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Presentation of the Mineralogical Society of America Award for 2015 to Nicholas J. Tosca

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In preparing this introduction, I looked at the list of former recipients of the MSA Award (http://www.minsocam.org/msa/awards/MSA_Award.html) and was struck by how many of the towering lights in our field are on that list. The rules demand that they receive their awards within just a few years of their Ph.D., and the inevitable conclusion is that the MSA Award must be one of the world's greatest predictors of sustained scientific excellence! I am confident that this year's selection will further enhance the Award's reputation on that front and so, President Shirey, MSA members and guests, it is both an honor and pleasure to introduce this year's Mineralogical Society of America Awardee, Nick Tosca.

Nick came to Stony Brook after completing undergraduate studies at SUNY Albany, where he was mentored (and highly recommended) by John Delano. I believe he arrived expecting to start with a Masters on rare earth elements in sedimentary rocks, but I had just received a NASA Cosmochemistry grant to set up a low-temperature experimental lab designed to test some of the predictions about martian sedimentary mineralogy arising from the Pathfinder mission. Although I knew very little about how to perform experiments, I had already talked Joel Hurowitz—who indeed *had* just completed a Masters on REE in sedimentary rocks—into jumping off the planetary science cliff with me for his Ph.D., and Nick arrived just in time to bolster that cause. Armed with a single page schematic from the proposal, directions to the offices of Martin Schoonen and Rich Reeder for advice on low-temperature experiments, Don Lindsley for high-temperature synthesis, John Parise for all things mineralogical, and a NASA check book, the two of them set up a first-rate low-temperature experimental laboratory in about the time expected from most seasoned experimentalists. Nick's Master's thesis then demonstrated that if you got the starting igneous rock compositions right, you could begin to explain martian secondary mineralogy with an acid fog alteration model—work that earned him the prestigious Stephen E. Dwornik Award from the Planetary Science Division of GSA.

A big break came when my students and I got to go to the Jet Propulsion Lab and work on the landed operations of the *Spirit* and *Opportunity* rovers that arrived on Mars in early 2004. The Principal Investigator of those missions, Steve Squyres, strongly promoted all of the student collaborators and in Nick's case supported him in taking the lead on the aqueous modeling of the evaporite mineralogy in the Burns formation at Meridiani Planum. We were on crazy schedules running two rovers on opposite sides of the planet but, once we found a place that would rent a car to someone as young as Nick so that he could actually get to the lab, he began working closely with Joel, Steve, John Grotzinger, Andy Knoll, Ben Clark, Hap McSween, and many others on the rover team learning so much about the sedimentary geology and geochemistry of Mars. Between operational shifts on Mars time and helping to build scale models in the JPL Mars Yard to figure out how to drive *Opportunity* into (and even more importantly, back out of) Endurance crater, Nick recognized that to understand martian aqueous geochemistry he needed a thermodynamic database that included a diversity of iron minerals, something of course lacking in terrestrial evaporites. So he delved into the acid mine drainage literature, built and validated an internally consistent database, and carried out some remarkable modeling that tied together the diverse sedimentary mineralogy found at Meridiani Planum—Ca-Mg-sulfates, jarosite, and the famous hematitic concretions (blueberries)—through combined processes of evaporation and groundwater diagenesis in a low-pH, high ionic strength aqueous setting. In the seminal 2005 *EPSL* special issue documenting the sedimentary history of Meridiani Planum, his was the only paper led by a student. Nick went on to complete a tour de force Ph.D. combining evaporation and diagenesis experiments and innovative aqueous modeling that carried us a great distance towards explaining the sedimentary mineralogy of Mars.

Nick then went off to Harvard as an Origins Postdoctoral Fellow with Andy Knoll. They continued with Mars, producing great papers: in one case constraining water activity—and thus the limits of habitability—at Meridiani Planum, and in another case demonstrating that temperature-time integrals needed to explain the remarkably immature diagenetic mineral associations on Mars required highly water-limited conditions. But a critical point came when Andy introduced Nick to the sedimentary record of Earth and the many problems dealing with diagenesis, climate evolution, and links between sedimentary geochemistry and biological evolution that an outstanding low-temperature mineralogist could sink his teeth into. And sink his teeth he has done! For example, he examined clay mineral compositions over geological time, relating them to evolving oxygen contents of surface waters and he constrained conditions for the formation of Late Proterozoic diagenetic talc. More recently, he has followed up on the talc story by examining a wide array of Mg-silicates (e.g., talc, stevensite, sepiolite, kerolite) that in turn strongly constrain depositional/diagenetic environments and thus are of great interest to the petroleum industry. For one of his talks at this meeting he presented exciting experimental results pointing to novel mechanisms for authigenic greenalite formation during the early Precambrian that have profound implications for understanding Precambrian seawater and iron formations.

From Harvard, Nick went on to Cambridge as a Churchill College Research Fellow, followed by a stint as Lecturer at the University of St. Andrews. Last year, Nick moved to Oxford as an Associate Professor of Sedimentary Geology and has been busy setting up a new lab and research group, from which we

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expect—and indeed are beginning to see—great things. Along the way he got married to his wonderful wife Bex who, due to the imminent arrival of the third member of the Tosca family, was unable to be with us today, took up long-distance running, became a drummer in a local rock band, and received many awards and honors, including NASA Group Achievement Awards, the Max Hey Medal and most recently the Philip Leverhulme Prize.

Nick has a rare and special knack of identifying how important problems in sedimentary geology can be addressed from combined experimental-theoretical approaches—and he always seems to gravitate towards difficult problems. He then does whatever homework is needed to best frame the problem, designs (and if necessary builds) an experimental setup to get the job done, and finally circles back and interleaves the modeling so that he places the results into the strongest possible geological and geochemical context. And when it's all finished, he writes lucid papers that are a pleasure to read. Another characteristic that carries Nick along to success is that he is simply a really nice guy! He attracts collaborators effortlessly, I think largely because he provides the intellectual generosity required of good collaborations and he is just great fun to work with.

And so, ladies and gentlemen, please join me in welcoming this year's truly well-deserving MSA Awardee, Nick Tosca.