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Joel Johnson Associate Professor of Geology travels to Sweden

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Joel Johnson

Associate Professor of Geology -- Sweden

During the summer of 2013, I served as a research mentor and co-mentor for three undergraduate students who took part in a NSF funded International REU (Research Experience for Undergraduates) program coordinated and led by UNH Department of Earth Sciences Associate Professor, Ruth Varner. The multi-year REU program, titled *REU Site: The influence of climate change on biogeochemical processes in northern ecosystems: An international perspective in Earth System Science*, is focused on providing student research experiences in Earth System Science (ESS), with special emphasis on investigating the impacts of climate change on biogeochemical processes in northern upland and wetland ecosystems. The Stordalen Mire research site is located in sub-Arctic Sweden and is characterized by expansive wetlands and small lakes adjacent to the larger Lake Torneträsk. During the last 30 years the disseminated permafrost in this region has been thawing and methane and carbon dioxide emissions have increased, making it an ideal place to monitor and study active environmental change. The nearby Abisko Scientific Research Station, established in 1913, has a 100 year record of many environmental variables (e.g. climate, vegetation, hydrology, and chemistry data) and serves as an elegant base of operations for research teams year round. Our group of ten REU student researchers and five UNH faculty mentors lived and worked out of the Abisko Scientific Research Station during the 4 week field season of this REU program. Prior to the field season the students spent 3 weeks in research labs at UNH learning laboratory techniques and developing their research plans with their faculty mentors. After the field season, the final 3 weeks were spent at UNH analyzing their data, developing summary posters for their projects, and writing abstracts to present their work at the Fall 2013 American Geophysical Union Meeting.



A field of Eriophorum (cotton grass) adjacent to one of the small lakes in the Stordalen Mire near Abisko Sweden.



Sediment coring team at Lake Villasjön. From left to right: REU students Joel DiStasio, Lance Erikson, and Maddie Halloran.

A subgroup of the student researchers, Maddie Halloran (Carleton College), Joel DiStasio (UNH), and Lance Erikson (Gustavus Adolphus College), UNH Researchers Florencia Prado and Jacob Setera, and UNH faculty co-mentors Ruth Varner, Julie Bryce, and I focused on the shallow lake sedimentary environment, specifically characterizing the sedimentary host and biogeochemical processes active in each lake's methane system.

During the field season in July, we collected 48 cores at 16 sites throughout three lakes of varying depths across the Mire. At each sample site, we retrieved 2 to 4 cores from the lake bottom, up to 80 cm in length. The cores were sub-sampled for measurements of bulk TOC, TC, TN, TS, CaCO₃,



Collecting sediment cores in Lake Mellan Harrsjön. From left to right, REU students Joel DiStasio (partially hidden) and Lance Erikson, and UNH Associate Professor Joel Johnson.

Hg, particle grain size, DIC and stable carbon isotopes of DIC, and headspace CO₂ and CH₄ yielded production rates and CH₄ sediment concentrations. These data were integrated to characterize the sedimentology and geochemistry of the lake sediments to better understand the production, distribution, and flux of CO₂ and CH₄ from these lakes. The recovered sediments are consistent between sites and are composed of an upper layer of organic rich sediment, a middle transition layer of mixed organic and lithogenic materials, and a deep layer of grey lithogenic clay. Preliminary results from Lake Villasjön indicate that CH₄ is present and produced from the organic-rich layer in the upper 20-40 cm of the sediment. Core sites with known high lake surface methane fluxes from bubble trap measurements also show high methane concentrations in the sediment, high DIC concentrations in the pore fluids, and $\delta^{13}\text{C}$ signatures of CO₂ ranging from 0 to 10, consistent with methanogenesis.



UNH Associate Professor of Geology and REU Mentor

As a mentor for this REU program, my experience was fantastic. The students were enthusiastic, engaged, and hard-working throughout the summer, the environment and conditions at the field site were beautiful, and working without the limit of darkness was forever memorable. All the REU students produced high quality data sets, adding to and continuing the 100 year legacy of research at this site. The results from this summer's field season also provided the impetus to develop and submit a proposal to continue high latitude methane study in lakes with Associate Professor and UNH REU Director Ruth Varner and Research Assistant Professor Mike Palace (also a REU mentor this summer). This summer's productive research and mentoring experience would not have been possible without the support provided from a UNH Faculty International Development Grant. I am eager to get back to Sweden to continue this research in the near future.

Joel Johnson at Lake Villasjon near Abisko Sweden.



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