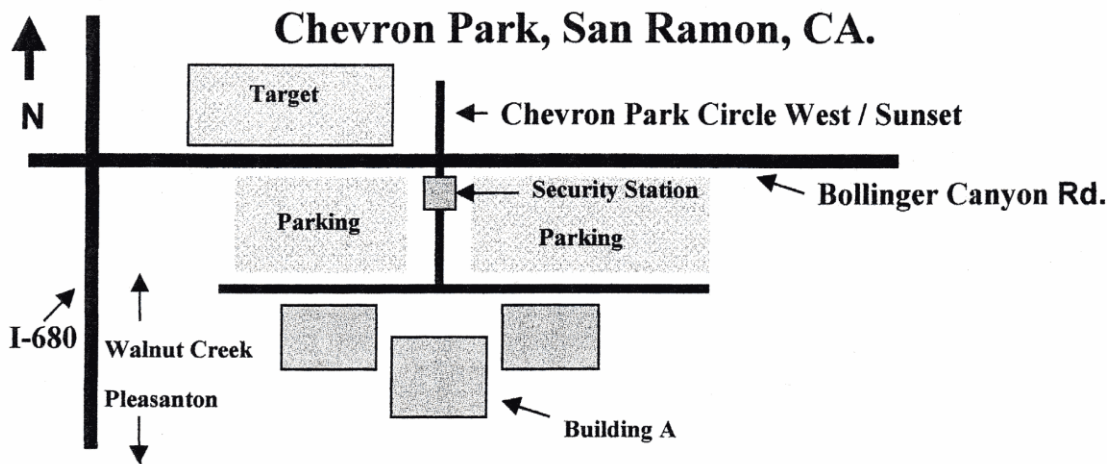
Chevron Overseas Petroleum Inc. (COPI) relies on state-of-the-art computer technology in its exploration and production of oil and natural gas outside of North America. One of the company's 3-D Visualization Centers is in COPI's headquarters in San Ramon. Powered by an SGI Onyx computer, this center has a 25-foot-wide screen on which groups of earth scientists can view seismic and well data, reservoir simulations, and other large data sets. Two large COPI projects from the Caspian Sea region will be presented to NCGS attendees in the Visualization Center.

First, **Bob Kieckhefer** will show 3-D seismic data and will review the Absheron prospect, in the deep-water Caspian Sea offshore Azerbaijan. This prospect is a large 4-way dip-closed anticline in Plio-Pleistocene clastic sediments, located between a 4-billion-barrel oil field and a recent major gas discovery. Chevron and its partners TotalFina and SOCAR plan to drill the first well later in 2000.

Next, **Frank Picha** will present 3-D seismic data and will review the geology of the onshore Tengiz field, in western Kazakhstan, just east of the northern Caspian Sea. This field, discovered by the Soviets in the 1970s, is a Middle Devonian-Carboniferous carbonate platform capped by Permian salt. The producing carbonate reservoirs with recoverable reserves of several billion barrels of light oil are at a depth greater than 4 kilometers. The production is complicated by high pressure and high sulfur content in the associated gases. The joint-venture company Tengizchevroil, owned 45% by Chevron and the remainder by Exxon-Mobil, KazakhOil, and LukOil, has operated the field since April 1993 and currently produces over 200,000 barrels of oil per day. The 3-D seismic data over the Tengiz oil field also revealed interesting channelized depositional systems in the Jurassic and Cretaceous portion of the stratigraphic section. These fluvial to shallow marine channel sands and associated facies represent an important hydrocarbon play elsewhere in western Kazakhstan.

Attendance will be limited! In order to provide access to this center on a weekend, **Chevron security requires you to register with NCGS for this meeting no later than Thursday evening, March 30th. Register before March 30th by leaving your name and a phone number where you can be reached on the NCGS voice recorder at 925-294-7530. Food and drink are strictly prohibited in the Visualization Center, and smoking is not allowed in any Chevron building.**

Directions: Exit I-680 at Bollinger Canyon and go east one block to the stoplight at Chevron Park Circle West. Turn right and check in with security. Park in one of the lots, and enter Building A at the Main Lobby. The security guard at the receptionist desk will give attendees clearance badges. **Frank Picha and Bob Kieckhefer will escort the group to the Visualization Center for the 3-D demonstration. If you need more detailed directions to Chevron Park, San Ramon, please call Dan Day at 925-294-7530.**



