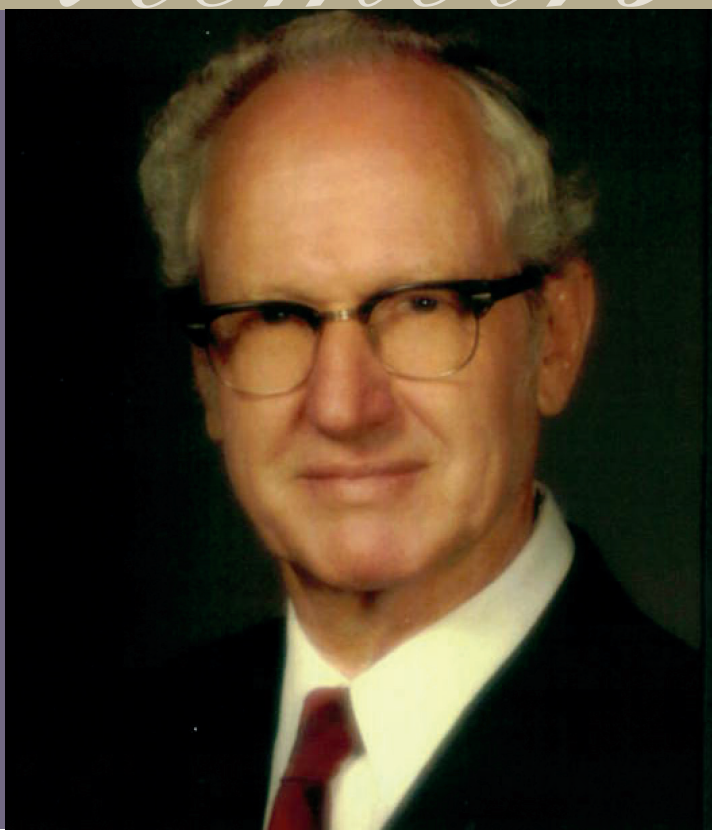
Donald E. White

1914–2002

BIOGRAPHICAL *Memoirs*



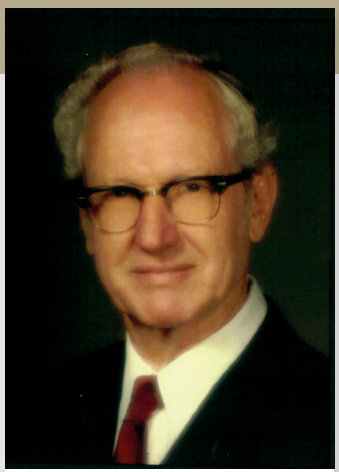
A Biographical Memoir by
L. J. Patrick Muffler

NATIONAL ACADEMY OF SCIENCES

DONALD EDWARD **WHITE**

May 7, 1914–November 20, 2002

Elected to the NAS, 1973



By L. J. Patrick Muffler

Donald E. White was a leading scientist for the U.S. Geological Survey, where his career was devoted almost entirely to the study of hydrothermal processes in the Earth's crust, from the dual perspectives of active geothermal systems and of extinct hydrothermal systems now represented only by ore deposits and alteration patterns. White was devoted to analyzing the mechanisms by which ore-forming metals are concentrated, transported, and deposited. His early work on antimony deposits and on mercury transport led to the understanding that these elements, as well as some precious metals, were concentrated in hydrothermal convection systems characterized by dilute chloride waters of predominantly meteoric origin. He concluded, on the other hand, that base metals required more concentrated brines, as was impressively confirmed in the early 1960s by the discovery of the metal-rich fluids of the Salton Sea geothermal system and subsequently by the recognition of sulfide-depositing hydrothermal systems on the sea floor. His studies of active hot-spring systems elucidated the principles of geyser activity and provided the scientific foundation for research programs aimed at the understanding of geothermal systems throughout the world.

White earned a bachelor's degree in geology from Stanford in 1936 and a Ph.D. from Princeton in 1939. That same year he joined the USGS, where he worked as a research geologist until 1981, save for a two-year period beginning in 1958 when he returned to USGS headquarters to serve as assistant chief of the Branch of Mineral Resources. After his retirement in 1981 he was rehired as an annuitant until 1986 and then served as an emeritus volunteer until 1993.

