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Presentation of the Dana Medal of the Mineralogical Society of America for 2017 to Thomas W. Sisson

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I have the pleasure of introducing Thomas W. Sisson, the Mineralogical Society of America Dana Medalist for 2017. Tom is known for his scientific rigor and landmark publications that have contributed to a diverse spectrum of fields closely tied to the mineralogical sciences. He is particularly recognized for his work on magma differentiation and the role of water in subduction-related magmatism. Beginning with his Ph.D. research with Tim Grove, Tom's early papers showcase difficult high-temperature experiments on hydrous basalt and magmatic processes recorded by the Sierra Nevada batholith. This landmark work was soon followed by ion microprobe measurements of dissolved water concentrations in melt inclusions from a range of arc basalts and by infrared spectrometric determinations of dissolved H_2O and CO_2 concentrations in unusually primitive arc basalt.

Tom's research has broadly influenced the field of arc magmatism from source to eruption. He led experimental studies of partial melting of hydrous gabbro as a source of silica-rich arc magmas, compared his experimental results with compositions of granitic rocks, and produced both a general process-oriented paper and a specific application to the Sierra Nevada. In exploring shallower processes, he used data from volcanic rocks to point out the potential significance of gas-driven filter pressing of residual melt from crystal mush as a differentiation mechanism. Tom later guided colleagues in experimental studies of the vapor exsolution that drives volcanic eruptions, and most recently, on the differentiation of arc basalt and generation of dacitic liquids at deep crustal pressures.

Early in his career, Tom recognized the power of the ion microprobe for determining trace element partition coefficients between crystals and silica-rich melts quenched to glass. This approach provided a major advance over laboratory experiments fraught with disequilibrium and bulk mineral separate analyses compromised by trace-element-rich mineral inclusions. He obtained natural samples that preserve crystal–liquid equilibrium and determined partition coefficients for key trace elements for hornblende, pyroxene, and garnet through ion probe analysis of crystal rims and adjacent glass. These coefficients have proved so accurate that his three early 1990s papers continue to be widely cited.

Tom also has advanced understanding of Hawaiian volcanism. He was a key player in an international assault on undersea geology of Kīlauea volcano, featuring advanced Remotely Operation Vehicles of the Japan Agency for Marine Earth-Science and Technology. From the JAMSTEC expeditions came three senior-authored papers and nine with Sisson among the authors, commonly second. This body of work has produced a new paradigm for the early life cycle of Hawaiian volcanoes and a host of topical studies, including discovery of ultrahigh-chlorine glass and native gold.

Tom Sisson is *the* expert on the geology, eruptive history, petrology, and geochemistry of the classic Cascades arc volcano, Mount Rainier. His 2014 paper contrasting Rainier magma geochemistry with that of nearby Mount St. Helens and Mount Adams integrates the role of basement geology with magma isotopic and elemental composition though an exceptionally lucid and compelling interpretation that discriminates between several igneous processes. The Rainier paper defines the state-of-the-art in understanding controls on magma evolution at subduction-related volcanoes and presents a general model for crustal processing of magmas to yield the common andesite of volcanic arcs. At 4392 m elevation and capped with ice, Rainier is arguably the volcano that poses the highest risk to communities in the conterminous United States. Tom's detailed geologic mapping, enabled by his mountaineering prowess and steady nerves, and his critical insight redefined the potential for edifice collapse and fundamentally changed assessment of hazards to populous low-lying communities from voluminous debris flows sourced at Rainier and, by analogy, at hundreds of volcanoes around the world. A 2008 paper with Jim Vallance presents evidence for numerous, previously unknown Rainier eruptions in the last 2600 years and led to reevaluation of a now-greatly enhanced eruption probability. His quantitative analysis of ice volume change over four decades resulted in a 2011 paper that gives dramatic evidence of changing climate. Other papers characterize hydrothermal alteration, define ice-bounded lava flows and explain their distinctive topographic expression by debunking long-accepted dogma, and document compositional zonation in lava flows. The Rainier papers are outstanding scientific contributions and examples of real-world applications of mineralogy, petrology, geochemistry, and volcanology to societal issues.

Contributing substantially to Tom's scientific vision is that he is a field geologist of exceptional caliber. In my 40+ years with the U.S. Geological Survey, I have known several world-class field geologists. None has had greater insight in the field or made a more elegant or thought-provoking geologic map than Tom Sisson. Tom began his geological career in the Sierra Nevada as a protégé of Jim Moore. Their published maps raised the bar on documentation of geologic features that are the ground truth for processes of magma evolution, pluton emplacement, and batholith growth. Subsequently, Tom took on Mount Rainier, and, more recently, ice-clad Alaskan volcanoes, always using geologic observations as a springboard to understanding fundamental magmatic or volcanic processes. Tom's geologic maps are lasting products that will be used by generations of petrolo-

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gists, students of batholiths, volcanologists, and the public. They represent a great amount of original work and their long-term impact is indisputable.

Finally, Tom has a strong record of collaboration with scientists in diverse fields, working with students, and mentoring early career researchers. He gives generously of his time to the scientific community and to internal USGS program leadership. Those of us sufficiently fortunate to have given a lecture with Tom in the audience, discussed our research with him, or benefited from his review of a paper, know that his insightful questions cut to the core of critical issues. His sometimes rather blunt remarks are meant to ensure defensible science, not to intimidate their object, and Tom's wry sense of humor has tempered the impact of many a bureaucratic nightmare and enlivened innumerable conversations. Tangibly, he has published landmark papers on the role of water in arc magmas, generation of granitic batholiths, ocean island magmatism as expressed by early Kīlauea volcano, and hazards from arc volcanoes exemplified by Mount Rainier. These papers have advanced Earth science on four fronts and have influenced research by countless scientists. It is my honor to present you with the 2017 Dana Medalist, Thomas Sisson.