The Association of Continental Flood Basalts with Extraterrestrial Impacts and Mass Extinction Phenomena in the Geologic Record Presented at the January NCGS Meeting

Dr. Paul Renne, Director of the Berkeley Geochronology Center, opened the new year for the NCGS with an intriguing comparison of various major continental flood basalt events, meteorite impact craters, and major faunal/floral extinctions and their startling temporal coincidences in the geologic record. His January 26th talk "*Continental Flood Basalts and Associated Phenomena*" probed the temporal nature of these events which have been refined in recent years by advances in geochronological dating techniques. Paul's specialty is the Ar^{40}/Ar^{39} dating technique. This method involves irradiating the rock or mineral sample in a nuclear reactor and then carefully measuring the ratio of these two argon isotopes with a mass spectrometer. This technique can cover age ranges from several hundred million down to a few million years, and does not suffer the problems that plague the classical K/Ar method. Hence, more accurate dates can be determined using the newer Ar^{40}/Ar^{39} process. Much of Paul's research hinges on the reliable dating of geologic materials, in particular, basalts, by this technique.

Paul described some of the key mass extinctions in the geologic record which mark the Ordovician-Silurian, Permian-Triassic, Triassic-Jurassic, and Cretaceous-Tertiary boundaries. These events involved major reductions in biological diversity and the extinction of many species followed by often dramatic increases in the diversity of the survivors. Particularly significant in its impact was the Permian-Triassic event. Various causes for these mass extinctions have been set forth, and one of the more popular, if not controversial ones is the bolide (meteorite) impact theory. The latter has focused much attention on the Cretaceous-Tertiary extinction event due largely to the work of renowned Berkeley physicist Walter Alvarez and his research team's discovery of an iridium (Ir) trace element anomaly in a thin sedimentary clay layer at this boundary. Since iridium is concentrated in meteorite bodies, the discovery of high iridium values at the boundary lent credence to Alvarez's hypothesis that a meteorite impact was responsible for the demise of fauna that had flourished during most of the Mesozoic Era. The only obstacle to this conclusion was the lack of evidence for major impact events coincident with the Cretaceous-Tertiary boundary.

Key evidence for meteorite activity was obtained during the lunar expeditions of the early 1970's. The Apollo 14 mission provided impact ejecta spherules that could be dated by the Ar^{40}/Ar^{39} technique to determine the lunar impact frequency. The results indicate a decrease in lunar impact events from levels 4.0 to 3.5 billion years ago to a minimum 1 billion to 800 million years ago, followed by an increase 500 to 800 million years ago that coincides with an enormous explosion of biological diversification on earth. The conclusion is that impact events may also have had a positive effect on life by stimulating the evolution of more advanced species while eradicating those that could not cope with the sudden environmental changes these catastrophes must have caused. The impact phenomena could essentially stimulate a brief period of natural selection, followed by intense diversification to fill vacated ecological niches. In 1992, the Chixalub Crater in the Yucatan Peninsula was discovered. Dating of appropriate material recovered in drillings from the impact zone were dated at 65 million years old, coincident with ages of the Cretaceous-Tertiary boundary. The voluminous Deccan Trap continental flood basalts on the Indian subcontinent have been dated by the Ar^{40}/Ar^{39} technique as well as by the exotic Re^{187}/Os^{187} technique (65.6 ± 0.3 m.y.) and showed excellent agreement with K/T boundary and Chixalub ages. These ages likewise coincide with tektite ages (tektites are glass beads considered extraterrestrial in origin and thought to be ejecta from meteorite impacts on other planetary bodies).

Paul then discussed one of his specialties, the study of continental flood basalts. These are extensive fissure outpourings of basaltic magma that cover large surface areas with multiple layers of lava flows. Examples include the Siberian Traps, the Deccan Traps, the Parana basalts (South America), the Karroo basalts (Southern Africa), and the Columbia River basalts of Oregon and Washington. The estimated total volume of lava erupted during these events could cover the earth's surface to a depth of 10 feet! These represent unique magmatic events that originated from deep mantle plumes. Because of the magnitude of these volcanic outpourings, scientists in the 1980's speculated that these events could have had an effect on the evolution of life via their gaseous emissions, but much of the volcanologic data was derived from convergent plate margin activity (island arcs) rather than on the more quiescent basaltic activity. This is an on-going area of study that needs to be better defined before its impact on global climatic conditions can be speculated upon. However, Benjamin Franklin noted the effects of Icelandic volcanism on Paris weather conditions in his writings, so the concept of climatic changes tied to these geologically short-term events is not necessarily out of the question. It should be mentioned that Ar^{40}/Ar^{39} dates place the Siberian Traps at 250 m.y. old, which is emerging as the accepted age for the Permian-Triassic boundary based on numerous tephra deposit dates that occurred at this boundary.