Donald E. White was born on May 7, 1914, on a fruit farm near Dinuba, in the San Joaquin Valley of California. Don was the third child of five, being preceded by a brother, Addison, and a sister, Eleanor. The youngest of the five siblings were twin brothers, Neil and Halbert. His father, Arthur T. White, was born in Hokah, Minnesota, and his

mother, Alice Louise White (née Hughson), in Grant County, Kansas. Both parents had a love of high mountains, including the Sierra Nevada, visible to the east of the family farm on clear winter days. The Sierra Nevada was the family's preferred destination for summer camping vacations, often in Yosemite National Park. Don's life in Dinuba was dominated by the hard economic conditions of the Great Depression, but his father emphasized the value of a good college education for all his children. The results were impressive: two Ph.D.s, one M.D., and two with B.A. degrees, one of whom became the head of the Division of Physical Research at Bell Labs. Parental influence, guidance, and support were certainly significant for the children of Arthur and Alice White.

Don was accepted at Stanford University in 1932 with an initial emphasis on chemistry. In his sophomore year, however, he came under the influence of Aaron C. Waters, a world famous volcanologist and popular teacher, and became a geologist for the rest of his life. A summer field course took Don to the Sonoma Range in northern Nevada and instilled in him a love of geologic mapping. After graduating from Stanford in 1936, Don entered Princeton University, where he worked under the direction of Arthur F. Buddington, and in 1939 completed a doctoral dissertation on the geology and molybdenite deposits of the Rencontre East Area, Fortune Bay, Newfoundland, under the auspices of the Newfoundland Geological Survey.

Scientific career

A congressional appropriation for a Strategic Minerals Program allowed the United States Geological Survey (USGS) to hire Don as the commodity geologist for antimony, under the guidance of D. Foster Hewett. From 1939 to 1942 Don carried out investigations of antimony, mercury, and tungsten deposits in California, Nevada, Idaho, and Alaska, with an office in the Geology Department at Stanford. Perhaps Don's most notable scientific accomplishment during this time resulted from routine examination of drill core from the Yellow Pine antimony mine in Idaho, where he identified the tungsten mineral sheelite. This discovery led to the mining of a large deposit of a metal critical to the U.S. war effort. The Yellow Pine mine ultimately produced 40 percent of the U.S. tungsten supply in World War II.

Don's other success during this period was a direct result of being based at Stanford. At an exchange dinner at a women's dorm, he met Helen Beth "Jo" Severance, then an undergraduate. Seventeen months later, Don and Jo were married, the beginning of over 61 years together, during which they reared their three daughters: Margaret, Eleanor, and Cathy.

In January 1942 the USGS assigned Don to study antimony deposits in Mexico, then the major reliable source of this element. Although neither Don nor Jo spoke Spanish, they departed for Mexico, living until March 1944 in the states of San Luis Potosí, Oaxaca, Querétaro, and Sonora. In some of the mining camps in which they lived, Don and Jo were the first English speakers that the inhabitants had ever encountered.

Their time in Mexico also allowed them in 1943 to visit the volcano Paricutín, then in active eruption. They reached the volcano on horseback, through ash eight inches deep, spending the night in a shack that was used for horses, scooping out beds in the ash. As Jo wrote to her mother, "We were very happy in spite of our physical discomforts. From this little shack we had a perfect view of the volcano and the lava flow, and we spent much time just sitting and watching it." A photo shows them posed in front of Parícutin—with huge grins on their faces. This experience instilled in Don an interest in active geologic processes that marked much of his subsequent career.

Don and Jo White at Partícutin volcano, Mexico in 1943.

After returning to the United States, Don was based for a year at the USGS headquarters in Washington, D.C., where he prepared reports on Mexican antimony deposits. It was here that a rapidly degenerating arthritic hip made him realize that he could no longer carry out the physically rigorous kind of fieldwork he had loved during his years in Mexico. Wisely, the USGS allowed him to focus his research on epithermal ore deposits—essentially fossil geothermal systems—by studying active geothermal systems, most notably Steamboat Hot Springs near Reno, Nevada. The Steamboat Springs project

Don White in his office at the USGS, Menlo Park, CA.

provided a combination of field and laboratory investigations of the deposition of mercury, antimony, gold, and silver in hot-spring systems, and it fell within Don's physical abilities.

From the Steamboat Springs project Don produced three fundamental review papers elucidating the nature of magmatic, connate, and metamorphic waters and their relationships to volcanoes and to epithermal ore deposits. The project also led to a detailed understanding of the dynamics of the Steamboat Springs hydrothermal system, supported by meticulous field observations, by innovative research drilling into the upper parts of the hydrothermal system, and by application of geochemistry, hydrology, mineralogy, isotopes, and geophysics. Few scientists in the United States were involved at that time in hydrothermal or geothermal studies, so Don sought out collaboration with foreign scientists, most notably in Iceland and New Zealand, building scientific interactions that provided the foundation for many subsequent USGS geothermal studies.

