

Acceptance of the Roebling Medal of the Mineralogical Society of America for 2011

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Mr. President, Members of the Society, and Guests:

I am most grateful to the Mineralogical Society of America and to my many teachers, colleagues, students, and friends who made this award possible. I am the luckiest person in the world! How many of you have such fortune to have my Ph.D. advisor as lifetime friend, colleague, boss, coach, and mentor for nearly half a century to give such a wonderful introduction? Indeed, Gary, thanks for your kind words and for your nomination, and to Gordon Brown, Doug Rumble, Harry Green, Nick Sobolev, Shige Maruyama, and Brad Hacker for support to make this exciting occasion for my wife and me. Of course, without the support and love of my wife Hsiu-Yin (Sue) and family members, this medal would not be possible.

I have been blessed with much good fortune. I was raised in a very poor family in a small town during the Second World War when Taiwan was occupied by Japan. I was transformed from a water-buffalo boy through a college student to a university Professor. I passed several stiff entrance examinations and was admitted to the best high school and university (NTU) in Taiwan. In fact, the only Taiwanese Nobel Prize winner graduated from the same high school and university. I thank the late Chief Geologist of the Chinese Petroleum Cooperation in my hometown, Prof. Meng Zao-Yi for introducing me to the field of geology when I was a high school kid. I received a solid undergraduate training in geology and have interacted with several outstanding NTU students including Bor-Ming Jahn, Dave Mao, Yui-Ning Hsieh, I-Ming Chou, Chin-Hwa Lo, Tzen-Fu Yui, and many others.

In 1965, I was admitted to UCLA and started my graduate training under Gary's supervision. Instead of following his pursuit of amphibole stability, I conducted experiments on the stabilities of Ca-zeolites and the low-*P* stability limit of lawsonite; I was able to establish a low-*T* petrogenetic grid for metabasites. Prof. Yotaro Seki provided me with lawsonite starting materials and guided my study of zeolites in geothermal fields. At the same time, I learned from Gary about subduction-zone metamorphism and high-*P* Franciscan blueschists and eclogites, and how to be effective in doing research. Before I finished my Ph.D., I applied for a post-doc position and intended to study the zeolite minerals of lunar basalts at NASA. My proposal was accepted in 1968, but I did not start until July 1970 when I got my green card to work at the Manned Spacecraft Center in Houston. By that time, the Apollo 11 mission had been completed and study of the returned lunar samples indicated that there was no water on the moon, hence no zeolites for me to study! Instead, I worked on (1) the stability of epidote and the greenschist-to-amphibolite transition and (2) used the best microprobe to work on some blueschist and ophiolite samples from Taiwan; this research led to a success-



ful US-Taiwan Project in 1974-80 with Gary and John Suppe. During my 2-year stay at NASA, I had abundant support from the geochemistry group, particularly the branch chief, Robin Brett; then and later, I met and associated with many world-class mineralogists, petrologists, and geochemists.

In 1972, I joined the faculty at Stanford University. During the last 40 years, I have been working with many outstanding students, post-docs, research associates, and faculty members. At the beginning, I leaned from Dick Jahn, Konnie Krauskopf, Bill Luth, Frank Dickson, and Gordon Brown regarding mineralogy, geochemistry, and experimental petrology, and from Ben Page, Bill Dickinson, and Bob Coleman about Franciscan blueschist and the Coast Range ophiolite. Gordon arrived a year later in 1973; for many years, we taught Earth Materials and supervised graduate students together. For example, the incoming MSA president, Mike Hochella, was one of the Gordon's best students; Mike and I published a paper on the stability of Mg-idocrase. For the first three years at Stanford, I had two NSF projects in addition to US-Taiwan projects on experimental and Franciscan studies. My students including Mary Keskinen, Peter Schiffman, Rona Donahue, and Moon-sup Cho, carried out experiments, whereas my blueschist-eclogite projects in the Franciscan, Oman, and the Maksutov complex of South Urals were carried out by Diane Moore, Lina Echeverria, Chain-Whan Oh, Aley El Shazly, Rachel Beane, Mary Leech, and several master students.

During a Guggenheim Fellowship in Japan in 1978, I met many Japanese petrologists including Profs. A. Miyashiro,

Y. Seki, and S. Banno, and a young graduate student, Shige Maruyama. Shige was (and is) remarkably energetic. I invited him to be my post-doc-research associate for the first five years and continuously on and off for scientific colleague even up to the present time. Shige worked extremely hard and often slept in his office. He is the most creative and accomplished Japanese geologist I have ever been associated with. Shige was the only Japanese geologist who has been honored by the Japanese Emperor with the Purple Ribbon Award.

