

Nicholas J. Tosca

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Academic Experience:

- 2003-Present** **Ph.D.** – State University of New York at Stony Brook (*in progress*)
Dissertation Title: Experimental and theoretical investigation of the formation of saline minerals at the martian surface
Advisor: Scott M. McLennan
- 2003** **M.S.** – State University of New York at Stony Brook
Thesis title: Acid-sulfate weathering of synthetic Martian basalt: the acid fog model revisited.
Advisor: Scott M. McLennan
- 2001** **B.S.** – State University of New York at Albany
Major – Geology
Minor – Chemistry

Positions Held:

- 2004-Present** **Student Collaborator** – Mars Exploration Rover Mission, Jet Propulsion Laboratory, Pasadena, CA. Past and present responsibilities include:
- Science Operations Working Group Chair
 - Science Operations Working Group Documentarian
 - Long-term planning group lead
 - Soil and rock physical properties group lead
- 2001-Present** **Research Assistant** – State University of New York at Stony Brook
- 2002 (Spring)** **Teaching Assistant** – State University of New York at Stony Brook
GEO 107 – Natural Hazards
- 2001 (Fall)** **Teaching Assistant** – State University of New York at Stony Brook
GEO 316 (Class & Lab) – Geochemistry of Surficial Processes

Awards / Honors Received:

- 2006** **Pellas-Ryder Award (Honorable Mention)** – Geological Society of America
- 2006** **GAANN Fellowship** – Dept. Geosciences, SUNY Stony Brook
- 2005** **GSA Graduate Student Research Grant** – Geological Society of America

- 2005** **Mars Exploration Program Student Travel Grant** – Planet Mars II Workshop, Les Houches, France
- 2005** **NASA Group Achievement Award** – Mars Exploration Rover Science Team for Extended Mission 2
- 2004** **Stephen E. Dwornik Planetary Geoscience Student Paper Award (Best oral presentation)** – GSA, Planetary Geology Division
- 2004** **NASA Group Achievement Award** – Mars Exploration Rover Science Team for Extended Mission 1
- 2003** **Mars Exploration Program Student Travel Grant** – NASA-JPL
- 2003** **Student Travel Grant** – GAANN
- 2002** **GAANN Fellowship** – Dept. Geosciences, SUNY Stony Brook
- 2002** **Excellence in Teaching Award** – State University of New York at Stony Brook

Professional Activities:

- *Co-chair*, Mars: Sediments and Geochemistry session, 37th Lunar and Planetary Science Conference, 2006
- *Invited speaker*, Brown University Colloquium, 2006
- *Invited paper*, Mars Exploration Rovers: One Martian Year of in Situ Planetary Geology session, AGU Meeting, Fall 2005
- *Invited speaker*, Brown University “Lunch Bunch” seminar, Spring 2005
- *Invited paper*, Role of Brines in Crustal Processes session, AGU Meeting, Fall 2004
- *Co-chair*, Mars Mineralogy: Weathered and Dry session, 35th Lunar and Planetary Science Conference, 2004
- *Panelist*, NASA-JPL Press Briefing, Mars Exploration Rover Mission, June 2004
- *Referee*: *Geology*, *Geochemical Transactions*, *Geochimica et Cosmochimica Acta*, *Journal of Geophysical Research – Planets*
- *Member*, Geological Society of America (2005-present), Mineralogical Society of America (2003-present), American Geophysical Union (2003-present), Geochemical Society (2001-present)

Educational Outreach:

- *Speaker*, “Science and Technology Family Academic Conference”, Johns Hopkins Center for Talented Youth, State University of New York at Stony Brook, NY, 2004.
- *Speaker*, Southington High School, Southington, CT, 2004
- *Mentor*, Undergraduate research projects, State University of New York at Stony Brook, Fall 2004, Fall 2005 and Spring 2006 (in collaboration with Washington University in St. Louis).
- *Mentor*, Summer Scholar Program, Mineral Physics Institute, State University of New York at Stony Brook, Summer 2006

Research Interests:

- Aqueous geochemistry and mineralogy of planetary surfaces, experimental geochemistry, geochemical thermodynamics, environmental geochemistry

Publications (Peer-Reviewed Journals):

Tosca, N.J., McLennan, S.M., Lindsley, D.H., Schoonen, M.A.A. (2004) Acid-sulfate weathering of synthetic Martian basalt: The acid fog model revisited, *Journal of Geophysical Research*, 109, E05003, doi: 10.1029/2003JE002218.