For much of the Steamboat Springs research, Don, Jo and their daughters lived in westernmost Nevada, primarily in Carson City. In 1960 the family moved to Menlo Park, California, where Don joined the recently created USGS Western Regional Center. Instead of being in a one-man Carson City office, with most scientific contact limited to mail, he found himself in an exciting intellectual environment amid a wide spectrum of earth-science expertise, both at the USGS and at nearby Stanford. Don remained in Menlo Park for the rest of his career, interrupted only by a 1958-60 tour of duty in Washington, D.C., where he served for two years as assistant chief of the Branch of Mineral Resources.

Don's scientific accomplishments were based in great part on his detailed three-dimensional analyses of hot-spring systems. In the early 1960s he led investigations of the Salton Sea geothermal system, at a time when the high temperatures, high salinities, and extensive rock-water interactions in hydrothermal systems were considered almost as

fantasy. In the middle ’60s he formulated and led a major USGS study of the hydrothermal systems in Yellowstone National Park, including research core drilling to temperatures of 220°C in the hot-spring basins. These investigations produced a unique data set documenting the temperature, pressure, fluid geochemistry, and hydrothermal minerals in the upper few hundred meters of these hydrothermal systems. The project was not without excitement and some danger, since the hydrothermal systems were nearly everywhere at the boiling point, and thus unstable, provoking many eruptions through the drill rods.

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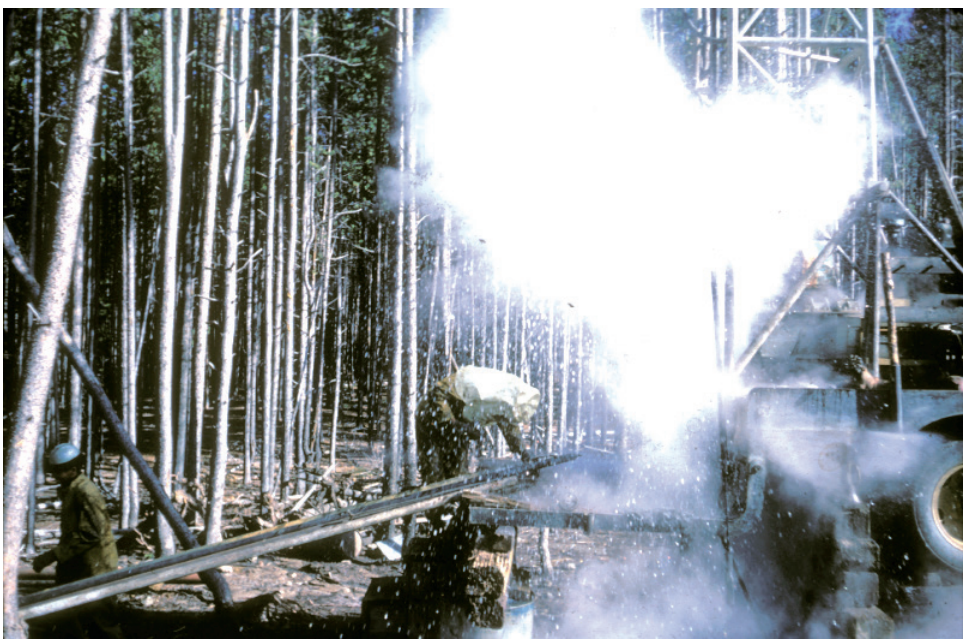
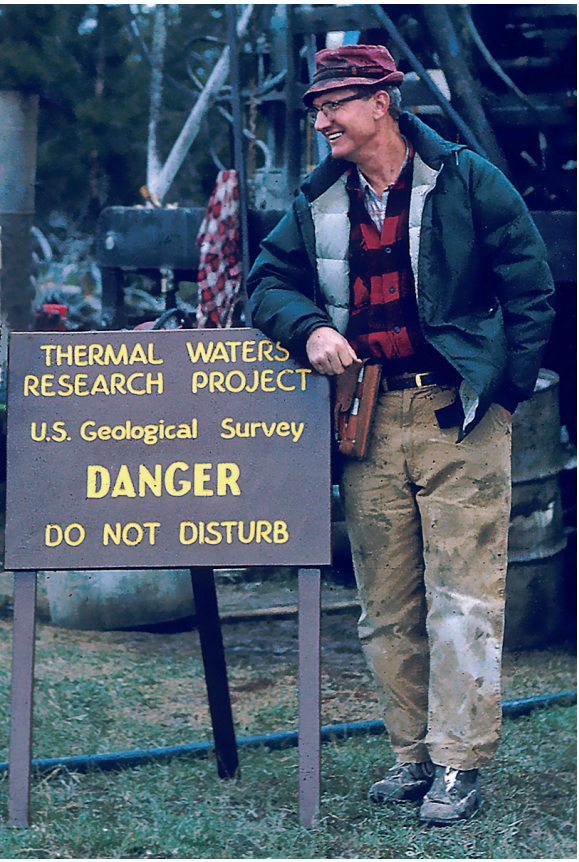
Although Don’s studies were originally undertaken in order to understand processes of metal deposition and formation of epithermal ores, the resulting models provided



Photograph of eruption of steam from the drill rods in drill hole Y-9, Norris Geyser Basin, Yellowstone National Park, 1966. The driller and his helper (with white hood) are moving rapidly to escape the steam exploding from the drill rods.



