American Mineralogist, Volume 91, pages 965–966, 2006

Presentation of the Roebling Medal for 2005 of the Mineralogical Society of America to Ho-kwang Mao

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Mr. President, Members, and Guests:

It is an honor and a pleasure to introduce Ho-kwang "David" Mao as recipient of the Mineralogical Society of America's highest honor, the Roebling Medal. David was born in Shanghai, China, and moved with his family to Taiwan when he was seven years old. He received his B.S. degree from the National University of Taiwan in 1963, served as a second lieutenant in the Air Force for a year, and entered the University of Rochester the next year. He became involved in high-pressure studies with Bill Bassett and Taro Takahashi, leading to his early interest in iron at high pressure as well as in exploring phase transitions in mantle silicates. Upon graduation from the University of Rochester in 1968, Dave joined the Geophysical Laboratory of the Carnegie Institution of Washington as a postdoctoral fellow and became a staff member in 1972.

I have known Dave for many years as a friend and professional colleague. I first met him on Connecticut Avenue in Washington, I think in 1968. He and Peter Bell were walking near the Sheraton Park Hotel where the spring AGU meeting was being held. Peter introduced Dave and said that this fellow was going to revolutionize the field of high-pressure science. That prediction has certainly come true and there is no doubt that Dave's research has had an enormous impact on the field of high-pressure research and technology as well as on a wide range of disciplines related to this work. During his tenure at the Geophysical Lab, Dave has made breakthrough after breakthrough in high-pressure mineralogy, from repeatedly establishing world record pressures, to synthesizing dozens of new materials, documenting the behavior and properties of deep-earth materials, establishing lasting scientific links between mineralogy and the greater earth sciences, materials sciences, physics, chemistry, and biological communities, and leading in the establishment of several world-class high-pressure research stations at Brookhaven, Argonne, and Oak Ridge National Laboratories.

During the past 35 years, Dave has concentrated on improving the diamond-anvil pressure cell and his refinements of the cell design have had great influence on the high-pressure community. Diamond cells, though generally restricted to samples smaller than 0.3 mm, have greatly increased the range of static high-pressure experiments and have permitted experiments to be performed that would have been thought impossible 35 years ago. Since 1975, maximum static pressures have soared from less than 30 GPa to more than 300 GPa and samples at high pressure have been subjected to temperatures above 5000 K, corresponding to conditions even beyond those in the Earth's core. This capability has enabled Mao and now many others to investigate properties of planetary systems from Mercury to Mars, and from Jupiter to the outer Solar System.

X-ray diffraction, vibrational spectroscopy, Brillouin scattering, inelastic X-ray scattering, and a host of other experimental techniques have been adapted to probe samples at high pressure. Dave has been the world leader in all of these developments and, in 1986, achieved the current record static pressure in the 500 GPa range, in collaboration with J. Xu and Peter Bell. He has published hundreds of papers in major scientific journals and is primarily responsible for the design and performance of many experiments that have established new records or made important advances in high-pressure science. In recognition of his many accomplishments Dave has received an impressive range of awards and is a member of the USA National Academy of Science, Academia Sinica, and a Foreign Member of the Chinese Academy of Sciences, a distinction shared by few, if any, other people in the world.

Following Bill Bassett's lead, Dave developed and extended the application of synchrotron radiation to high-pressure mineralogy. This started with work at the National Synchrotron Light Source at Brookhaven National Laboratory where the X-17 beamline is based on a superconducting wiggler magnet that allows production of very high energy X-rays that are ideal for high-pressure experiments. Although physicists were interested in using this beamline for certain experiments and the medical community wanted to develop a high-resolution X-ray imaging system, it was the potential of high-pressure experiments that led to the eventual almost exclusive use of this facility for both diamond-cell and multi-anvil experiments. Dave and his colleagues performed many experiments at X-17 and went on to use other synchrotron sources around the world, culminating in development and operation of the HPCAT facility at the Advanced Photon Source, Argonne National Laboratory, that includes instrumentation for high-pressure inelastic X-ray scattering and spectroscopy, as well as X-ray diffraction.

One new project that Dave and several colleagues are pursuing currently involves design, construction, and operation of SNAP, the new high-pressure instrument at the Spallation Neutron Source, Oak Ridge National Laboratory. Neutron diffraction experiments at high pressures are of great interest to the earth and materials sciences, but have been limited in the past because of the requirement for much larger samples than could be accommodated in the diamond-anvil cells then in use. Dave first worked with large moissanite SiC single crystals that

0003-004X/06/0506–965$05.00/DOI: 10.2138/am.2006.459

allowed larger samples to be compressed, but attainable pressures were limited because moissanite is not as strong as diamond. The next step was to obtain larger diamonds, an increasingly expensive activity when the only sources were in nature. Then, in collaboration with Rus Hemley, Dave decided to explore the possibility of growing large single-crystal diamonds using the chemical vapor deposition (CVD) process. To achieve this goal, Dave and Rus initiated a Geophysical Laboratory project for growing such crystals and thus far have been very successful, as was just reported in the Summer 2005 edition of Carnegie Science, the newsletter of the Carnegie Institution.

Dave Mao is a warm, caring individual who has the complete trust and admiration of his colleagues. He has trained many others in the art and science of high-pressure research who are now working in different institutions around the World. I would also like to recognize the contributions of Agnes Mao to the successes described here. Agnes has been a constant and valuable scientific colleague as well as wife and mother in the Mao family.

It has been an amazing and rewarding experience to be a friend and colleague of Dave Mao over these past 37 years and to realize all that he has accomplished. Even more striking is that he is still going full speed and constantly exploring other new frontiers in high-pressure and related scientific research. Mr. President, I am proud to present for the Roebling Medal the world's leading scientist in high-pressure research, Ho-kwang "David" Mao.