IUGS Émile Argand Medal

Rationale for naming the award

Émile Argand (1879-1940) was born in Eaux-Vives near Geneva, Switzerland. He started working as a draftsman, then began studies in medicine but was soon attracted by geology under the influence of Prof. Maurice Lugeon at the University of Lausanne. Émile Argand quickly developed an understanding of Alpine tectonics. In 1911, he secured a geology professorship at the University of Neuchâtel and published what soon became a classic memoir on the structure of Western Alps. His studies enabled him to improve knowledge of structural geology, as well as metamorphism and stratigraphy, of this key reference region in central Europe. Later, Émile Argand advanced from regional problems in Europe to geology on the planetary scale by accepting the challenge to prepare a geological map of Eurasia. The resulting map became famous, leading to Argand receiving the Spendiaroff Prize in 1913. After the publication by Alfred Wegener of his fundamental paper on continental drift in 1915, Émile Argand became a resolute supporter of that hypothesis. He used it as a framework to explain Eurasian structural development in his inaugural address to the Brussels International Geological Congress in 1922. In 1924, Émile Argand finished his masterpiece entitled “La Tectonique de l’Asie” in which he clearly developed modern ideas about tectonics following Alfred Wegener’s theory. Thus, the geologist Émile Argand was a key scientist in promoting new explanations of the folded and buckled strata of the Alps as well as undertaking the pioneering application of modern tectonics to the vast continent of Asia.

Awardee profile

The IUGS Émile Argand Medal is IUGS highest award. It is intended to honour an active senior geoscientist of high international recognition and outstanding scientific record. His/her work might have included at least one major discovery that has been strongly influential in the understanding of Earth System Sciences; and/or leading a large scientific project, or projects, that have contributed significantly to establishing basic principles or ground-breaking observations for understanding Earth System processes; and/or has heralded new interdisciplinary developments for resourcing of energy, ore deposits or groundwater with possibly major impacts on socioeconomic issues. Mid-career scientists who have already made exceptional contributions should be given full consideration for the award.

Professor George E. Gehrels

Citation for Professor George E. Gehrels

Professor George E. Gehrels, the son of post-WW2 Dutch immigrants to the United States, is a Distinguished Professor of Geosciences at the University of Arizona, a Fellow of the American Geophysical Union and the Geological Society of America, the Arthur L. Day Medalist (GSA), and the recipient of numerous University of Arizona teaching and research awards.

Over a roughly 35-year-long career, George Gehrels has been a pioneering, tireless force in developing and applying U-Th-Pb geochronology to fundamental Earth and planetary science problems. He is among the very few geoscientists who can legitimately claim to have created a whole new approach to doing geoscience. His staggering publication record with more than 47,000 citations at this writing stems from his creativity, generosity and collaborative spirit. He nearly single-handedly developed the Arizona LaserChron Center (ALC) and availed to the broader geoscience community a pair of multicollector-laser ablation-inductively coupled plasma mass spectrometers. Under George's supervision, these instruments have generated millions of U-Th-Pb ages, and they serve as a testbed for experimental development and application of techniques to measure Hf, Nd, Li, and B isotope ratios, and trace element and REE concentrations in accessory minerals along with U-Th-Pb ages. In 2021-22 alone, 371 researchers (including 91 graduate and 63 undergraduate students) worked in George's lab, and 179 peer-reviewed papers using ALC data or software were published during that period. This is a typical annual output, and George has played a key role in almost all this work, while not claiming co-authorship in most of it.

Through the development of the ALC George has ignited a scientific revolution in detrital provenance and chronostratigraphic studies aimed at determining amalgamation histories of continents, continental-scale sediment transport systems, and tempos of continental arc magmatism. The ongoing explosion of U-Pb laboratories worldwide, which began about 20 years ago, can largely be credited to George's leadership. Perhaps the greatest contribution of George's pioneering geochronological work is the development of methods for routinely dating the largely unfossiliferous global siliciclastic stratigraphic record. Detrital zircon (DZ) ages are now routinely reported in practically all papers on siliciclastic sedimentary rocks.

Because of its dependence on radiometric ages rather than biostratigraphy, the DZ approach can be applied to the entire span of Earth's (and other planets') stratigraphic record; because the approach employs a relatively refractory isotopic system it can be used even in high-grade metasedimentary rocks. But the work of the ALC goes well beyond zircon geochronology, with ground-breaking applications on other minerals (titanite, apatite, monazite, baddeleyite, etc.) in petrochronology, sediment provenance, palaeoclimate, palaeo-mohometry, and igneous petrogenesis from the entire >4 Ga history of Earth and even older extraterrestrial samples.

In his parallel career as a field-oriented structural/metamorphic geologist, George has contributed fundamentally to understanding of the tectono-magmatic histories of orogenic systems throughout the world. In the American Cordilleras, George has been a stalwart in assessing the origin and accretion history of Cordilleran "suspect" terranes from Argentina to Mexico to Nevada to Alaska, working out the geological evolution of the Coast Mountains batholith and adjacent terranes, documenting provenance of Palaeozoic-Mesozoic miogeoclinal strata, and helping to constrain models for the Baja-BC hypothesis. His four-paper series with W.R. Dickinson constitutes the gold-standard for how detrital zircon studies should be designed and implemented. His ongoing work in the Coast Mountains batholith and igneous rocks in the Andean magmatic arc involves new petrogenetic and mohometric methods developed in the LaserChron facility.