Don White at the USGS drill rig at drill hole Y-3, Lower Geyser Basin, Yellowstone Natinal Park.

much of the scientific basis for modern geothermal exploration and resource assessment. The unifying thread of Don's work was the development of the now universally accepted model of hydrothermal convection systems—systems of circulating water, largely of surface origin, driven either by high-level intrusive bodies or by deep circulation along faults and fractures in regions of high conductive heat flow.

Don was passionately interested in the underlying behavior of geysers and hot springs. His exhaustive observations, primarily at Steamboat Springs, Nevada, at Beowawe, Nevada, and at Yellowstone National Park led to his classic 1967 paper on the principles of geyser activity. In addition, his observations, combined with research-drill-hole data and his scientific insight, led to a robust hydrologic framework for geyser systems and allowed objective science to be brought to bear on the issue of preserving natural geyser activity during geothermal development.

Don also played a key role in devising, organizing, and implementing a broad spectrum of geothermal investigations, both within the USGS and throughout the domestic and international geothermal communities. In response to the energy crisis of the early 1970s, the USGS built on Don's research and his scientific leadership to establish its Geothermal Research Program. Don was the leader of the first comprehensive geothermal resource assessment of the United States, published by the USGS in 1975, and his insight and acumen guided all Survey geothermal research for the next two decades. In addition, he served as an advisor on geothermal development to many

countries, including Iceland, New Zealand, Mexico, Nicaragua, El Salvador, Taiwan, Philippines, Turkey, Ethiopia, Kenya, and India.

Don also had an important impact on modern international geochemistry as the principal organizer and the first chair of the Working Group on Water-Rock Interaction. The International Symposium on Water-Rock Interaction, still held every three years, is testimony to his vision of the importance of this subject in virtually all geological processes from magmatic to meteoric.

Professional recognition

Don received many prestigious awards testifying to his impact on the scientific community. He received Penrose medals from both the Geological Society of America (1984) and the Society of Economic Geologists (1992); at that time he was only the fifth person to have been awarded both medals. In 1987 he received the Geothermal Pioneer Award from the Geothermal Resources Council; in 1971, the Distinguished Service Award of the Department of Interior. He was a member of the National Academy of Sciences (1973) as well as a Fellow of the American Geophysical Union and President of the Society of Economic Geologists. When the Geothermal Training Programme of the United Nations University (UNU) was established in Iceland in 1979, Don was invited to be the first UNU Visiting Lecturer. He, as a mentor to the international geothermal community, set the pace for the annual geothermal lecture series of the UNU.

This memoir of Don White would be incomplete without explicit recognition of his wife, Jo, who shared with him not only the mining camps of Mexico and the bumpy dirt roads to obscure hot springs in the middle of nowhere, but also the glories of crisp fall days in the geyser basins of Yellowstone. Jo's support for Don and his science and her unfailing hospitality and friendship to a host of geological colleagues are legendary.

For nearly four decades Don White had a dynamic and pervasive impact on the geothermal, mineral-deposit, and geochemical communities throughout the world. He made outstanding contributions not only through his scientific originality and distinguished scholarship, but also through his scientific leadership. Although not a university professor, he was an outstanding teacher, directly in day-to-day association with his colleagues and indirectly to the broader scientific community through his prodigious publication record, his generosity of time and ideas in the service of others, and his infectious enthusiasm in search of geologic truth. In all these endeavors, his boundless

Don and Jo White in 1990.

scientific energy, intensity, and perseverance have been models to all of us privileged to have been his scientific colleagues.

Don died in Portola Valley, California, on November 20, 2002. He was survived by his wife of 61 years Helen (Jo), and his daughters Margaret White Matlin, Eleanor White Cannan, and Catherine Marie White.

ACKNOWLEDGMENTS

This memoir draws heavily on several memorials written in 2003 by me, Robert O. Fournier, and my international geothermal colleagues Ingvar Birgir Friðleifsson, W. A. J. Mahon, and Tomáš Pačes. It also draws on my 1984 citation of Don for the Penrose Medal of the Geological Society of America. I am grateful to Margaret White Matlin and Eleanor White Cannan for photographs, for details about Don's personal life, and for careful review.

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