Haskin, L.A., Wang, A., Jolliff, B.L. McSween, H.Y., Clark, B.C., Des Marais, D.J., McLennan, S.M., **Tosca, N.J.**, Hurowitz, J.A., Farmer, J.D., Yen, A., Squyres, S.W., Arvidson, R.E., Klingelhofer, G., Schroeder, C., de Souza, P., Ming, D.W., Gellert, R., Zipfel, J., Bruckner, J., Bell, J.F., Herkenhoff, K.E., Christensen, P.R., Ruff, S.W., Blaney, D., Gorevan, S., Cabrol, N.A., Crumpler, L., Grant, J., Soderblom, L. (2005) Water alteration of rocks and soils from the Spirit rover site in Gusev Crater, *Nature*, 436, 7047, 66-69, doi: 10.1038/nature03640.

Crumpler, L., Squyres, S., Arvidson, R., Bell, J., Blaney, D., Cabrol, N., Christensen, P., Des Marais, D., Farmer, J., Furgeson, R., Golombek, M., Grant, J.F., Grant, J., Greeley, R., Hahn, B., Herkenhoff, K., Hurowitz, J., Knudson, A., Li, R., Maki, J., McSween, H., Ming, D., Moersch, J., Rice, J., Richter, L., Sims, M., Thompson, S., **Tosca, N.**, Wang, A., Whelley, P., Wyatt, M. (2005) MER geologic traverse by the Spirit Rover in the plains of Gusev Crater, Mars. *Geology*, 33, 10, 809-812, doi: 10.1130/G21673.1.

Yen, A., Gellert, R., Schroeder, C., Morris, R.V., Bell, J.F., Knudson, A.T., Clark, B.C., Ming, D.W., Crisp, J.A., Arvidson, R.E., Blaney, D., Brückner, J., Christensen, P., Des Marais, D.J., de Souza, P., Economou, T., Ghosh, A., Hahn, B., Herkenhoff, K.E., Haskin, L.A., Hurowitz, J.A., Jolliff, B.L., Johnson, J.R., Klingelhofer, G., Madsen, M.B., McLennan, S.M., McSween, H.Y., Richter, L., Rieder, R., Rodionov, D., Soderblom, L., Squyres, S.W., **Tosca, N.J.**, Wang, A., Wyatt, M., Zipfel, J. (2005) An integrated view of the chemistry and mineralogy of Martian soils, *Nature*, 436, 7047, 49-54, doi: 10.1038/nature03637.

Tosca, N.J., McLennan, S.M., Clark, B.C., Grotzinger, J.P., Hurowitz, J.A., Knoll, A.H., Schröder, C., Squyres, S.W. (2005) Geochemical Modeling of Evaporation Processes on Mars: Insight from the Sedimentary Record at Meridiani Planum. *Earth and Planetary Science Letters*, 240, 1, 122-148, doi: 10.1016/j.epsl.2005.09.042.

McLennan, S. M., Bell, J. F., Calvin, W. M., Christensen, P. R., Clark, B. C., de Souza, P. A., Farmer, J., Farrand, W. H., Fike, D. A., Gellert, R., Ghosh, A., Glotch, T. D., Grotzinger, J. P., Hahn, B., Herkenhoff, K. E., Hurowitz, J. A., Johnson, J. R., Johnson, S. S., Jolliff, B., Klingelhöfer, G., Knoll, A. H., Learner, Z., Malin, M. C., McSween, H. Y., Pockock, J., Ruff, S. W., Soderblom, L. A., Squyres, S. W., **Tosca, N. J.**, Watters, W. A., Wyatt, M. B., Yen, A. (2005) Provenance and diagenesis of the evaporite-bearing Burns formation, Meridiani Planum, Mars. *Earth and Planetary Science Letters*, 240, 1, 95-121, doi: 10.1016/j.epsl.2005.09.041.

