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Presentation of the Mineralogical Society of America Dana Medal for 2001 to George R. Rossman

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The scientific career of George Rossman is a work in progress. Despite all his contributions to original research in mineral spectroscopy and despite his inspirational role in the career of many young scientists, it is therefore most suitable to recognize him with a mid-career award. Simply put, to award George the Roebling Medal today would be to risk pre-empting the Mineralogical Society's opportunity in the future to recognize for posterity all the work that we confidently expect George to contribute over the next decade and more. The Society therefore keeps its powder dry by selecting George Rossman as the ideal recipient of the inaugural Dana Medal.

George works on many things, but in my unauthorized, petrologist's view, the simplest way to characterize the unifying theme of all his work is mineralogy that goes beyond X-ray diffraction and hence incorporates the study of non-periodic phenomena. This tendency is probably attributable to his background in chemistry; indeed, George loves to brag that he never took a course in mineralogy. Hence, when George began working on minerals as a graduate student in chemistry at Caltech in the late 1960s, he may not have realized that spectroscopy was decidedly a fringe activity in mineralogy. Today, however, in part because of George's role as leader and bellwether, spectroscopy of all kinds lies at the very core of mineralogy. Anyone can recognize this trend by looking at the rising number of papers using spectroscopy as their primary tool in the pages of *American Mineralogist*. George's star has risen not only with the growing importance of mineral spectroscopy but also the increasing interest in X-ray amorphous materials ranging from desert varnish to nanoscopic biominerals.

Within the general rubric of mineral spectroscopy, George's work can be grouped into three principal categories: the origin of color, the effects of natural and artificial radiation damage, and the concentration and crystal chemistry of hydrogen in minerals both hydrous and nominally anhydrous.

Some combination of George's background in crystal field theory and his innocent and enthusiastic love for the beauty of minerals motivates his work on color and on ultraviolet, visible and near-infrared spectra of minerals. He has debunked many old ideas and solved numerous long-standing problems in mineral color, explaining most recently the color of rose quartz. George has a unique and productive symbiosis with the gemological community; he gets access to extraordinary specimens, and they get access to the kind of scientific rigor rarely applied to gemological matters.

George's work on hydrogen in minerals has been characterized by a never-ending quest for absolute concentration measurements and believable calibration of infrared data on H_2O and OH concentration. This demands the use of oriented specimens and polarized radiation to account for the orientation of O-H bonds in particular crystallographic sites. Hence George's measurements are often useful not only for defining concentration but also for testing the mechanism of hydrogen incorporation in minerals. Working downward in water concentration over the course of his career, George has proceeded from hydrous minerals such as lawsonite to minerals like cordierite and beryl that can accommodate variable amounts of molecular water in channel sites to minerals with known substitution mechanisms like hydrogarnet and finally to phases where the presence of water before George's work was marginally documented or unknown.

Outside of mineralogy and gemology this is George's most profound contribution: recognition of the virtually ubiquitous presence of hydrogen in minerals lacking formula water. Of particular importance, George and his students have found water in natural samples of every major upper-mantle phase: in garnets, pyroxenes, and olivines. This work has stimulated a vast experimental enterprise and revolutionized our view of water in the earth's mantle because we now know that at the expected bulk concentration of water in non-arc mantle there need be no hydrous phase. The geophysical, geochemical, and petrologic implications are remarkably broad. A few hundred parts per million H_2O can have dramatic effects on the rheology, seismic velocity, and anelasticity of the mantle when distributed as mobile defects throughout the major matrix phases. The storage of water without a hydrous host phase changes the partitioning of H_2O and trace elements during melting and the melting behavior below the dry solidus is fundamentally different for the case of continuous water-undersaturated melting rather than dehydration melting. Finally, George's discovery and its subsequent extension to transition-zone phases like wadsleyite dramatically changes the overall water budget of the earth.

George's many contributions are sufficient to make him a great scientist and widely-admired, but his record as teacher, mentor, collaborator, host, friend, and webmaster make him also a great spirit and widely loved. Not only his relatively few Ph.D. students but also the many other Caltech graduates and undergraduates who took his class or worked in his lab, and indeed every Caltech student who has sheltered beneath his benevolent rule as academic officer, all can testify to George's commitment to teaching and his skill at communicating his infectious love of science to others. George has welcomed dozens of visitors into his lab to make their measurements, and has created an enormous resource for the community of mineralogy by single-handedly building and maintaining the mineral spectroscopy webserver (at minerals.gps.caltech.edu). It

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is impossible to walk by George's door without receiving a friendly inquiry into your progress, and there is inevitably a fascinating and uniquely colored specimen sitting out beckoning to be asked about. Equally inevitable then is a long and learned disquisition involving at least the chemistry and usually the history, economics, and skullduggery associated with that particular variety. I once casually mentioned pleochroism in his presence and was treated to a showing of a large zircon crystal from George's collection that shows a different color along every direction and every polarization. When a prospective student recently volunteered a question about the color of tourmaline during a tour, I believe she was positively alarmed at the enthusiasm of George's response and at the number of example specimens he had just lying around.

I'm honored that George asked me to make this presentation, and I'm pleased to present to you my friend and colleague and winner of the first Dana Medal, George Rossman.

[George R. Rossman was presented with the Dana Medal at the Goldschmidt Conference, Hot Springs, VA, May 21, 2001.]