PARKLAND LAKES WATER CHEMISTRY SURVEY

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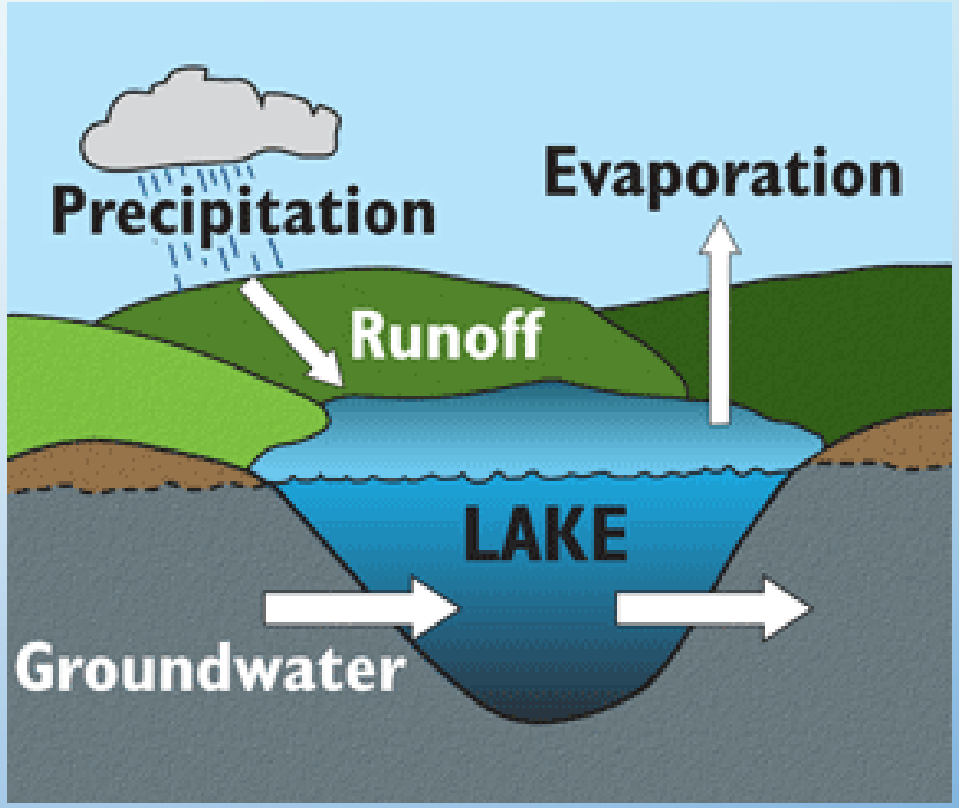
THE WATER CYCLE