After the visit of President Nixon to China, the U.S. Geological Survey established several US-China projects in 1980s; one of them was on blueschist and ophiolite convergent suture markers, led by Bob Coleman. I joined him and was responsible for blueschist belts in China. Zhe-Meng Zhang was my first Chinese student; together with Bob, we three completed the first plate tectonic interpretation of China and identified many plate sutures. The GSA Bulletin paper in 1984 was the most cited one in my publication list. Subsequently we expanded our effort to include sedimentary basins to look for oil and gas in western China. The Stanford China Industrial Affiliate Program was lead by Steve Graham and provided excellent support for work on tectonics, sedimentary basins, and the adjacent mountain belts of western China.

Gary was convinced that most global blueschists are Phanerozoic in age, but the first Metamorphic Map of China published in 1986 showed four Precambrian blueschist belts. During our fieldwork in western China in 1986, we found a red-color Late Proterozoic sandstone formation lying unconformable on the deformed blueschist-bearing Aksu group in a nearly 100% exposed region. The field relation alone suggests that the Aksu blueschists formed before the deposition of the Late Precambrian sandstone. The Chinese map was right and Gary's prediction was wrong. Later that year, Gary agreed to be our dean of the School of Earth Sciences at Stanford; we airmailed a package of an Aksu Precambrian blueschist sandwich to him from western China. He did not relish it!

Without any hesitation, Shige Maruyama and I together with my second Chinese student, Xiao-Ming Wang went to the Dabie Mountains as the largest Precambrian HP belt then shown in the Chinese Metamorphic Map. To our surprise, blueschist is extremely rare in Dabie. Instead, we saw abundant eclogite blocks enclosed in granitic gneisses; petrographic examination revealed widespread traces of coesite inclusions and its pseudomorph in both garnet and omphacite. Subsequent age dating indicated that they are Triassic ultrahigh-*P* (UHP)—not Precambrian rocks.

Since our finding of coesite, published in 1988, the Dabie-Sulu collision zone has become a classic and celebrated UHP

region and has attracted the research efforts of many Chinese and international geoscientists. Dr. Ruth Zhang from Beijing immigrated to the U.S. in 1989 after the Tiananmen Square incident, and joined me as my research associate; her hobby is research and Ruth is the best petrographer and most efficient Chinese scientist I have ever known. Ruth helped me to carry out the Dabie-Sulu and Kokchetav UHP projects until her retirement in 2009. For the 10-year US-Russian-Japan Kokchetav project, we worked with and received support from Nick Sobolev, Shige Maruyama, Yoshi Ogasawara, and many Japanese students and post-docs. Our Kokchetav project is now continuing with the help of my Taiwanese colleagues including Yui Tzen-Fu and others.

Three major events happened for my UHP activities in early 1992–1995.

First, with the involvement of Doug Rumble, Brad Hacker, Shige Maruyama, Gary Ernst, Bor-Ming Jahn, Tatsuki Tsujimori, and Dennis Bird, together with many students including Leslie Ames, Liz Eide, Laura Webb, Mary Leech, Chin-Ho Tsai, Rachel Zhao, Chris Mattinson, and Uwe Martens, our Stanford UHP projects expanded from central China and Kokchetav to Norway, western China, the Himalaya, and even to Guatemala.

Second, the UHP research in China was sufficiently successful that the Chinese government provided a multi-million dollar grant to establish the first Chinese Continental Scientific Drilling project in 1999. This CCSD project, led by Prof. Yang Jingsui and Xu Zhiqin, has recovered many core samples for our joint study. During the last 25 years, we have had very productive research with many Chinese colleagues that include but were not limited to Profs. Cong Bolin, Liu Fulai, Zhang Zeming, Zhang Lifei, Zheng Yong-Fei, and Song Shuguang.

Third, I organized and led an International UHP Task Group to bring all active researchers together for workshops, symposia, and field trips nearly every year for 10 years until my retirement in 2005. This responsibility is now in the very capable hands of Larissa Dobrzhinetskaya.

I was very lucky to have been associated with many international UHP scientists and have received a lot of support from many organizations including Stanford University, NSF, Continental Dynamic program, International Lithosphere Program, Chinese and Japanese research institutions, DuPont, and the Stanford China affiliate program. There is a Chinese saying, to win a war, you need these three essentials: “天時，地利，人和”. In every step of my scientific adventure, I was blessed to be in the right place at the right time, and associated with the right people. Again, Mr. President, I humbly accept this medal with many thanks to the MSA, to my wife Hsiu-Yin (Sue), family members, and to my many colleagues, students, and friends. Thank you all.