



pennsylvania

DEPARTMENT OF ENVIRONMENTAL PROTECTION

Bureau of Point and
Non Point Source Management



Ionic Composition of PA Reference Streams

WRAC Meeting

February 18th 2015

Background

- Inorganic solids dissociate in water forming positive cations and negative anions
 - Major Cations: Calcium, Magnesium, Sodium
 - Major Anions: Bicarbonate, Chloride, Sulfate
- The mixture and concentrations of ions influence the toxic effects of individual species of ions
- Necessary to know the natural ionic composition to develop chloride and sulfate criteria

Milligram Equivalents

Milliequivalents (meq)

- Unit concentrations of all ions are equivalent
 - total cation meq/l = total anion meq/l of a sample
- $\text{Meq} = \text{mg/l} \div \text{equivalent weight}$
 - Equivalent weight = atomic weight \div charge
- Calculate the charge imbalance (CI) to determine the quality of the data
 - $\text{CI} = (\text{cations} - \text{anions}) / ((\text{cations} + \text{anions})/2)$
 - values are in meq/l
 - $\text{CI} < 10\%$ is acceptable

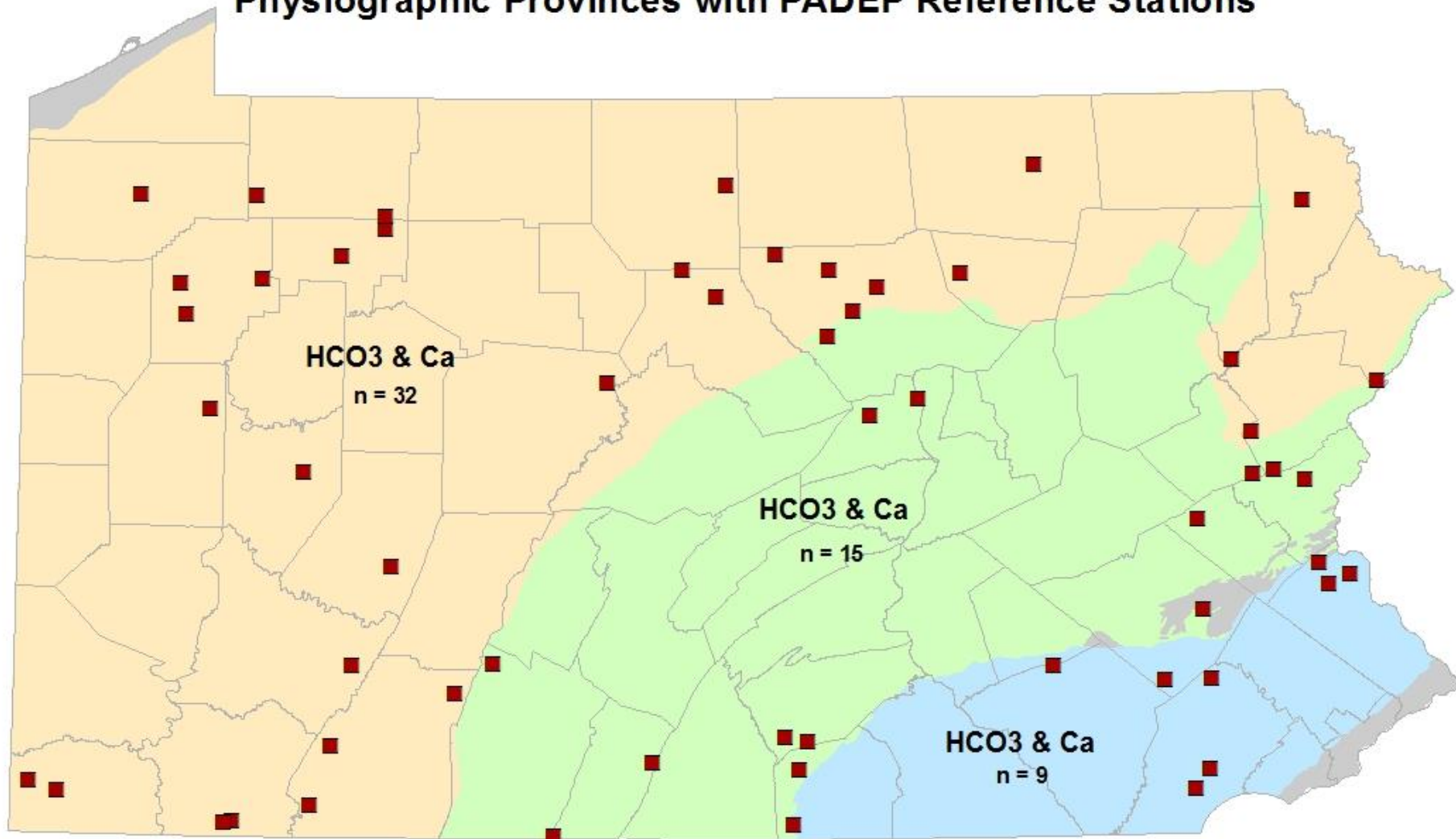
Ionic Composition of PA Streams

- Goal is to measure the ionic composition of least impacted typical streams spread across the three major physiographic provinces
 - Appalachian Plateau
 - Ridge & Valley
 - Piedmont
- Landscape and geology

Ionic Composition of PA Streams

- 56 reference stations
 - 30 regional reference stations
 - started with 47 but many couldn't be used because their charge imbalance was $> 10\%$
 - 26 reference Water Quality Network (WQN) stations
- Obtained the mean meq for each station and used those to obtain the mean meq per physiographic province
- Bicarbonate & Calcium were the major ions in all 3 provinces

