



International Association of GeoChemistry

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A REMEMBRANCE OF THOMAS (TOM) BULLEN, 1951–2018

Thomas Darwin Bullen, a research hydrologist at the U.S. Geological Survey in Menlo Park (California, USA) and a former Secretary of the International Association of GeoChemistry (IAGC) from 2008 to 2014, passed away 7 September 2018 after struggling with glioblastoma multiforme for almost two years. Tom had a career of distinguished scientific contributions and enthusiastic service to the geochemistry community. He graduated from Dartmouth College (New Hampshire, USA) in 1972 with BS in engineering geology and, later, obtained an MA in geology in 1978 from the same institution. He obtained his PhD in geology from the University of California, Santa Cruz (USA) in 1986.

Tom joined the U.S. Geological Survey, Menlo Park in January 1987, initially in the Branch of Igneous and Geothermal Processes to conduct isotopic investigations of igneous rocks from the Lassen region of the Cascade Range (northern California). In 1990, Tom moved to the National Research Program, Water Mission Area, and continued there until his death at the age of 67. A scientist emeritus since 2014, Tom remained extremely active in research and engaged in collaborations worldwide.

Tom's primary research focused on the use of metal and metalloid isotopes (e.g. stable isotopes of Cr, Fe, Ca, B, Se and Te, and radiogenic Sr isotopes) and water chemistry to understand hydrologic and biogeochemical processes at scales ranging from mineral–water interfaces to water flow paths in watersheds and regional aquifers. He developed and refined methods to determine the isotopic composition of metals and metalloids in water, rocks and other natural materials using thermal ionization mass spectrometry and multi-collector inductively coupled plasma mass spectrometry. Tom developed isotopic methods that today are used to improve understanding of water–rock interactions in natural and contaminated systems and to advance environmental science. In many cases, Tom's isotopic data and his interpretations of the observed isotopic variations were among the first reported in the literature. Furthermore, Tom had a long-standing interest in the science of small watersheds, large aquifers, contaminant transport and fate, human health, and biogeochemical tracing techniques in general. His last research studies were focused on developing novel metal stable-isotope tracing techniques to understand hydrogeological processes in forested watersheds and to determine the sources, transport mechanisms and fates of metals deposited on those watersheds as dust.

Tom collaborated with many colleagues and students from national and international institutions. His ultraclean isotope laboratory in Menlo Park provided high-quality isotope measurements of the metals and metalloids for the USGS (National Research Program and other water science centers) and for outside investigators through collaborative interactions. He was particularly strong in the conceptualization, development, and execution of interdisciplinary studies that utilize isotope tracers in novel ways to address a variety of scientific issues. Since 2008, Tom had an ongoing collaboration with scientists from the Bureau de recherches géologiques et minières (BRGM; the French geological survey) in Orléans (France) where he worked on the development of a technique to determine the oxygen isotope composition of chromate to determine sources of chromium contamination in groundwater, and, during a sabbatical year, also on the development of metal stable isotope multitracer approaches. Tom served on PhD committees where he shared his knowledge and experience with graduate students. Up to his death, he was an adjunct professor at the University of Waterloo (Canada).

Tom's research was characterized by the quality and number of his publications. He authored and coauthored more than 100 peer-reviewed journal and conference papers over the course of his career. He was invited to write overview chapters for books and to coordinate syntheses on the topic. One publication



Tom sailing in San Francisco Bay (2013)

(Bullen 2011) is the first such article that encompasses this new field of biogeochemical research. He authored a major chapter for the 2nd edition of the *Treatise on Geochemistry* (Bullen, T.D., 2014, Metal Stable Isotopes in Hydrology and Weathering).

In the geochemical community, Tom is best known for his hard work and commitment during his six-year service as the IAGC Secretary. Tom served with energy and enthusiasm during a critical time for the IAGC as it repositioned itself so it could grow within the geochemical community. Developing and implementing a procedure for regular

communication with the membership was an integral part of this transition. As a member of the IAGC leadership team, Tom always offered thoughtful and progressive counsel. The IAGC is definitely a much stronger organization today because of Tom. Furthermore, he was instrumental in helping organize multiple Applied Isotope Geochemistry (AIG) meetings over the years, including organizing AIG-4 in Monterey (California, USA) in June 2001. Moreover, Tom was extremely active at Water–Rock Interaction (WRI) meetings: he was the senior editor of the proceedings of WRI-12 (Kunming, China) in 2007 and did more than his share of reviewing numerous submitted manuscripts. Tom received the IAGC Harmon Distinguished Service Award in 2015 in appreciation for these and other contributions to the IAGC.

To his many friends and colleagues around the world Tom will always be known for his commitment to science and his ever-friendly and positive nature. The IAGC and the geochemistry community at large mourn his passing at such a young age.

Beyond work, Tom lived a robust and varied life. He loved travel and was able to visit all seven continents. Trips to Hawaii, Bali, Europe, Mexico, New Zealand were frequent, some of which involved collaboration for work, some just for vacation. He had the pleasure of working for a year near Orléans (France) where he broadened his love for good food and wine. Living near wine country in California, Tom discovered the charms of red wine. (He was also not one to decline a nicely chilled, super dry, vodka martini ... two olives minimum, please). Tom was an avid sailor and enjoyed sailing San Francisco Bay, as well as charting boats elsewhere in the world. After “retirement,” he rediscovered the joy, and heartache, of golf. One distinguishing trait of Tom was that he was never bored. He always had ideas to work out in his mind, be it isotope geochemistry or a workable pattern for pavers to be laid in the patio. He almost always had a smile on his face and a good word to say. Although cut short, no one can deny that Tom lived a full life.

Most significant research contributions:

Bullen TD, Eisenhauer A (2009) Metal stable isotopes in low-temperature systems: A primer. *Elements* 5: 349-352. [Tom was lead editor for this high-impact overview of the new science of metal stable isotope geochemistry. With a regular readership of ~15,000 earth scientists, this issue served as an introduction of the topic to a very broad new audience.]

Bullen TD, Walczyk T (2009) Environmental and biomedical applications of natural metal stable isotope variations: *Elements* 5: 381-385

Bullen TD (2011) Stable isotopes of transition and post-transition metals as tracers in environmental studies. In: Baskaran M (ed) *Handbook of Environmental Isotope Geochemistry*. Springer-Verlag, pp 177-204. [This is the first publication that encompasses the greater field of transition-metal stable isotope geochemistry and its particular applicability to environmental science. The novel aspect was the demonstration of the value of using multiple isotope systems together in a multitracer approach, rather than relying on the results of single system analysis.]

Izbicki JA, Bullen TD, Martin P, Schroth B (2012) Delta chromium-53/52 isotopic composition of native and contaminated groundwater, Mojave Desert, USA. *Applied Geochemistry* 27: 841-853