Clark, B.C., McLennan, S.M., Morris, R.V., Gellert, R., Jolliff, B.L., Knoll, A.H., Lowenstein,

- T.K., Ming, D.W., **Tosca, N.J.**, Christensen, P.R., Gorevan, S., Yen, A.S., Brückner, J., Calvin, W., Dreibus, G., Farrand, W., Klingelhöfer, G., Wänke, H., Zipfel, J., Bell, J.F., Squyres, S.W., Grotzinger, J.P., McSween, H.Y., Rieder, R., Herkenhoff, K.E., and the Athena Science Team (2005) Chemistry and mineralogy of outcrops at Meridiani Planum. *Earth and Planetary Science Letters*, 240, 1, 73-94, doi: 10.1016/j.epsl.2005.09.040.
- Grotzinger, J.P., Bell, J.F., Calvin, W., Clark, B.C., Fike, D., Golombek, M., Greeley, R., Herkenhoff, K.E., Jolliff, B., Knoll, A.H., Malin, M., McLennan, S.M., Parker, T., Soderblom, L., Sohl-Dickstein, J.N., Squyres, S.W., **Tosca, N.J.**, Watters, W. (2005) Stratigraphy, sedimentology and depositional environment of the Burns Formation, Meridiani Planum, Mars. *Earth and Planetary Science Letters*, 240, 1, 11-72, doi: 10.1016/j.epsl.2005.09.039.
- Knoll, A.H., Carr, M.H., Clark, B.C., Des Marais, D.J., Farmer, J.D., Fischer, W.W., Grotzinger, J.P., Hayes, A., McLennan, S.M., Malin, M.C., Schroeder, C., Squyres, S.W., **Tosca, N.J.**, Wdowiak, T. (2005) An astrobiological perspective on Meridiani Planum. *Earth and Planetary Science Letters*, 240, 1, 179-189, doi: 10.1016/j.epsl.2005.09.045.
- Tosca, N.J.** and McLennan, S.M. (2006) Chemical divides and evaporite mineral assemblages on Mars. *Earth and Planetary Science Letters*, 241, 1-2, 21-31, doi: 10.1016/j.epsl.2005.10.021.
- Arvidson, R. E., and 60 others (including **N.J. Tosca**) (2006), Overview of the Spirit Mars Exploration Rover Mission to Gusev Crater: Landing Site to Backstay Rock in the Columbia Hills, *Journal of Geophysical Research – Planets*, 111, E02S01, doi: 10.1029/2005JE002499.
- Hurowitz, J.A., McLennan, S.M., **Tosca, N.J.**, Arvidson, R.E., Michalski, J.R., Ming, D.W., Schroeder, C., Squyres, S.W. (2006) In situ and experimental evidence for acidic weathering of rocks and soils on Mars, *Journal of Geophysical Research – Planets*, 111, E02S19, doi: 10.1029/2005JE002515.
- Wang, A., Korotev, R.L., Jolliff, B.L., Haskin, L.A., Crumpler, L., Farrand, W., Herkenhoff, K.E., de Souza, P., Kusack, A.G., Hurowitz, J.A., **Tosca, N.J.** (2006) Evidence of phyllosilicates in Woolly Patch, an altered rock encountered at West Spur, Columbia Hills by the Spirit rover in Gusev crater, Mars, *Journal of Geophysical Research – Planets*, 111, E02S16, doi: 10.1029/2005JE002516.
- Wang, A., Haskin, L.A., Squyres, S.W., Arvidson, R.E., Jolliff, B.L., Crumpler, L., Gellert, R., Schroeder, C., Herkenhoff, K., Hurowitz, J.A., **Tosca, N.J.**, Farrand, W., Anderson, R.C. (2006) Sulfate deposition in subsurface regolith exposed in trenches at the plains traversed by the Spirit rover in Gusev Crater, Mars. *Journal of Geophysical Research – Planets*, 111, E02S17, doi: 10.1029/2005JE002513.
- Squyres, S.W., Aharonson, O., Arvidson, R.E., Bell III, J.F., Christensen, P.R., Clark, B.C., Crisp, J.A., Farrand, W.H., Glotch, T., Golombek, M.P., Grant, J., Grotzinger, J., Herkenhoff, K.E., Johnson, J.R., Jolliff, B.L., Knoll, A.H., McLennan, S.M., McSween, H.Y., Moore, J.M., Rice, J.W., **Tosca, N.J.** (2006) Planetary Science: Bedrock Formation at Meridiani Planum. *Nature*, 443, E1-E2, doi:10.1038/nature05212.