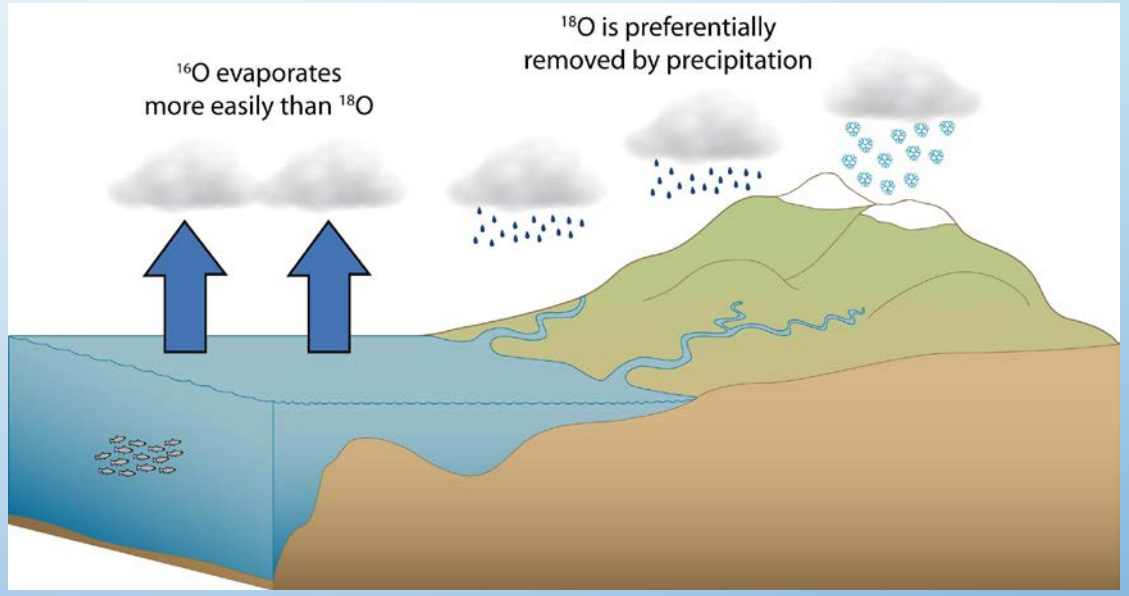
- PRECIPITATION
- EVAPORATION
- RUNOFF
- GROUNDWATER
- TRANSPIRATION



HTTPS://WWW.TES.COM/LESSONS/SWS-JYQLFR8GNQ/WATER-CYCLE-CARTOON

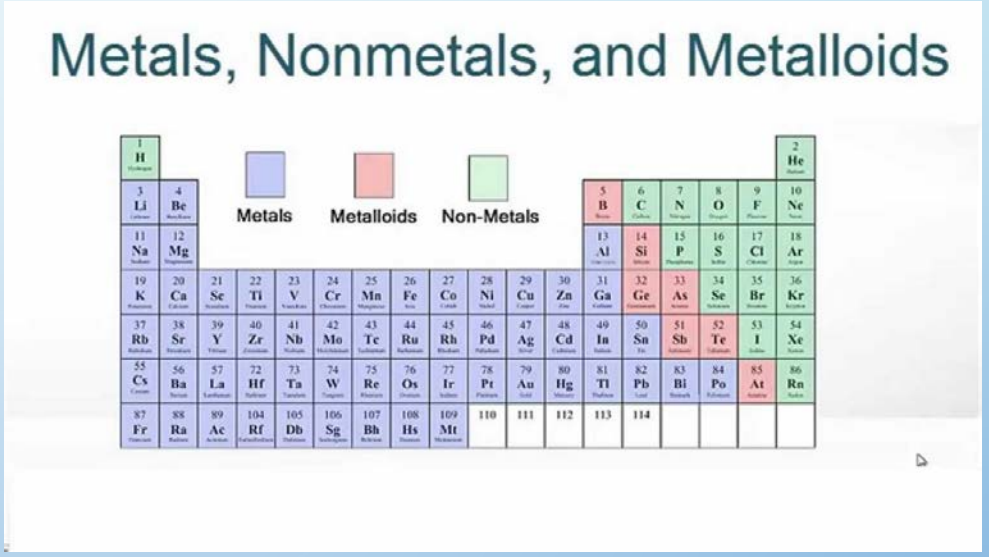
STABLE WATER ISOTOPES

- ISOTOPES: ELEMENTS WITH THE SAME ATOMIC NUMBER BUT DIFFERING ATOMIC MASSES
- STABLE WATER ISOTOPES USE THE ISOTOPES OF OXYGEN AND HYDROGEN TO TRACK THE WATER CYCLE



INORGANIC CHEMISTRY

- METALS AND NON-METALS ARE USED TO DETERMINE CHEMICAL REACTIONS WITHIN THE WATER CYCLE AND HOW CHANGES INFLUENCE THEM.



https://www.youtube.com/watch?v=OoooStZQHdA

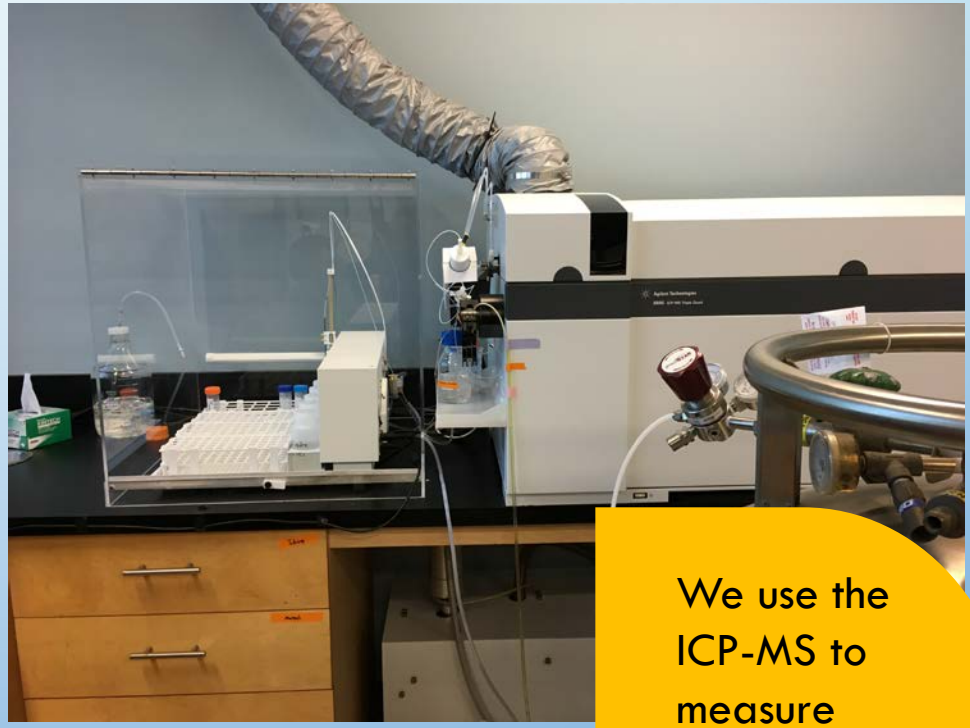
THE PROCESS

STABLE WATER ISOTOPES

- USED $\Delta^{18}O$ VALUES TO GENERATE ISOTOPE TIME-SERIES TO ASSESS FOR INTER-ANNUAL VARIABILITY
- USED $\Delta^{2}H$ AND $\Delta^{18}O$ TO GENERATE CO-ISOTOPE PLOTS
- CALCULATED RESIDENCE TIMES USING NUMERICAL MODELLING