In Nepal, George began to work on Himalayan tectonostratigraphy in the mid-1990's by analyzing hundreds of zircons from Neogene foreland basin deposits and bedrock outcrops throughout the orogenic belt. Although this work was done by the laborious ID-TIMS method, it represented at the time of publication an order of magnitude increase in the available U-Th-Pb database from the Himalaya, and the resulting interpretations have not been much changed by the subsequent flood of new data from MC-LA-ICPMS analyses. George and his colleagues were able to work out relationships among Himalayan tectonostratigraphic units at unprecedented levels of detail and accuracy, in some cases completely inverting erroneous concepts that were entrenched in the Himalayan literature. This work has strongly influenced our understanding of pre-Himalayan Greater India and northern Gondwanaland, and how structural cross-sections of the Himalaya are constructed and retrodeformed. George then turned to central Asia (North China block, Altyn Tagh Fault region, Qiangtang and Lhasa terranes in Tibet) and worked out Mesozoic and Palaeozoic palaeogeographies and tectonic histories and discovered a major Proterozoic orogenic event (ca. 960-930 Ma) in northern Tibet and neighboring regions. Along the way, he established the standard template for detrital zircon provenance throughout central Asia. More recently he has focused on petrochronological studies of high-grade metamorphic rocks in the high Himalaya, documenting thermo-barometric conditions and timings of key tectono-metamorphic events.

Beyond these research accomplishments stands George's legendary magnanimity, humility, and generosity. He teaches classes with more than 1,000 undergraduate students. He mentors graduate students and faculty colleagues. He carries a heavy burden of university service. He

is dedicated to helping disadvantaged students at all levels by involving them in ALC operations as researchers and employees. He has involved dozens of undergraduates in research over the decades. Every year he teaches short courses at national/international meetings to educate the geosciences community in potential applications of U-Th-Pb geochronology. In these courses he reveals all: data reduction, standards, calibrations, new applications, and sources of errors; everything is completely transparent. He has made all relevant information conveniently available on the ALC website, and all software developed by the lab can be freely downloaded (including source codes) from open repositories so that anyone with data has easy access to the best analytical tools. George's attention to precision, accuracy, efficiency, spatial resolution, and data dissemination and archiving is characteristic and exemplary. George's development of the ALC and the numerous discoveries that have come from it are important research accomplishments that demonstrate the power of engaging the geoscience community sensu lato in fundamental geochronology over a vast range of problems, from global to regional, from terrestrial to extraterrestrial. George has ensured that all these applications have the advantage of the best analyses available. His analytical and geological contributions stem from a profound faith in the value and promise of new data and the potential for fundamental discoveries by any earnest geoscientist through the power of geochronology.

For all these accomplishments and more, George Gehrels is worthy of the Émile Argand Medal. Indeed, it could be reasonably argued that George Gehrels, who was born in Lake Geneva (Wisconsin!), is to geochronology what Émile Argand was to plate tectonics: he was the first to visualize and actualize the global potential of enormous geochronological datasets, generated by thousands of geological researchers from all over the world, for solving worldwide problems in palaeogeography, chronostratigraphy, petrogenesis, and plate tectonics. Like Professor Argand, Professor Gehrels will be a major figure in the history of geoscience, as the originator of the detrital zircon revolution.

Peter Decelles
Professor
Department of Geosciences
The University of Arizona

Professor George E. Gehrels' response to Argand Medal

Thank you for being recognized as the 2024 recipient of the Emile Argand Medal. It is a great honor to receive an award in the name of one of the founding fathers of geology, and to receive this award from the International Union of Geological Sciences.

I would like to take this opportunity to thank a few geologists who have guided me in my career.

First, I thank my undergraduate mentors at the University of Arizona, George Davis and Peter Coney, who set me on my career path. I recall the moment distinctly – during an informal lunch session, George and Peter reported that a geochronologist from Caltech had just presented some new U-Pb ages from our backyard mountain range, the Catalina Mountains, and these ages completely changed

our understanding of the local geology. They suggested that students in the group learn more about this new technique of U-Pb dating.

So I followed their advice and went to Caltech for my PhD to learn U-Pb geochronology. My advisor, Jason Saleeby, provided me with an amazing opportunity to learn the technique and apply it to a variety of tectonic problems in western North America.

I was then very fortunate to be hired at the University of Arizona, where Jon Patchett and Joaquin Ruiz were setting up new geochemistry labs, and had just received one of the world's first multicollector mass spectrometers. They very generously provided access to their labs and instruments, and I was able to set up my own geochron lab.

I was also able to work closely with some of the world leaders in understanding orogenic systems, including George Davis, Peter Coney, Bob Butler, Pete DeCelles and Bill Dickinson. Most exciting was working with Bill and Pete on detrital zircon geochronology. This was something I started working on as graduate student, but I really did not appreciate the power of the technique until we generated data from several different sedimentary basins. This was a very exciting time as we developed the methods necessary to generate large, unbiased data sets, and figured out how to use the data to constrain provenance, source terrane characteristics, and maximum depositional ages.

This set the stage for the rest of my career, which has focused on generating and interpreting detrital zircon data, and also on providing access for non-geochronologists to come to our lab and generate DZ data for their projects. Over the past two decades, with funding from the US National Science Foundation and the University of Arizona, and through collaboration with my colleagues Joaquin Ruiz and Mauricio Ibanez, we have been able to host visits from thousands of geologists to generate data in support of thousands of different projects. As described in my Argand Lecture, I think these advances – providing non-geochronologists with the ability to generate large data sets on detrital minerals – are some of the drivers of what I refer to as the Geochronology Revolution in Earth Sciences. As you listen to presentations during the coming week, I invite you to contemplate all of the different geochronologic tools and applications that are advancing so rapidly, and also celebrate the fact that many of these techniques can now be applied by non-geochronologists.

I would like to end by noting that none of this would have been possible without the support of my wife, Jennifer O'Brien, and our three children, Aleida, Taiya, and Jim. To them I will say that I'm sorry to have spent so many evenings and weekends in the lab!

Thank you for the honor of being awarded the 2024 Argand Medal!