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NASA internship for student Chris Orth

Summary: Physics and mathematics major Christopher Orth completed a NASA Planetary Geology and Geophysics Undergraduate Research Program Internship at Washington University in St. Louis, Missouri, during summer 2005.

(March 27, 2006)-Physics and mathematics major Christopher Orth, Sleepy Eye, completed a NASA Planetary Geology and Geophysics Undergraduate Research Program (PGGURP) Internship in the Department of Earth and Planetary Sciences at Washington University in St. Louis, Missouri, during summer 2005. He credits excellent academic preparation, wonderful UMM research opportunities, and strong faculty relationships for his successful NASA internship.

Deciding to attend the University of Minnesota, Morris was the first step towards Orth's journey to NASA. He found the small town, small class sizes, and, especially, the ample opportunities to participate in research with faculty very appealing. Orth's first research opportunity was conducted with Chris Reese, former assistant professor of physics at UMM, through the Morris Academic Partnership (MAP) program. Orth and Reese "tested the hypothesis that the resurfacing of Venus was caused by the cessation of widespread volcanism due to the diminished vigor of mantle convection beneath an immobile surface." When Reese accepted a position at Washington University, he kept in contact with his former UMM student. He believed Orth would be a perfect candidate for the NASA internship and encouraged him to apply.

Orth was overjoyed with his acceptance. "It is a very prestigious internship that is only offered to 12 applicants," he shared. "I wanted to have research experience to help me prepare for graduate school, and I enjoyed working with Dr. Reese in our MAP. It was also an exciting opportunity for us to continue the project we began at UMM."

Through the NASA internship, Orth was assigned to work with the geodynamics group at Washington University. The NASA research conducted there involves gathering data related to the study of the surfaces and interiors of planetary bodies including Earth, Mars, Venus, and other terrestrial objects.

Orth describes a typical workday during his internship: "First, I would check the status of the simulations that were either running on my computer or on the 96 node Beowulf Cluster, named Sputnik. If everything was running properly, I would usually write FORTRAN code to accomplish a task or work on the visualization of data. Often I would join a group of professors for lunch, where we would discuss various topics from recent trips to breakthroughs in research. In the afternoons I usually worked closely with Dr. Reese on projects and started new simulations."

Orth provided an overview of the importance of the simulations he worked on: "Venus is Earth's closest neighbor and has long been thought of as Earth's sibling planet because of its many similarities. However, Venus exhibits many differences. From a geophysical standpoint, the most prominent is a solid, immobile surface with no evidence of plate tectonics. NASA's 1989 Magellan Mission provided radar images of the Venusian surface that allowed scientists to

determine that the surface of Venus has an approximately uniform age. The age distribution on Venus is much different than the Earth, which has older continents and younger ocean basins. This observation has been interpreted as the end of a period of widespread volcanism that resurfaced the planet. Understanding this resurfacing event is crucial to understanding why Venus and Earth are so different." Orth also ran numerical simulations that were three-dimensional, spherical geometry simulations of Venus' mantle dynamics in order to discover how the mantle of Venus functions under different conditions.

Orth graduates from UMM this spring and plans to attend graduate school concentrating on an area of physics. He believes that the PGGURP internship was a wonderful experience that strengthened his research skills. "I truly enjoyed working on all of the projects and discussing many aspects of planetary science, graduate schools, and life in general with my two supervisors, Dr. Slava Solomatov and Dr. Chris Reese." Solomatov is an associate professor at Washington University and an expert in both geodynamics and planetary evolution. Working together since the mid-1990s, Solomatov and Reese have published groundbreaking papers in the field of planetary evolution.

Since returning to UMM, Orth continues to work with Solomatov and Reese. They are submitting a paper called "Local magma ocean evolution and Martian mantle dynamics" to a Geological Society of America book, titled *Origins of Melting Anomalies: Plumes, Plates, and Planetary Processes*. In addition, they have been asked to submit a paper to a special issue of the *Journal of Geophysical Research* consisting of topics that Solomatov presented at the 2006 Chapman Conference on exploring Venus as a terrestrial planet. Orth plans to present some of these ideas at his physics senior seminar this spring. Orth has also been researching the Method of Borel Resummation with Barry McQuarrie, UMM assistant professor of mathematics, as a follow up to his mathematics senior seminar, "Padé and Algebraic Approximants applied to the Quantum Anharmonic Oscillator." He will present the results at the Undergraduate Research Symposium this spring as well as submitting the results, along with McQuarrie, to a mathematics journal for publication.

Orth noted: "Everyone who attends UMM has the opportunity to make connections with professors and mold their education the way they choose. I have been given many opportunities and experiences that have helped shape my education and prepare me for my future. From the very first time I visited UMM everyone was so helpful and friendly that it just felt like a place where I could excel."

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