INORGANIC CHEMISTRY

- METALS: FOCUSED ON SODIUM, CALCIUM, POTASSIUM, AND MAGNESIUM
- NON-METALS: FOCUSED ON CARBONATE, BICARBONATE, SULPHATE, AND CHLORIDE
- PLOTTED GEOCHEMICAL DATA TO LOOK FOR DIFFERENCES IN WATER CHEMISTRY
  - GROUNDWATER VS SURFACE WATER
  - GEOGRAPHICALLY

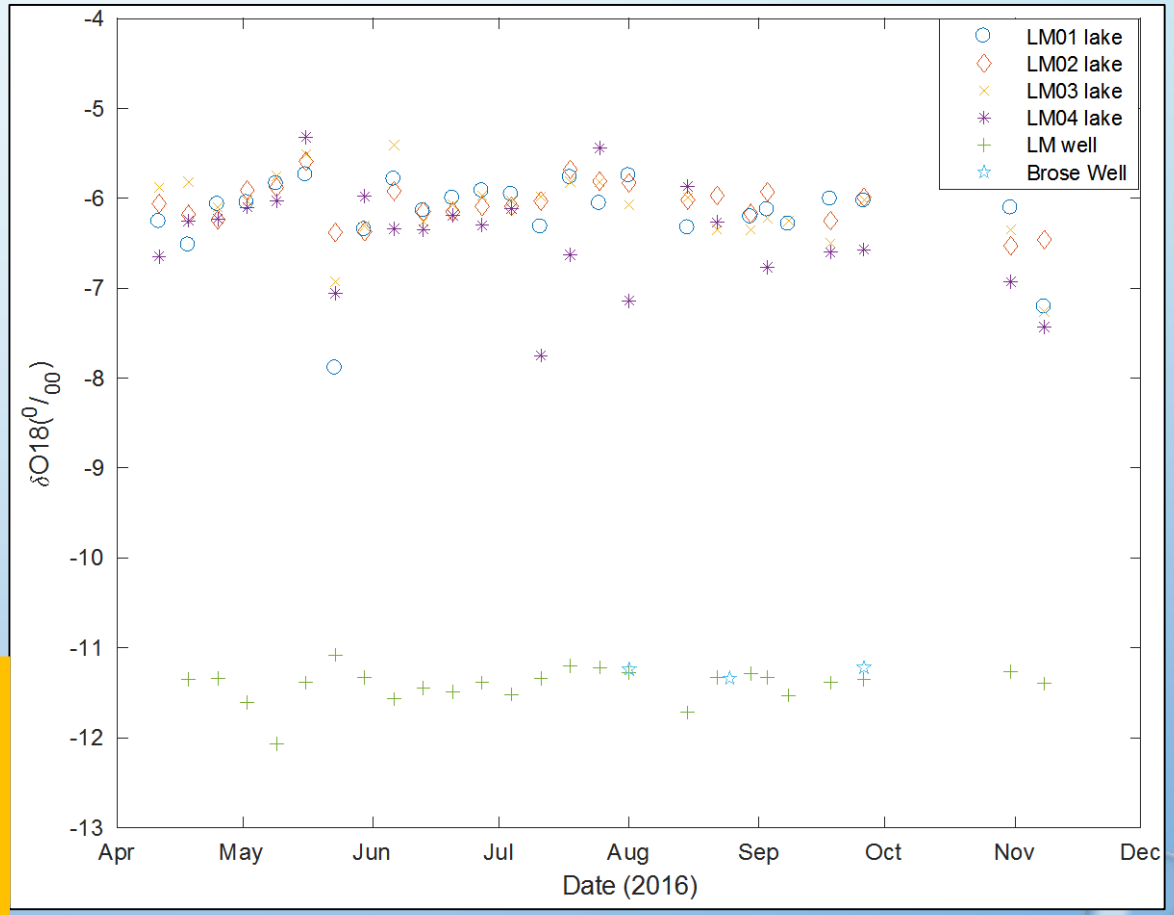


We use the ICP-MS to measure metals, not non-metals

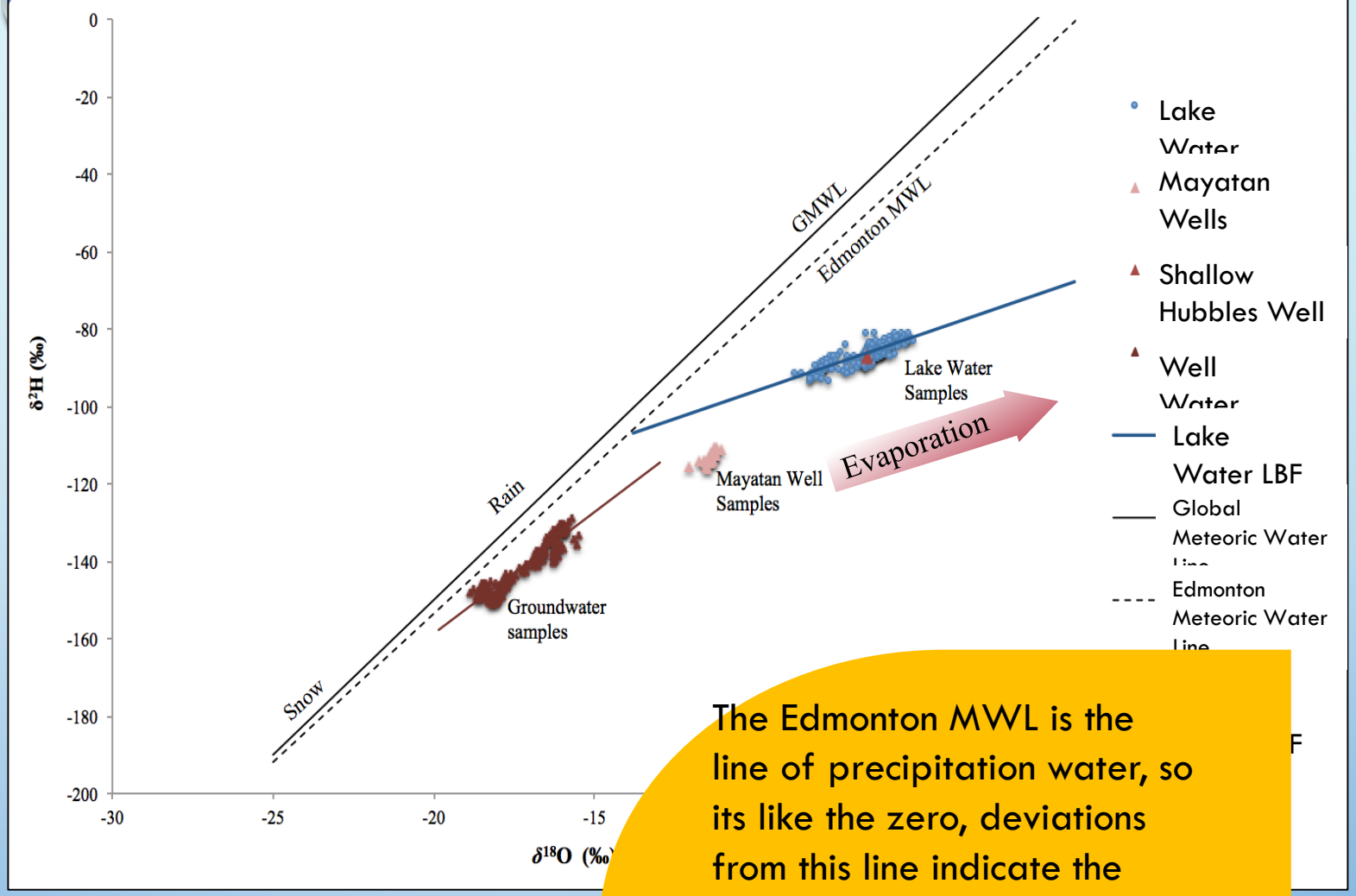
THE RESULTS

STABLE WATER ISOTOPES

- TIME-SERIES DIAGRAMS: ILLUSTRATE LOW INTER-ANNUAL VARIABILITY



The peaks and variation in the graph represent precipitation



- CO-ISOTOPE PLOT: ILLUSTRATES STRONGLY EVAPORATIVELY ENRICHED LAKE WATER

The Edmonton MWL is the line of precipitation water, so its like the zero, deviations from this line indicate the water has been subjected to evaporation which has reduced the amount of 16-oxygen isotope molecules

