METHANE CONCENTRATION GRADIENTS ASSOCIATED WITH SMALL, THERMOKARST LAKE ON THE ICE-FREE MARGIN OF WESTERN GREENLAND. J.R. White[1,2], K.D. Webster[1], and L.M. Pratt[1], [1]Department of Geological Sciences, Indiana University, [2]School of Public and Environmental Sciences, Indiana University (whitej@indiana.edu).

Introduction: Northern wetlands are thought to contribute from < 6 – 25 % of Earth's annual atmospheric methane inputs. However, despite extensive areal coverage, little is known about methane emissions from lakes and wetlands in the Arctic and associated local affects on atmospheric methane concentrations. We report initial results of methane concentrations from the water column associated with Potentilla Lake (informal name) and in nearby air, lowland and uplandsoils. The site is located near Kangerlussuaq, Greenland (N 67° 04.888', W 050° 21.084'). The area is rich in thermokarst lakes, and provides an appropriate analog for plausible martian ecologies in seasonally ice-covered paleolakes.

Site Description: Potentilla Lake is part of a chain of 7 small lakes (<1 km^2), spanning a distance < 6 km along a narrow valley overlying a structural shear zone and extending from the Russell Glacier to the Søndre Strømfjord in southwestern Greenland [Site 4, Fig. 1]. Potentilla Lake has a surface area of 1.8 ha and a maximum depth of 8 m. Bedrock at the study site is composed of ultramafic alkaline dyke swarms with varying amounts of pyroxene, olivine, hornblende and carbonate minerals, a mineralogically useful analogue for martian regolith. Due to close proximity we anticipated similar physical parameters and methane concentrations. Here, we describe the preliminary results from four weeks of fieldwork in summer 2012, and focus on methane concentrations spanning environments from the water column of the Potentilla Lake to surrounding soils and bedrock fracture zones.

Figure 1. Lake location map: 1) EVV Upper Lake, 2) EVV Lower Lake, 3) Teardrop Lake, 4) Potentilla Lake, 5) Little Long Lake, 6) North Twin Lake, 7) South Twin Lake.

The study area occurs between the airport/village at the head of the Søndre Strømfjord, Kangerlussuaq and the active terminal moraine of the Russell Glacier. The area is characterized by a Low Arctic continental climate, with continuous permafrost < 1m below surface and low precipitation (< 150 mm yr-1). The mean annual air temperature is -6°C, with peaks of +20°C in June to early August when mean temperatures are over +8°C. The lakes are ice-covered from mid-September to mid-June. Groundwater seepage to and from the lake is probably limited to the spring snowmelt period due to a negative precipitation-evaporation balance and the presence of shallow permafrost.

Methods: We measured methane concentrations in the hypolimnion, metalimnion, and epilimnion of Potentilla Lake as well as in several nearby soil transects and ground-level (1.5 m) atmosphere grab samples. The dissolved methane concentrations in the water column were collected using a gas stripping method. Methane concentrations in atmosphere, soils and water were analyzed on a Los Gatos Instruments MCIA employing cavity enhanced absorption spectroscopy with off-axis ICOS technology. Additionally, a Boreal open-path laser (OPL) for methane was used to measure the average atmospheric methane concentration across the long axis (283 m) of the Potentilla Lake for a period of 37 hrs from 12:00 pm on July 20, to 1:00 am on July 22, 2012. The laser was 0.8 m above the surface of the lake and micrometeorology was collected with a Davis Vantage Vue meteorological station. The OPL measured atmospheric methane concentrations once every minute and 13 seconds while the meteorological station recorded conditions every minute. A linear interpolation was used to pair the data for statistical analysis in order to correct for the differing data collection rates.

Dissolved methane was stripped in the field using an Erlenmeyer flask engineered with a 3-way luerlock inlet and 3-way luerlock valve attached to the stopper. For each 500 mL of water, the valves are closed and flask is shaken vigorously for 1 minute to release gas. Gas was displaced into an attached Tedlar bag by injecting water through the syringe. Ebullition gas samples were collected from littoral sediments using an 28 cm diameter plastic funnel with a gas-tight sampling tube and 3-way luerlock valve attached to the neck. Gas samples were transferred into Tedlar bags and processed on the LGR MCIA within 24 hours of collection.

Results: Methane concentrations in Potentilla Lake ranged from 30 ppm in the epilimnion to 5300 ppm in the hypolimnion to 320,000 ppmv in sediment gas bubbles collected from near-shore areas. Soil gases from lowland areas contained methane that ranged from 0.9 to 77 ppmv. Upland soils contained methane concentrations below local ambient air concentrations

(1.82 ppmv), ranging from 0.09 to 1.07 ppmv. All LGR MCIA and OPL measurements of atmospheric methane concentrations collected downwind or above Pontentilla Lake were at or near ambient concentrations despite close proximity to a methane-enriched lake system. Further work is needed to identify factors influencing source and sink strengths of methane in the areas around these thermokarst lakes.