

UNIVERSITY OF
WATERLOO



Program and Abstracts

Spring Session

B.Sc. Thesis and Year 4

Project

Symposium Day

July 19, 2018

DC 1304

Organized by

Department of Earth and Environmental Sciences

Final Program

Session A – All talks are 15 minutes and 5 minutes for discussion. All are Earth 436B presentations unless otherwise indicated.

Room: DC 1304

<i>Time</i>	<i>Speaker and Supervisor(s)</i>	<i>Title</i>
Session Chair: Shaun Frape		
9:00-9:20	Ya Gao (Philippe Van Cappellen, Homa Kheyrollah Pour)	Identification of algal bloom indicators using Principal Component Analysis (PCA)
9:20-9:40	Mingjie Luo (Dusseault)	Shallow geothermal energy application in Waterloo using GIS-supported modelling
9:40-10:00	Katelyn Scott (Yakymchuk)	Mineral Alteration Vectors at the Island Gold Mine
10:00-10:20	Haoyang Jiao (Durr)	Earthquake mortality and risk management in Japan
10:20-10:35	Break	
10:35-10:55	Connor Gorrie (Endres)	Characterizing seasonal snowpacks using ground penetrating radar (GPR)
10:55-11:15	Ke Qin (Dave Rudolph)	Season groundwater-surface water interactions in a perennial stream
11:15-11:35	Shuai Yuan (Brain Kendall)	
11:35-11:55	Chuqi Zhou (Durr)	The abundance of N, P in the groundwater and the development of analysis in a specific area
11:55-12:15	Taleeha Waheed (Rooney)	Assessment of Pesticide Risk to Wetland Aquatic Biota through Analysis of Periphyton

ABSTRACTS

Gao, Ya: Identification of algal bloom indicators using Principal Component Analysis (PCA)

Harmful algae blooms (HABs) have been implicated in fish kills, wildlife poisonings, and human health impacts related to consumption and recreational use. HAB reports are increasing both globally and within the Great Lakes basin, including Lake Erie. The frequency and intensity of HABs in Lake Erie have increased over the decades, which impacts surface water quality and public health. The objective of this study is to identify potential indicators of HABs in Lake Erie using Principal Component Analysis (PCA) method. The data set in this study is going to be selected from available weather/monitoring stations located along and, in the Lake. This study will show that PCA method using coefficients of linear regression is an appropriate tool for this purpose. The study aimed to test the relevance of this tool for Lake Erie, which could be applied for water resource management.

Gorrie, Connor: Characterizing seasonal snowpacks using ground penetrating radar (GPR)

Ground penetrating radar (GPR) is a family of techniques for mapping structures in the subsurface by emitting an electromagnetic (EM) signal into the ground and recording reflections from those features. GPR is commonly used in the shallow subsurface of soil and rock layers, glacial structures, and permafrost layers. It can also be employed in less common scenarios such as seasonal snowpacks, the topic of this study. GPR data were collected from a seasonal snowpack in Churchill, Manitoba to better understand how certain features within the snowpack affect EM wave velocity and reflectivity. This study is investigating how the reflectivity and EM wave velocity can be used to image snow stratigraphy and determine equivalent water content in a seasonal snowpack. Preliminary work has looked at the appropriate use of one-dimensional filters and gains and has applied them to the data set. Different parameters of the filters and gains, such as time window length and maximum gain value, have been tested to observe how the data are affected by such parameters. This analysis will help characterize the different features within the snowpack and provide results regarding its stratigraphy and water content.

Jiao, Haoyang: Earthquake mortality and risk management in Japan

Excessive nutrient enrichment due to anthropogenic activity is a major cause of ecological degradation and drinking water concerns. This study focuses on the east coast of the US. Periodically eutrophication can occur in the region. Many studies demonstrate the surface water behavior, but the regional scale impact of nutrients from groundwater is not well understood yet. Here we use a large regional dataset and rigorous mathematical approaches as well as GIS to understand the large scale groundwater nutrient behavior. The dataset, collected by the United States Geological Survey (USGS), will be used in this study to analyze the characteristics of nitrogen (N) and phosphorus (P) in groundwater, and to explore the relationships between groundwater nutrients and land use, aquifer type, surface material, the well depth, and time span. The major findings are: a) High nitrate levels are likely to occur in shallow overburden aquifers, and in particular where agricultural activities are abundant b) High phosphorus levels occur in shallow aquifers near urban areas or downstream of agriculture areas c) The N and P results observed at different time periods are related to changes in land use. Finally, this will improve our understanding of nutrient interactions between groundwater and surface water.

Luo, Mingjie: Shallow geothermal energy application in Waterloo using GIS-supported modelling

Shallow geothermal energy is an accessible, renewable and clean energy resources. It is imperative to evaluate the potential of using geothermal energy sources to fulfill the urban energy demand. However, the shallow geothermal energy in the Waterloo region has not been estimated. This thesis will focus on the shallow geothermal energy application in the Waterloo region. The methods include the calculation of heating energy demand and the estimation of geothermal potential. Simplification is required for the purpose of reducing costs in the small-scale plants. Assuming borehole heat exchangers (BHEs) are equipped to provide space heating energy for urban buildings, the percentages of total heating demand provided by geothermal energy can be calculated. By using a GIS-based model, the heating demand and percentage fulfilled in the study area can be mapped. The majority of the heating demand for single detached residential buildings can be satisfied by the shallow geothermal system where 100 meters drilling depth of BHEs is implemented. It was observed that the mean value of demand fulfilling is 60%. The maps point out the feasibility of applying shallow geothermal energy in the City of Waterloo.