- MODELLING: INDICATES SHORT RESIDENCE TIMES AND SUGGESTS GROUNDWATER INPUT TO LAKES IS SMALL

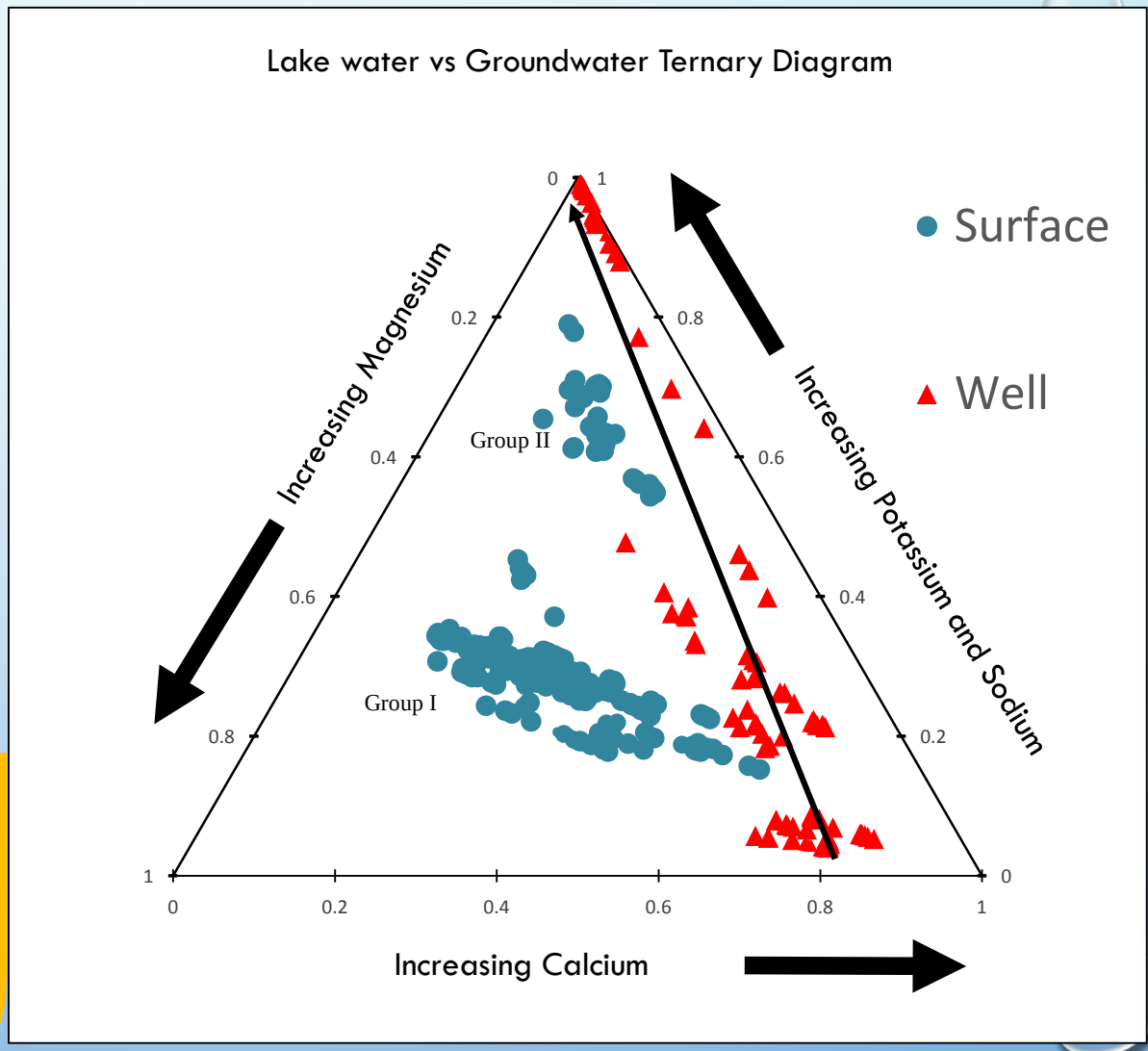
Lake	Residence Time (yrs)
Cottage Lake	-
Hasse Lake	4.1
Hubbles Lake	11.4
Jackfish Lake	3.6
Mayatan Lake	6.9
Spring Lake	2.3
Wabamun Lake	39.4

A residence time is the amount of time a single water molecule spends in the system. So it takes 4 years for a molecule to enter and leave the lake system of Hasse lake.