Squyres, S.W., Knoll, A.H., Arvidson, R.E., Clark, B.C., Grotzinger, J.P., Jolliff, B.L., McLennan, S.M., **Tosca, N.J.**, Bell III, J.F., Calvin, W.M., Farrand, W.H., Glotch, T.D., Golombek, M.P., Herkenhoff, K.E., Johnson, J.R., Klingelhofer, G., McSween, H.Y., Yen, A.S. (2006) Two years at Meridiani Planum: Results from the Opportunity Rover. *Science*, 313, 5792, 1403 doi: 10.1126/science.1130890.

Squyres, S.W., and 53 others (including **N.J. Tosca**) (*submitted*) Overview of the Opportunity Mars Exploration Rover Mission to Meridiani Planum: Eagle Crater to Purgatory Ripple. *Journal of Geophysical Research – Planets*.

Smirnov, A., **Tosca, N.J.**, Chidambaram, D., Halada, G., Schoonen, M.A.A. (*submitted*) The fate of nickel during olivine dissolution at hydrothermal conditions: Implications for prebiotic synthesis. *Earth and Planetary Science Letters*.

Tosca, N.J., Smirnov, A., McLennan, S.M. (*submitted*) Application of the Pitzer Ion Interaction Model to the $\text{Fe}_2(\text{SO}_4)_3\text{-H}_2\text{SO}_4\text{-H}_2\text{O}$ System at 25°C. *Geochimica et Cosmochimica Acta*.

Hurowitz, J.A., **Tosca, N.J.**, McLennan, S.M., Schoonen, M.A.A. (*submitted*) A simple mechanism for oxidant production in the martian and lunar soils. *Earth and Planetary Science Letters*.

Publications (Abstracts):

Tosca, N.J., Hurowitz, J.A., McLennan, S.M., Lindsley, D.H., Schoonen, M.A.A. (2002) Surficial processes on Mars: an experimental approach. In *Lunar and Planetary Science XXXIII*, Abstract #1354, Lunar and Planetary Institute, Houston (CD-ROM).

Tosca, N.J., McLennan, S.M., Lindsley, D.H., Schoonen, M.A.A. (2003) Acid-sulfate weathering of synthetic Martian basalt: the acid fog model revisited. In *Lunar and Planetary Science XXXIV*, Abstract #1325, Lunar and Planetary Institute, Houston (CD-ROM).

Tosca, N.J., McLennan, S.M., Lindsley, D.H., Schoonen, M.A.A. (2003) Low-temperature aqueous alteration on Mars: insights from the laboratory. In *Sixth International Conference on Mars*, Abstract #3178, Lunar and Planetary Institute, Houston (CD-ROM).

Tosca, N.J., Hurowitz, J.A., Melzer, L., McLennan, S.M., Schoonen, M.A.A. (2004) Olivine weathering on Mars: Getting back to basics. In *Lunar and Planetary Science XXXV*, Abstract #1043, Lunar and Planetary Institute, Houston (CD-ROM).

Hurowitz, J.A., **Tosca, N.J.**, McLennan, S.M., Lindsley, D.H., Schoonen, M.A.A. (2004) A reappraisal of adsorbed superoxide ion as the cause behind the reactivity of the Martian soils. In *Lunar and Planetary Science XXXV*, Abstract #1699, Lunar and Planetary Institute, Houston (CD-ROM).

Arlaukas, S.M., Hurowitz, J.A., **Tosca, N.J.**, McLennan, S.M. (2004) Iron oxide weathering in sulfuric acid: Implications for Mars. In *Lunar and Planetary Science XXXV*, Abstract #1868, Lunar and Planetary Institute, Houston (CD-ROM).

Smirnov, A., **Tosca, N.J.**, Chidambaram, D., Halada, G., Schoonen, M.A.A. (2004) Ni-(Fe)

alloy and sulfide formation during forsterite-fayalite dissolution at hydrothermal conditions: Importance for prebiotic synthesis. *International Journal of Astrobiology*, Supplement, 1-120, doi: 10.1017/S14735500404001648NASA.