Physiographic Provinces with PADEP Reference Stations



n = number of stations

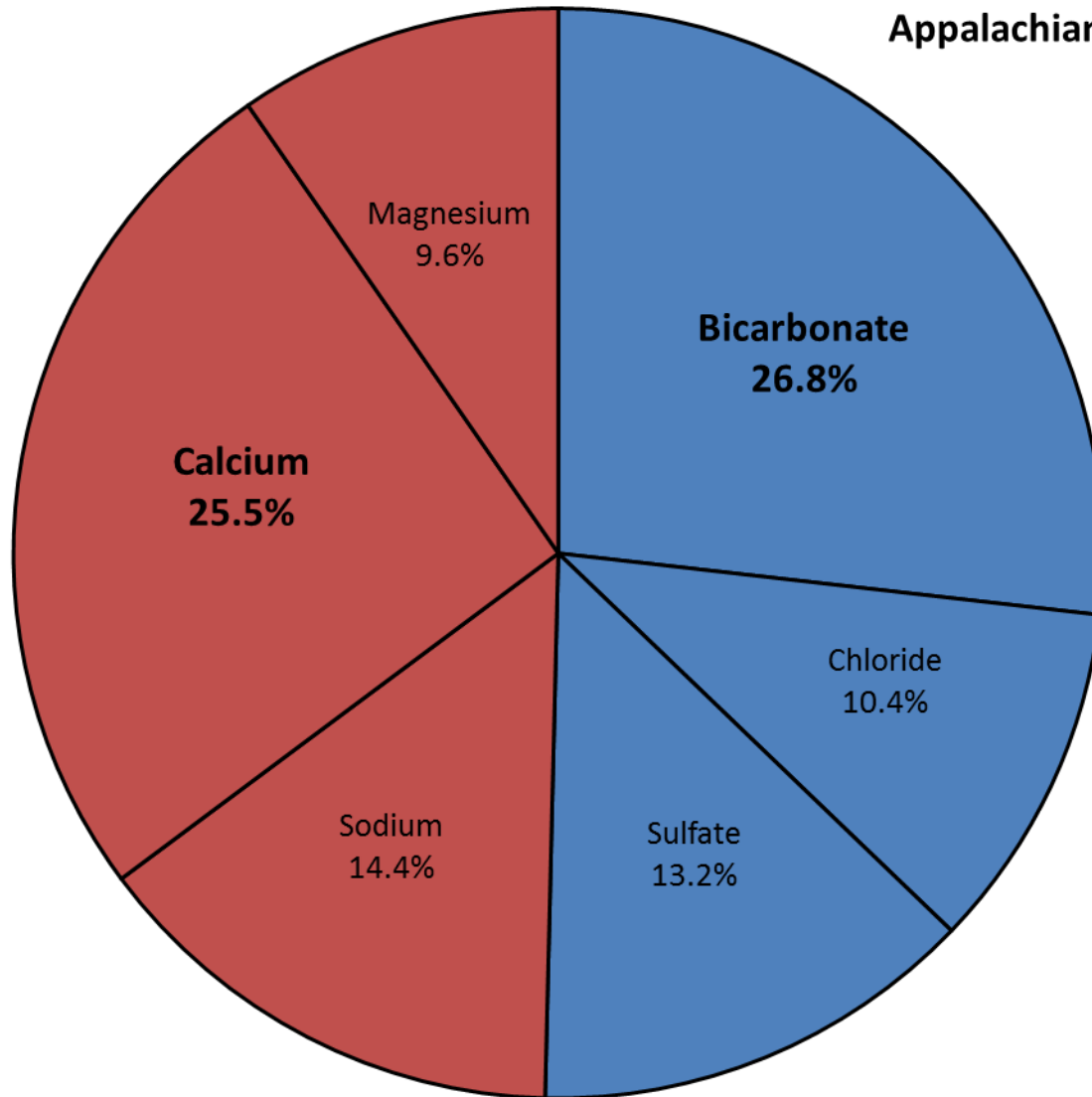
■ Reference Stations

