Association of Applied Geochemists

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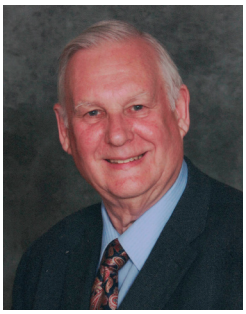
R.G. GARRETT – AAG GOLD MEDAL AWARD FOR 2022



Dr. Robert (Bob) G. Garrett has been awarded the Association of Applied Geochemists' (AAG) Gold Medal for 2022 for his outstanding scientific achievements in exploration and environmental geochemistry. Bob has an extensive publication record spanning more than 50 years that includes 38 years as a Research Scientist and 17 years as an Emeritus Scientist (still active) at the Geological Survey of Canada (GSC). His research and resulting publications cover a wide range of topics including the design of regional geochemical surveys, management of geochemical data, geochemistry of organic lake sediments, drainage geochemistry, metals in the environment, and the influence of geology on agricultural soils and crops. Over the course of his career, he has authored or co-authored over 150 published papers, articles, and government reports, some 30 Open File reports, and 15 National Geochemical Reconnaissance data releases (1975–1977).

Bob's extensive scientific achievements include the following:

- Founding member of the GSC team that designed and implemented Canada's National Geochemical Reconnaissance (NGR) program in 1975 - whereby systematic regional geochemical surveys were conducted across Canada in support of mineral resource assessments. This program established the first national guidelines for sampling, analysis, and interpretation of regional geochemical data and went on to collect samples at more than 300,000 sites. Benefits are still being realized from the original work, and the program continues in a modified form today.
- Bob led important investigations and developments of statistical and mathematical methods for the interpretation of regional geochemical data and their application to mineral exploration. He was one of the very first to recognize early on the importance and power of EDA (exploratory data analysis) for data analysis in geochemistry. He created the IDEAS program library in the 1980s, and more recently, wrote the "RGR" package as part of the R open source statistical computing and graphics package to provide easy access to many powerful data analysis techniques and to assist applied geochemists in interpreting their data. He has written extensively on this subject, including co-authoring a textbook on statistical data analysis and two chapters in the Statistics and Data Analysis in Geochemical Prospecting volume of the Association's Handbook of Exploration Geochemistry series.
- His knowledge of field sampling methods, data management and processing contributed to a benchmark publication, "A global geochemical database for environmental and resource management", that was the foundation for the Global Geochemical Baselines IUGS Workgroup (now Commission).
- His regional-scale till and soil studies in the Canadian Prairies and collaborations with soil and agricultural scientists in Canada and the United States led to a new understanding of the phytoavailability of trace elements and their accumulation in food grains, demonstrating the influence of geology on the chemistry of agricultural soils and crops.
- Bob's participation in Canadian International Development Agency exploration geochemistry projects in Brazil (1977–79), Malaysia (1985–86), and Jamaica (1984–93) guided the development and implementation of successful regional geochemistry programs to support resource assessments in these countries.
- Bob made important contributions at a higher level to numerous national and international committees and working groups focused on research concerning, and regulatory aspects of, metals in the environment, heavy metals and the North America Free Trade Agreement, and toxic substances management and research.

Bob has been a member of the Association of Applied Geochemists since its founding in 1970. Since then, his commitment to the Association and its goals to advance the science of applied geochemistry has been demonstrated by his numerous presentations at several IAGS symposia and other conferences, his many scientific contributions to the Association's journal *GEEA* and newsletter *EXPLORE*, and his continued service on the editorial board of both. He has also served as reviewer for other prestigious journals such as *Science of the Total Environment*, *Applied Geochemistry*, *Environmental Science & Technology*, and *Journal of Geochemical Exploration*.

In summary, Bob has made lengthy and outstanding scientific contributions to applied geochemistry over his 50+ year career, most of which he spent guiding applied geochemical research at the GSC. He has greatly contributed to applied geochemistry through his numerous scientific journal papers, government publications, and book chapters, most notably in the development and application of statistical and mathematical methods to the interpretation of regional and exploration geochemical data.

Dennis Arne
AAG Past President
Chair, Awards & Medals Committee

The following abstract is for an article that appeared in issue 199 (June 2023) of the *EXPLORE* Newsletter.

"THE LOG TRANSFORMATION EXPLAINED"

Robert G. Garrett[1]

The manner in which natural multiplicative processes lead to logarithmic distributions of properties is briefly reviewed. Analytical geochemical, and other natural science, data are characterized by being counted fractions, i.e. they are bounded by zero and some upper limit, e.g. 106 mg/kg or 100%. As a result, data close to zero tend to be positively (right) skewed, and data close to the upper limit tend to be negatively (left) skewed. Counted fractions are not real numbers, as required by many statistical methods. To transform counted fractions to real numbers, a logit transformation is appropriate. From zero to 10% there is linear relationship between the logit or logarithm of a number. It is demonstrated that logit and logarithmic transformations, or plotting with logarithmic scaling, yields more symmetric, bell shaped, distributions for positively skewed data on the original scale, leading to the inference that trace element geochemical data tend towards lognormality. Plotting with logarithmic scaling, or logarithmic transformation, improves the visualization of trace element, especially at low concentrations, and presents the data in a form where differences are seen as multiplicative, congruent with the way applied geochemists consider their data. With bivariate plots, logarithmic scaling permits a check for homoscedasticity, a requirement for statistical methods involving least squares, e.g. ordinary least squares regression. Plotting bivariate data as ratios to a third variable with logarithmic scaling, effectively log-ratios, takes account of the fact that analytical data are 'closed', they sum to a constant, e.g. 100%, permitting the true inter-element relationship to be observed.

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