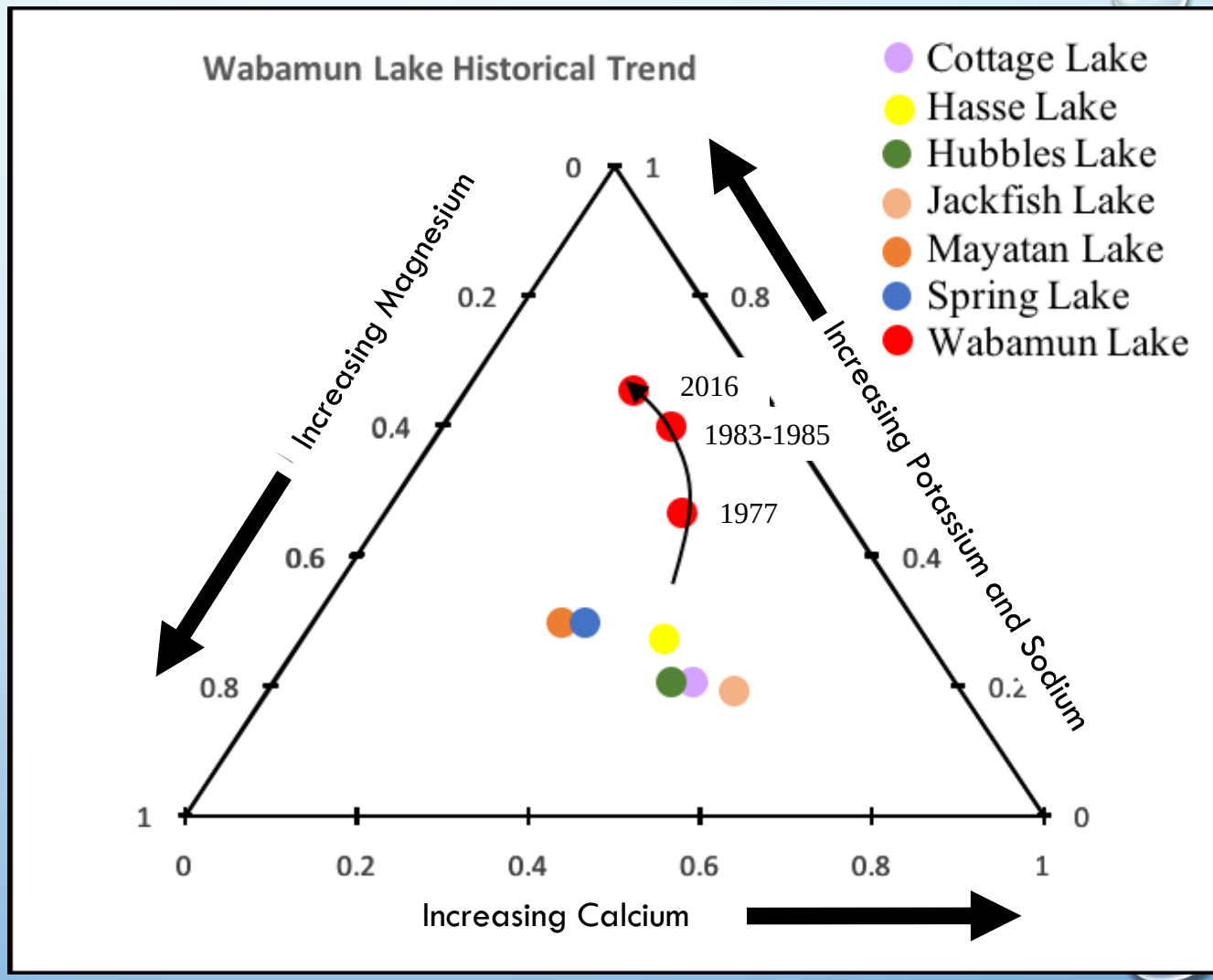
INORGANIC CHEMISTRY

- TERNARY DIAGRAMS
  - TWO GROUPS OF SURFACE WATER
  - DEEPER WELLS HAVE MORE SODIUM
  - SEPARATION IN CHEMISTRY BETWEEN SHALLOW WELLS AND LAKES

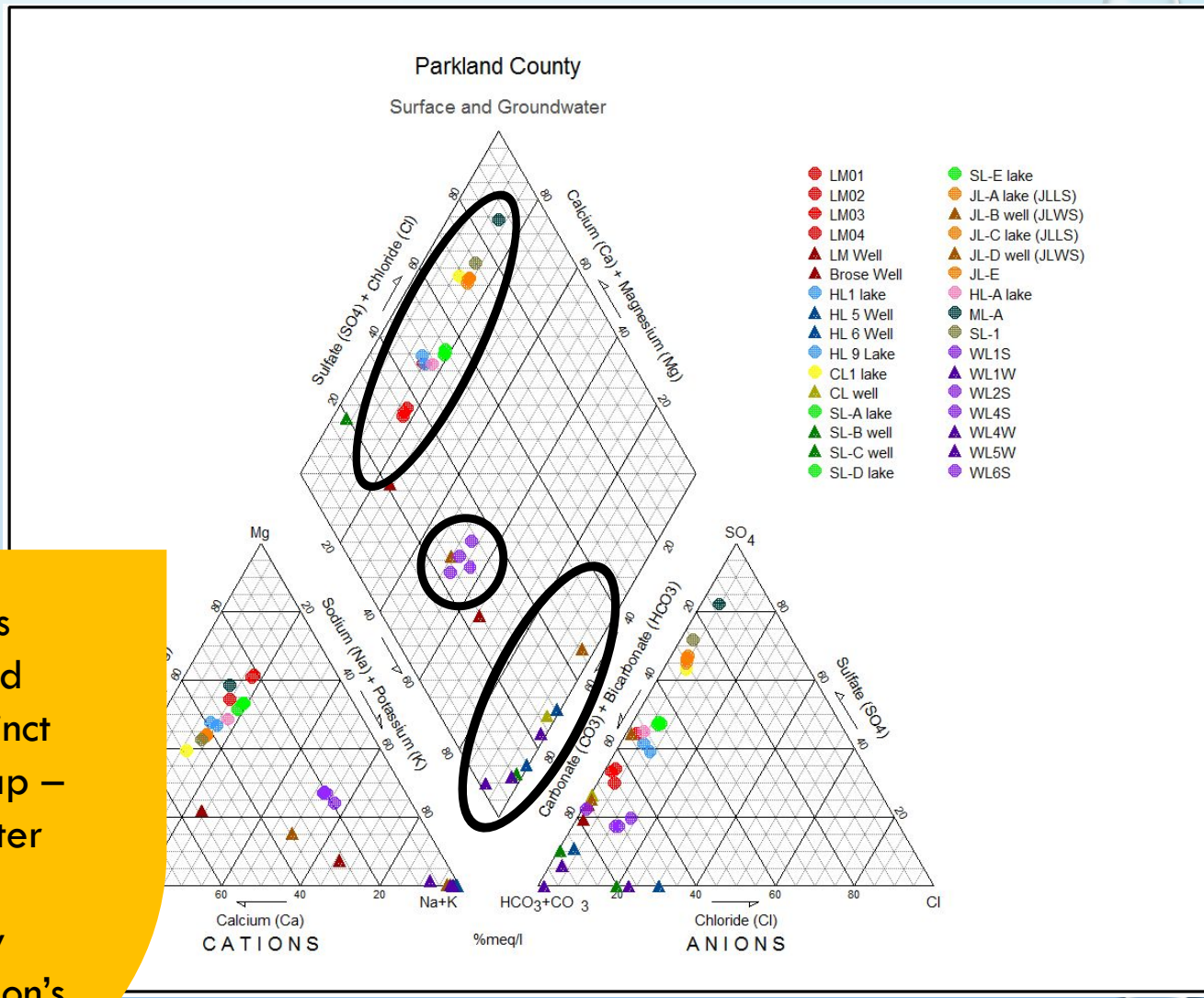
Wabamun Lake is the Group II surface water, and is enriched in sodium in comparison to the rest of the lakes in the study