- Smirnov, A., **Tosca, N.J.**, Chidambaram, D., Halada, G., Schoonen, M.A.A. (2004) Autocatalytic nickel reduction during forsterite-fayalite dissolution at hydrothermal conditions: Importance for prebiotic synthesis, *Proceedings from the 228th National Meeting of the American Chemical Society*, Philadelphia, PA.
- Tosca, N.J.**, McLennan, S.M., and the Athena Science Team. (2004) Geochemical Modeling of Evaporation Processes on Mars: Insight from the Sedimentary Record at Meridiani Planum. *EOS Trans. AGU*, 85(47), Fall Meeting Supplement, Abstract V34A-07.
- Wang, A., Haskin, L., Squyres, S., Arvidson, R., Crumpler, L., Gellert, R., Hurowitz, J., Schroeder, C., **Tosca, N.**, and the Athena Science Team. (2004) Chemistry and Mineralogy of the regolith at the Gusev Plains. *EOS Trans. AGU*, 85(47), Fall Meeting Supplement, Abstract P21A-0220.
- Tosca, N.J.**, McLennan, S.M., Clark, B.C., Grotzinger, J.P., Hurowitz, J.A., Knoll, A.H., Schröder, C., Squyres, S.W., and the Athena Science Team (2005) Geochemical modeling of evaporites on Mars: Insight from Meridiani Planum. In *Lunar and Planetary Science XXXVI*, Abstract #1724, Lunar and Planetary Institute, Houston (CD-ROM).
- Hurowitz, J.A., **Tosca, N.J.**, McLennan, S.M., and the Athena Science Team (2005) Experimental basalt alteration at low-pH: Implications for weathering relationships on Mars. In *Lunar and Planetary Science XXXVI*, Abstract #2025, Lunar and Planetary Institute, Houston (CD-ROM).
- Hurowitz, J.A., **Tosca, N.J.**, McLennan, S.M., Schoonen, M.A.A. (2005) Mechanically produced radical species at silicate surfaces and the oxidant in martian soils. In *Lunar and Planetary Science XXXVI*, Abstract#1991, Lunar and Planetary Institute, Houston (CD-ROM).
- Wang, A., Haskin, L., Squyres, S., Arvidson, R., Crumpler, L., Gellert, R., Hurowitz, J., Schroeder, C., **Tosca, N.**, Herkenhoff, K., Jolliff, B., and the Athena Science Team (2005) Sulfate deposition in regolith exposed in trenches on the plains between the Spirit landing site and Columbia Hills in Gusev Crater, Mars. In *Lunar and Planetary Science XXXVI*, Abstract #2236, Lunar and Planetary Institute, Houston (CD-ROM).
- Clark, B.C., McLennan, S.M., Morris, R.V., Gellert, R., Jolliff, B.J., Knoll, A.H., Lowenstein, T.K., Ming, D.W., **Tosca, N.J.**, Christensen, P.R., Yen, A., Bruckner, J., Calvin, W., Farrand, W., Zipfel, J., Gorevan, S., Squyres, S.W., and the Athena Science Team (2005) Results and implications of mineralogical models for chemical sediments at Meridiani Planum. In *Lunar and Planetary Science XXXVI*, Abstract #1446, Lunar and Planetary Institute, Houston (CD-ROM).
- McLennan, S.M., Bell, J.F., Calvin, W.M., Christensen, P.R., Clark, B.C., de Souza, P.A., Farrand, W.H., Fike, D., Gellert, R., Ghosh, A., Glotch, T.D., Grotzinger, J.P., Hahn, B., Herkenhoff, K.E., Hurowitz, J.A., Johnson, J.R., Johnson, S.S., Jolliff, B., Klingelhofer, G., Knoll, A.H., Learner, Z., Malin, M.C., McSween, H.Y., Pockock, J., Ruff, S.W., Squyres, S.W., **Tosca, N.J.**, Watters, W., Wyatt, M.B., Yen, A. and the Athena Science