Qin, Ke: Season groundwater-surface water interactions in a perennial stream

Interactions between groundwater and surface water can influence the quality of two water bodies, causing possible contamination in water resources. Surface water and groundwater chemistry typically reacts rapidly in a short period after the interaction, making it difficult to sample in-time and get complete and accurate information using current monitoring systems. The Advancing Water Technologies (AWT) Program has been proposed by the Rudolph Research Group to establish a reactive data collection system utilizing algorithms, triggers, and a two-way communication technology to realize the critical time-sensitive information collection. This research is designed to analyze the seasonal groundwater-surface water interaction and its effects on water quality with respect to nutrient and pathogen constituents during winter and spring around the Alder Creek in K22 site, which helps to identify triggers for the chemical exchange between groundwater and surface water in the AWT Program. Hydraulic head and temperature of groundwater and surface water are assumed triggers, which will be monitored and investigated with water chemistry to analyze their relationships. It is anticipated that the stream will lose water in winter and gain water in spring, and hydraulic head and temperature are both effective triggers for groundwater-surface water chemical exchange.

Scott, Katelyn: Mineral Alteration Vectors at the Island Gold Mine

The Island Gold Mine located northeast of Wawa, Ontario is an economically significant site that has undergone alteration by hydrothermal fluids. This project will deal with six thin section samples of rock that are representative of the rock types (dacite, trondhjemite, and gabbro) at the Island Gold Mine. Out of the two samples of each type, one is more strongly altered by hydrothermal activity, and the other is relatively unaltered. An electron probe micro-analyzer, also known as a microprobe, is used to analyze the chemical composition of pre-selected spots of 1-2 microns in size on the thin sections. The data collected from the microprobe analysis can be used to calculate the chemical formulae of the minerals in the samples. Differences in mineralogies and/or chemical compositions between the least altered and most altered samples could be an indicator of alteration that may be related to gold mineralization. Conversely, if the results show similar mineral assemblages and compositions in both sets of samples, evidence for mineralization as a result of alteration would be absent. The findings of this study will be useful for predicting the economic viability of mining operations at the study site.

Waheed, Taleeha:

The aim of this research paper is to assess the risk of pesticide bioaccumulation in Rondeau Provincial Park and evaluate whether these pesticides are presenting a risk to aquatic biota. This was done by collecting and analyzing samples to obtain pesticide concentrations in water, sediment and periphyton tissues of this area. These concentrations were then compared to established guidelines and ecotoxicology literature. By comparing measured concentrations

obtained in the field to the pesticide guidelines, it was determined whether the level of pesticide accumulation for a group of 20 pesticides exceeded the outlined safety standards, thereby posing a risk to the ecological community. This list included 9 herbicides, 6 fungicides and 5 insecticides, which were grouped by their mode of action for this assessment. It was determined that the current concentrations of pesticides measured in Rondeau Park are all noticeably below the recommended safety standards, and therefore, do not pose a significant impact on the aquatic biota individually. However, a research gap was identified around the cumulative effect of mixing multiple pesticides as they may combine to pose a different effect than the sum of their separate effects.

Yuan, Shuai:

The Sudbury Basin, Ontario, is one of the oldest impact craters with original size of 200 to 250 km diameter 1.85 Ga old. The Sudbury Mining district is one of the world class mineral deposits. Both geological value and economic value is significant in Sudbury Basin. However, the systematic summary and analysis of the Sudbury Basin insufficient. For further and exhaustive understanding of Sudbury Basin and mining in this district. This report collects the information and data in lithology, tectonometamorphism, mineral deposits type, and value of deposits from literature in diverse fields. Then the general knowledge of the Sudbury Basin is summarized. The metamorphism process of rocks in the Sudbury Basin are managed in chronological order. The relationship between footwall/surrounded rocks and differentiated melt sheet of Sudbury Igneous Complex (granophyre-quartz gabbro-norite-contact sublayer) is explained. In addition, the relative genetic model between magmatic (Ni-Cu-PGE) deposits and hydrothermal deposits (Zn-Pb-Cu) is concluded. Relationships between Lithology, Tectonometamorphism and mineral deposits are easily understood.

Zhou, Chuqi: The abundance of N, P in the groundwater and the development of analysis in a specific area

The abundance of nitrogen, phosphorus in the groundwater, is closely related to the human's agriculture and industry. In the west coast of US, most of scientists focused on the groundwater of California while I will focus on the states of Washington and Oregon. On the stage of preparing the background knowledge, by reading papers, essays and reports, the historical process of this project was organized. The conclusion is: (1) The global nitrogen cycle is divided into 4 parts and the cycle of phosphorus include inorganic and organic part. (2) The contamination plume and eutrophication could be distinguished by understanding the chemical environment in the groundwater. Though the basic knowledge was organized and literature review was finished, some practical techniques to organized 30,000 data should be learned in the following analysis. The target of research is to have an overall analysis of the change of abundance of nitrogen, phosphorus as well as inorganic and organic compounds in the groundwater of the states of Washington and Oregon. I expect to conduct suggestions for human society and predict the possibility of eutrophication and pollution.