Another interesting area of research Paul has been involved with is the dating of flood basalt events in the Circum-Atlantic. These events are part of the central Atlantic Magmatic province (CAMP), which include flows and diabase sills of the Newark Basin (the famous Palisade Sill is one member), CAMP diabase dikes in the Piedmont Province of eastern North and South America (Atlantic coast states and Brazil), in western Africa, and in the Iberian Peninsula (Spain and Portugal). These ages hover in the 199 to 201 m.y. age range and time the opening of the proto-Atlantic Ocean. Paul noted that discrepancies in the U/Pb and Ar⁴⁰/Ar³⁹ ages for these rocks are being attributed to errors in the decay constants for the radioactive isotopes, but that there is a real difference in the Triassic-Jurassic boundary age for marine rocks versus continental deposits (older).

What correlations do exist between mass extinctions in the geologic record, flood basalt eruptions, and meteorite impacts? Right now the flood basalt dates show better correlation with major extinctions in the fossil record than known bolide impacts. However, all three phenomena show outstanding correlation at the Cretaceous-Tertiary boundary (Chixalub Crater and Deccan Traps). However, not all flood basalt events are accompanied by major extinctions, as evidenced by the 30 m.y.-old Ethiopian Traps in eastern Africa. The effects of volatile output during these eruptions on the earth's atmosphere and on climatic conditions still need to be defined, as well as any links between flood basalt activity and major meteorite impacts. No cause and effect relationships have yet been established. Paul made no claims to have answers to these questions, but continued refinement of radiometric dates for these events adds fuel to the fire, and drives scientists to ponder the possible connections between these vastly different, yet potentially linked phenomena.

The NCGS wishes to thank **Dr. Paul Renne** for presenting this thought-provoking discussion of data that may link major volcanic phenomena and periods of unusually active meteorite activity to significant biological extinctions in the geologic record. As he and other geochronologists and igneous petrologists continue to amass data on key eruptive events and other datable phenomena, more pieces of the earth's complex history will fall into place. These important refinements in radiometric dating technology also help clarify the stratigraphic time scale and filter out important events in the tectonic evolution of our planet.

State Board of Registration for Geologists and Geophysicists Issues Statement on NHDS

The following statement was distributed at the start of the Saturday, February 5, 2000, meeting of the Board of Registration for Geologists and Geophysicists in Sacramento. Please distribute it to your colleagues, and please refer any questions to the board (geology@dca.ca.gov).

Betsy Mathieson, President
California Council of Geoscience Organizations (CCGO)

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The Board of Registration for Geologists and Geophysicists' (Board) legal counsel advises that the completion of a Natural Hazard Disclosure Statement (NHDS) is not the practice of geology.

The Natural Hazard Disclosure Act, section 1103.4(c), specifies Registered Geologists as one of the experts qualified to complete a NHDS. A Registered Geologist can demonstrate his or her qualifications by using his or her license number on the disclosure form. However, the Board concluded after receiving substantial written and oral testimony that affixing a seal to a NHDS is misleading to the public. Therefore, the Board advises that Registered Geologists not use his or her seal on a NHDS.

Because it is apparent from the testimony received that there is confusion on the use of seals, the Board will consider guidelines at its April 7, 2000, meeting at Country Suites by Ayres, 1945 East Holt Boulevard, Ontario, California, in hopes that this will clarify the matter. If guidelines are insufficient, the Board will consider adoption of regulations to resolve the issue.

Summer 2000 Denver Earth Science Project Courses

ANNOUNCING: A pilot test course for the ON-LINE version of the DESP module:

"Do You Know Your 3 R's?: Radiation, Radioactivity, and Radon".

Dates: On-line work on your own from June 12 to July 21.

Hands-on demonstrations with class materials: Saturdays from 9:00 am to noon, June 24, July 8 and 22.