- TERNARY DIAGRAM
  - WABAMUN LAKE HISTORICAL DATA
- INCREASING SODIUM IN WABAMUN LAKE



- PIPER DIAGRAMS
  - INDICATE LOW LEVELS OF CHLORIDE IN ALL WATER
  - GROUNDWATERS ARE SODIUM BICARBONATES
  - SEPARATION BETWEEN LAKE AND GROUNDWATER
  - SEPARATION BETWEEN WABAMUN AND OTHER LAKES



The main point from this is that the surface water and the groundwater are distinct groups and do not overlap – indicating that groundwater is not interacting with the lake water except in very shallow groundwater (Jason's well in spring lake 17ft)

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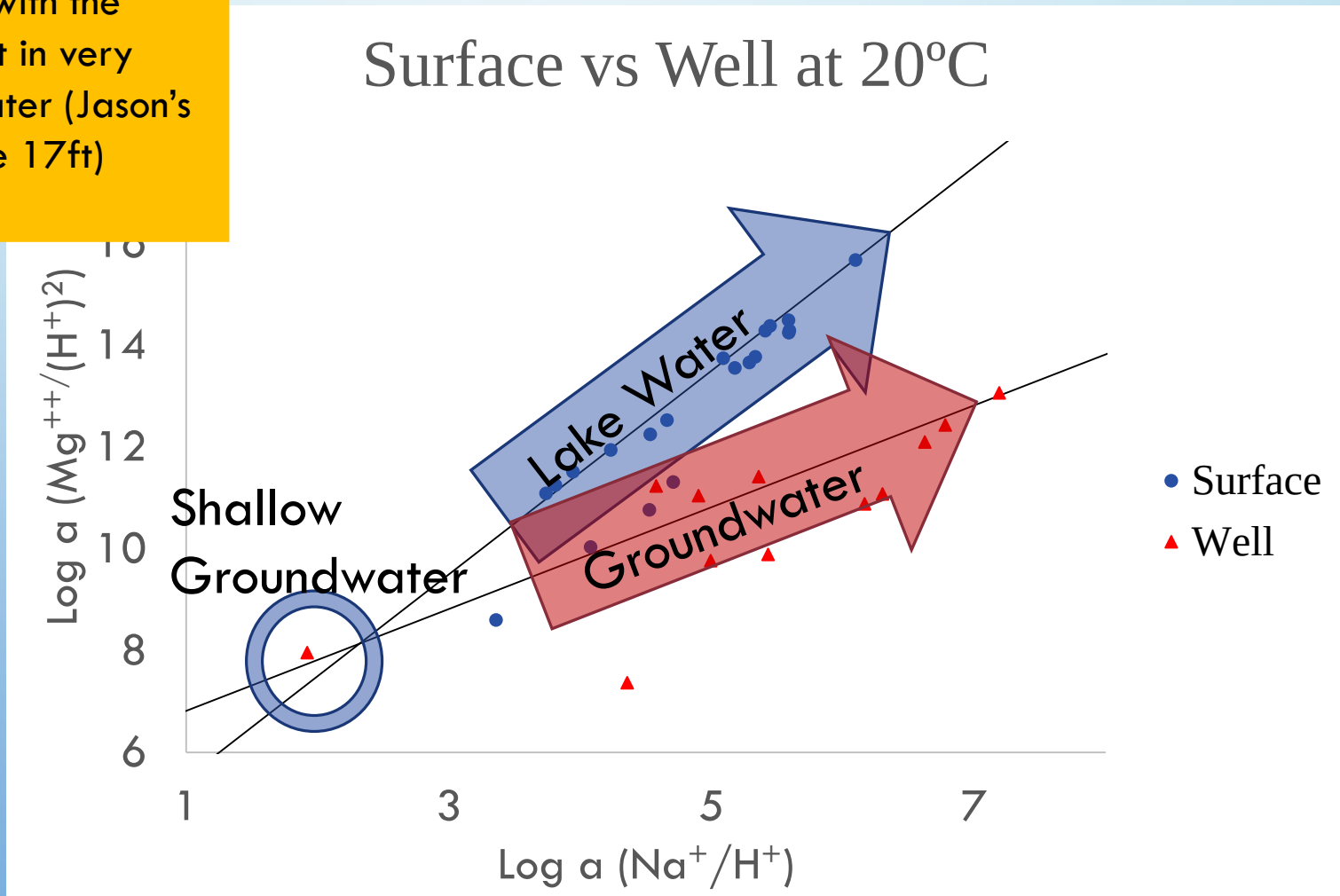
- ACTIVITY-ACTIVITY PLOTS INDICATE GROUNDWATER INPUT INTO THE LAKES IS LIMITED TO ONLY VERY SHALLOW GROUNDWATER