- Team (2005) Provenance and diagenesis of impure evaporitic sedimentary rocks on Meridiani Planum, Mars. In *Lunar and Planetary Science XXXVI*, Abstract #1884, Lunar and Planetary Institute, Houston (CD-ROM).
- Smirnov, A., **Tosca, N.J.**, Schoonen, M.A.A., Chidambaram, D., Halada, G., Luptak, B. (2005) Abiotic formation and fate of ammonium in the Hadean ocean. *Astrobiology*, 5, 2, 277.
- McLennan, S.M., Hurowitz, J.A., **Tosca, N.J.** (2005) Surficial processes on a basaltic planet. *18th Kongsbergseminar, The patterns of wet planets*.
- Korotev, R.L., Wang, A. Jolliff, B.L., Haskin, L.A., Crumpler, L., Farrand, W.H., Herkenhoff, K.E., de Souza, P., Kusack, A.G., Hurowitz, J.A., **Tosca, N.J.** (2005) Phyllosilicates in Woolly Patch outcrop investigated by Spirit Rover at West Spur, Gusev Crater. Geological Society of America, *Abstracts with Programs*, 37, 7, 233-3.
- Tosca, N.J.** and McLennan, S.M. (2005) Evaporites at Meridiani Planum and implications for surficial processes on Mars. *EOS Trans. AGU*, 86(52), Fall Meeting Supplement, Abstract P12A-07.
- Tosca, N.J.** and McLennan, S.M. (2006) Experimental constraints on evaporation processes at Meridiani Planum. In *Lunar and Planetary Science XXXVII*, Abstract #2260, Lunar and Planetary Institute, Houston (CD-ROM).
- Tosca, N.J.** and McLennan, S.M. (2006) Constraints on evaporation processes at Meridiani Planum: Combining theoretical and experimental data. In *Lunar and Planetary Science XXXVII*, Abstract #2278, Lunar and Planetary Institute, Houston (CD-ROM).
- McLennan, S.M., Arvidson, R.E., Clark, B.C., Grotzinger, J.P., Knoll, A.H., Squyres, S.W., **Tosca, N.J.** (2006) Constraints on the extent and timing of groundwater diagenesis in the Burns Formation, Meridiani Planum, Mars. In *Lunar and Planetary Science XXXVII*, Abstract #1926, Lunar and Planetary Institute, Houston (CD-ROM).
- Knoll, A.H., Arvidson, R.E., Grotzinger, J.P., McLennan, S.M., Squyres, S.W., **Tosca, N.J.** (2006) Toward an integrated understanding of outcrop rocks observed by Opportunity in Meridiani Planum. In *Lunar and Planetary Science XXXVII*, Abstract #1655, Lunar and Planetary Institute, Houston (CD-ROM).
- Grotzinger, J.P., Arvidson, R.E., Bell III, J.F., Clark, B.C., Farrand, W.H., Herkenhoff, K., Johnson, J.R., Knoll, A.H., McCartney, E., McLennan, S.M., Parker, T.J., Soderblom, J., Squyres, S.W., Sullivan, R., **Tosca, N.J.** (2006) Sedimentary facies, subaqueous sediment transport, and depositional environment of the Burns Formation, Meridiani Planum. In *Lunar and Planetary Science XXXVII*, Abstract #2254, Lunar and Planetary Institute, Houston (CD-ROM).
- Arvidson, R.E., Squyres, S.W., Grotzinger, J.P., Knoll, A.H., McLennan, S.M., **Tosca, N.J.** (2006) Regional setting and model for the Meridiani Planum deposits investigated by the Opportunity Mars Exploration Rover. In *Lunar and Planetary Science XXXVII*, Abstract #1400, Lunar and Planetary Institute, Houston (CD-ROM).
- McLennan, S.M., Hurowitz, J.A., **Tosca, N.J.**, Arlauckas, S.M. (2006) Surficial processes on Mars: A planet on acid. *Geochimica et Cosmochimica Acta*, 70, 18, Supp. 1, p. 34 doi: 10.1016/j.gca.2006.06.832

- Tosca, N.J.** and McLennan, S.M. (2006) Chemical divides and variation in martian saline mineralogy. In *Martian sulfates as recorders of atmosphere-fluid-rock interactions*, Abstract #7021, Lunar and Planetary Institute, Houston (CD-ROM).
- Dyar, M.D., Podratz, L., Sklute, E.C., Rusu, C., Rothstein, Y., **Tosca, N.J.**, Bishop, J.L., Lane, M.D. (2006) Mossbauer spectroscopy of synthetic alunite group minerals. In *Martian sulfates as recorders of atmosphere-fluid-rock interactions*, Abstract #7053, Lunar and Planetary Institute, Houston (CD-ROM).
- McLennan, S.M., Grotzinger, J.P., Hurowitz, J.A., **Tosca, N.J.** (2006) Sulfate geochemistry and the sedimentary rock record of Mars. In *Martian sulfates as recorders of atmosphere-fluid-rock interactions*, Abstract #7045, Lunar and Planetary Institute, Houston (CD-ROM).