The DESP, with a grant from the Colorado Department of Public Health and Environment, is developing an on-line version of the 3 R's course and will accept 10 science teachers (grades 7-12) to complete this pilot test to help evaluate and set up the course.

Registration cost: \$40.

Participants will receive a stipend of \$200 and 1 CEU of credit for taking the course and helping us to evaluate it.

Do You Know Your 3 R's? Radiation, Radioactivity, and Radon - Golden, Colorado

June 12-13

AND Applications of Nuclear Science and Technology

June 14-16.

This combination of two courses will be held back-to-back and sponsored by the American Nuclear Society. Each course will carry 1 graduate-level recertification credit.

Cost for each course: \$40.

Teachers may sign up for one or both courses.

Energy: A Closer Look At Oil and Gas - Aurora, Colorado

June 26-28

Registration: \$105

Ground Water Studies - Golden, Colorado

June 29, 30

Registration: \$105

Energy: A Closer Look at Oil and Gas - Houston, Texas

July 10-12

Registration: \$40

This course is sponsored by the Society of Petroleum Engineers, Gulf Coast Section

Teachers who successfully complete the course will receive a stipend of \$100 from the sponsors.

*The following workshops are accepting applications from teachers in the general area only. Please contact **Randy Kirby** for further information.*

Oil and Gas Exploration - Houston, Alaska

June 12-16

This course is sponsored by Ocean Energy, Inc. and Unocal Corporation.

Oil and Gas Exploration - Farmington, New Mexico

June 5-9

This course is sponsored by Burlington Resources, Inc.

Paleontology and Dinosaurs - Chicago, Illinois

Dates: First workshop: June 26-28

Second workshop: June 28-30. (Overlapping day to be a combined field trip.)

This course is sponsored by the Field Museum of Chicago.

For more information about any course, e-mail your regular mailing address to: **rkirby.geosci@usa.net** or call **Randy Kirby** at 510-254-2990.

through Tertiary, movement of the upper continental plates towards subduction zones resulted in strong plate coupling and accretion of the former island arcs and subduction zones to continental margins. Accretions were accompanied and followed by crustal thickening, anatexis, metamorphism, and uplift. And (6), in the middle and late Cenozoic, oblique to orthogonal convergence between the Pacific Plate, with respect to Alaska and Northeast Asia, resulted in formation of the modern-day ring of volcanoes around the Circum-North Pacific. Oblique convergence between the Pacific Plate and Alaska also resulted in major dextral-slip faulting in Alaska and the northern Canadian Cordillera, and along the western part of the Aleutian-Wrangell arc.

This work is the collaborative effort of the following international team of scientists: NOKLEBERG, Warren J., U.S. Geological Survey, Menlo Park, CA; SCOTESE, Christopher R., University of Texas, Arlington, TX; KHANCHUK, Alexander I., Russian Academy of Sciences, Vladivostok, Russia; MONGER, James W.H., and DAWSON, Kenneth M., Geological Survey of Canada, Vancouver, BC, Canada; NORTON, Ian O., Exxon Exploration Company, Houston, TX; PARFENOV, Leonid M., Yakutian Academy of Sciences, Yakutsk, Russia; STONE, David B., University of Alaska, Fairbanks AK

Dr. Warren J. Nokleberg is a research geologist in the Western Mineral Resources Team of the U.S. Geological Survey, based in Menlo Park, California. His current assignments are: (a) leader of a study of the Mineral Resources, Metallogenesis, and Tectonics of the Russian Far East, Alaska, and the Canadian Cordillera; (b) leader of a similar project on Northeast Asia (Siberia, Mongolia, and Northeastern China, South Korea, and Japan); and (c) participant in a Global Mineral Resource Assessment. Between 1966 and 1977 he studied the bedrock geology, mineral deposits, and tectonics of the central Sierra Nevada, California and the Stillwater igneous complex, Montana. Since 1977, he has studied the bedrock geology, metallogenesis, and tectonics of eastern Alaska, the Russian Far East, and Northeast Asia. He received a B.A. in geology from the University of California Los Angeles in 1961, and a Ph.D. in geology from the University of California Santa Barbara in 1970. He is a fellow of the Geological Society of America, a fellow of the Society of Economic Geologists, and a member of the American Geophysical Union. He was a Regular Line Officer in the U.S. Navy for four years, and an Associate Professor of Geology at California State University, Fresno for six years. He is author or co-author of over 200 scientific papers.

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