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JOSEPH W. STUCKI

2009 RECIPIENT OF THE MARILYN AND STURGES W. BAILEY DISTINGUISHED MEMBER AWARD

DR. PETER KOMADEL

It was a great honor for me to introduce Professor Joseph W. Stucki from the Department of Natural Resources and Environmental Sciences at the University of Illinois at Urbana-Champaign, the 2009 Recipient of The Marilyn and Sturges W. Bailey Distinguished Member Award, recognizing his excellent scientific achievements in pioneering systematic research on reduction and re-oxidation of ferric iron in the structure of clay minerals.



Joe received his B.S. in Chemistry from Brigham Young University, Provo, Utah, in 1970, and M.S. in Soil Chemistry from Utah State University, Logan, Utah, in 1972. The next step in his career was the work on his PhD thesis *Chemical and Spectroscopic Analysis of Oxidation-Reduction Mechanisms for Structural Iron in Nontronite* at Purdue University, West Lafayette, Indiana. The results were discussed continuously not only with his advisor, Dr. Charles B. Roth, but also with two of his other committee members, who later became recipients of the CMS Distinguished Member Award, namely, Joe L. White (1990) and Philip F. Low (1992). The thesis was defended in 1975 resulting in Joe's PhD degree in Soil Physical Chemistry, and, due to his scientific vision, it opened the door to his life-long research area of Fe(III) reduction and re-oxidation, mainly in Fe-rich smectites. It has continued and fully developed in Turner Hall at the University of Illinois at Urbana-Champaign, where Dr. Stucki was successively Assistant, Associate, and Full Professor of Soil Physical Chemistry from 1976 till his retirement in June, 2009, and where he continues his research activities as Professor Emeritus. He has been the recipient of many awards, including the first Marion L. and Chrystie M. Jackson Mid-Career Clay Scientist Award from The Clay Minerals Society (1992), Fellow of the Soil Science Society of America (1993) and of the American Society of Agronomy (1994), the Marion L. and Chrystie M. Jackson Soil Science Award from the Soil Science Society of America (1995), and the 10th George Brown Lecture from the Clay Minerals Group of the Mineralogical Society of Great Britain and Ireland (2009). He served The Clay Minerals Society in a number of positions, such as a Member of the Council (1984–1987), as Associate Editor of *Clays and Clay Minerals* (1985–1987), as a Member and Chair of the Policy and Administration Committee (1986–1989); and successively as Vice-President-elect, Vice-President, President, and Past-President of The Clay Minerals Society (1994–1999). On January 1, 2008, he assumed his current role as Editor-in-Chief of our journal, *Clays and Clay Minerals*.

The work in Professor Stucki's laboratory, which is probably the top facility worldwide for investigation of Fe(III) reduction in clays, on the modification of the well known Mehra-Jackson method, using sodium dithionite as the reducing agent in citrate-bicarbonate buffered suspensions and commonly applied to remove Fe-oxide admixtures from samples, led to the complete reduction of structural Fe in nontronites, provided the

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process used N_2-purged suspensions. The sulfoxylate free radical is capable of reducing virtually all of the structural iron. Application of this method in the following years allowed preparation of numerous series of samples with different extents of Fe reduction and Fe(II)/Fe(III) ratios, enabling subsequent detailed studies of different properties of reduced minerals to be carried out.

The results of Joe's research have made a substantial contribution to the current body of knowledge regarding the complex mechanism for Fe reduction in clay minerals. This process involves much more than the mere transfer of an electron to octahedral Fe(III) in the clay crystal. It also initiates other ancillary reactions which produce both reversible and irreversible structural modifications. Such changes in the crystal-chemical environment of structural Fe are thought to play a dominant role in altering the clay surface chemistry.

Professor Stucki also showed that microorganisms were able to effectively reduce structural Fe in smectites. In 1987 he published the first paper to prove this (Stucki *et al*., 1987). Substantial reduction has been observed both in the laboratory and *in situ* in the field. Bacteria from a variety of origins, including well drained and flooded soils can substantially reduce structural Fe. Bacteria are the second most-effective known reductant, after dithionite, and the most important agent responsible for this phenomenon in natural soils and sediments.

This award is the highest honor of The Clay Minerals Society, awarded solely for scientific eminence in clay mineralogy (in its broadest sense) as evidenced primarily by the publication of outstanding original scientific research and by the impact of this research on the clay sciences. Joe Stucki's scientific eminence in the area of structural Fe(III)/Fe(II) reduction/re-oxidation in clay minerals, confirmed by more than 130 contributions in peer-reviewed, international journals and books, is indisputable, as is the impact of his work on that of his successors in this area of clay research and in the clay sciences overall. He has shown that the oxidation state of Fe profoundly alters the basic physical-chemical properties of smectites, including the layer charge, cation exchange and fixation capacity, swelling in water, particle size, specific surface area, magnetic exchange interactions, octahedral site occupancy, surface acidity, chemical reactivity, reduction potential, abilities to degrade pesticides and to alter their mammalian toxicity, and to transform chlorinated organic compounds, all of which are influenced by the oxidation state of structural iron. These properties are not only essential for characterization of clay minerals in the laboratory but they are of great importance to agriculture, industry, and the environment because of the abundance of Fe in smectites and of smectite at the earth's surface.

Joe was the Director of the *NATO Advanced Study Institute on Iron in Soils and Clay Minerals*, held in Bad Windsheim, Germany (1985). The lectures presented during this Institute were reviewed extensively, revised, edited, and published in the book of the same name, edited by J.W. Stucki, B.A. Goodman, and U. Schwertmann. Though it is now 21 years old, it remains the most valuable and comprehensive information available on the subject. Nineteen years later Joe was the Lead Organizer of the *Bouyoucos Conference on Electron Transfer and Environmental Biogeochemistry of Iron in Phyllosilicates* in San Antonio, Texas, 2004, which was another excellent meeting on various aspects of science involved in studies of iron in phyllosilicates.

Professor Stucki successfully advised more than thirty-five graduate students and post-doctoral research associates and has hosted colleagues from many countries in his lab, thus spreading his knowledge of Fe in clays. All have enjoyed the opportunity to work on exciting problems relating to Fe in clays. I will never forget the extremely friendly relations with Joe, his wife, Penny, and their six children back in 1986/87. These children have now blessed Joe and Penny with 15 grandchildren and meetings of the whole family are the top events for all the members, but dominantly for the grandparents.

Professor Stucki has infused The Clay Minerals Society with new ideas resulting from his innovative research. He has proved scientific eminence in clay mineralogy as is evidenced by the publication of outstanding original scientific research and by the impact of this research on others who share his love and enthusiasm for clay science. There is no doubt that he merits the honor of the Marilyn and Sturges W. Bailey Distinguished Member Award of The Clay Minerals Society.

Reference Cited

Stucki, J.W., Komadel, P., and Wilkinson, H.T. (1987) Microbial reduction of structural iron(III) in smectites. *Soil Science Society of America Journal*, **51**, 1663–1665.

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