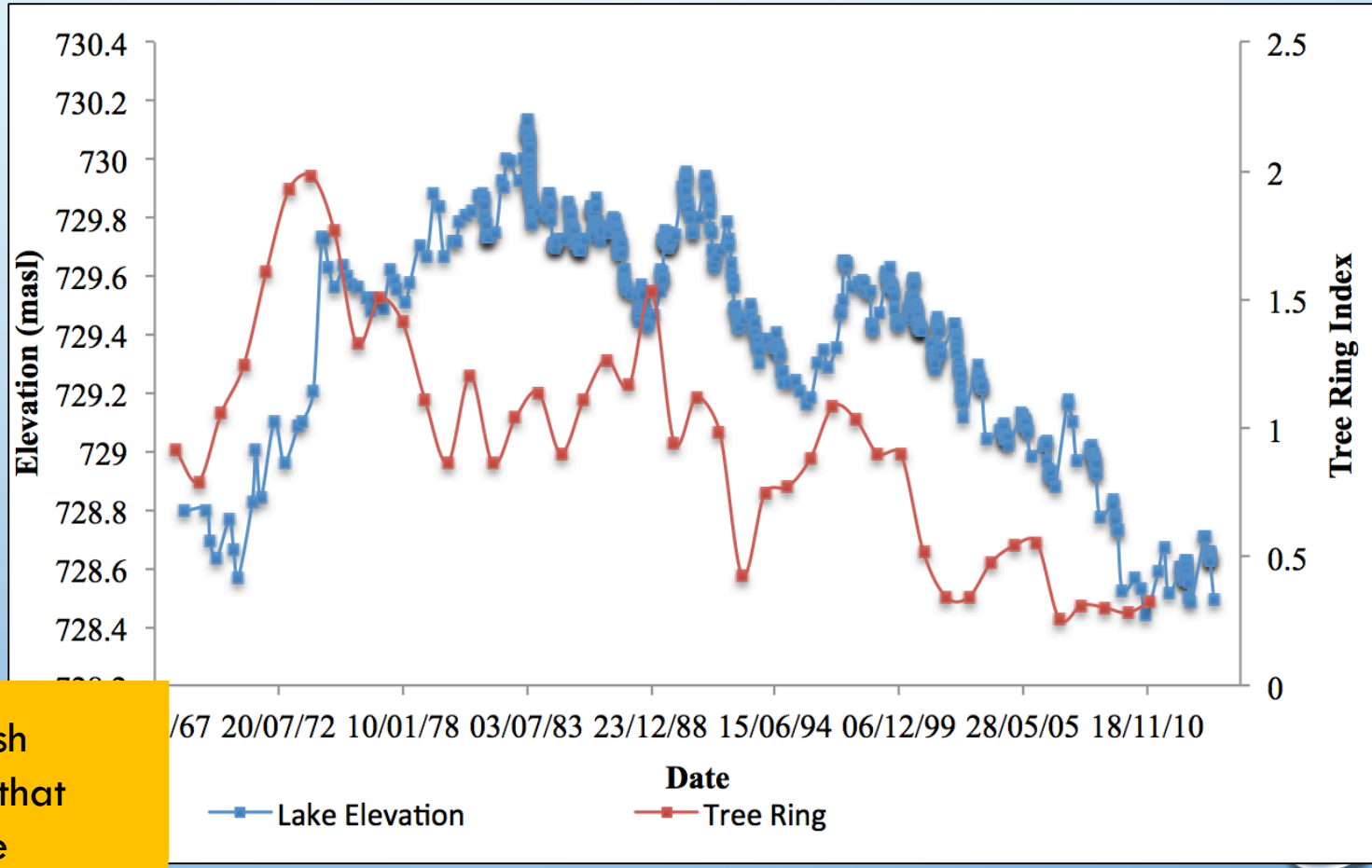


THE TAKE-HOME POINTS

- WATER LEVELS OF THE LAKES ARE MOSTLY REGULATED BY PRECIPITATION AND EVAPORATION
- GROUNDWATER INPUT INTO THE LAKES IS SMALL AND LIMITED TO ONLY SHALLOW GROUNDWATER
- WATER IS WELL MIXED AND SPENDS MULTIPLE YEARS IN THE LAKE
- WABAMUN LAKE HAS HIGH LEVELS OF SODIUM IN COMPARISON TO THE OTHER LAKES IN THE STUDY WHICH HAVE BEEN INCREASING SINCE AT LEAST 1977

TREE RING DATA

- LONG TERM MOISTURE TRENDS



This is from Jackfish lake and it shows that the lake levels are reflecting climate changes

FUTURE STEPS FOR THE PROJECT

- PUBLICATION OF A PEER REVIEWED ARTICLE IS IN PROGRESS
- UNIVERSITY INVOLVEMENT COMING TO AN END
- POTENTIAL OTHERS TO CONTINUE THE WORK

THANK YOU!

QUESTIONS?

https://www.freepik.com/free-photos-vectors/question-mark