APPALACHIAN PLATEAUS

RIDGE AND VALLEY

PIEDMONT

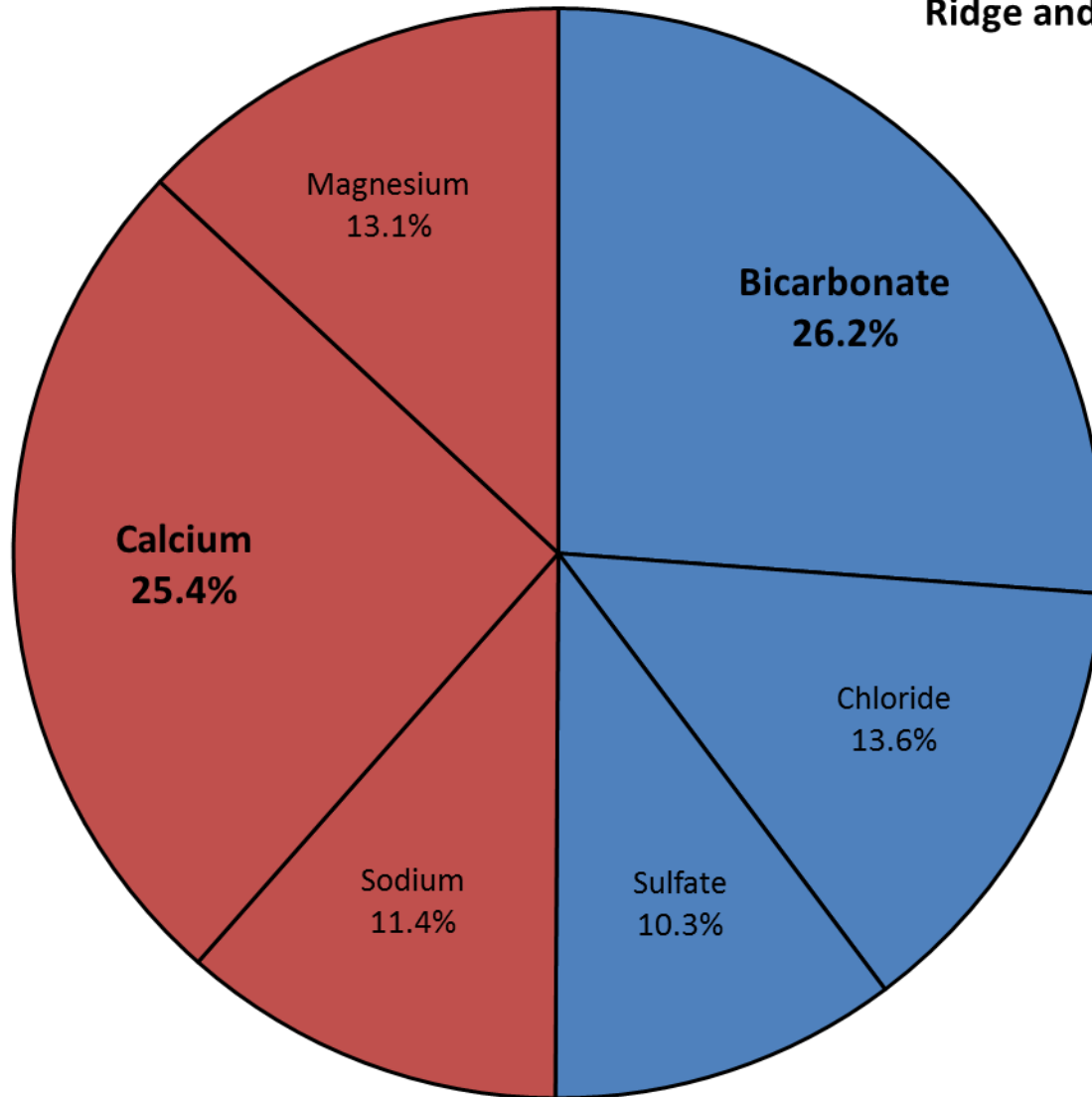
Appalachian Plateau Province



Cation = 49.6%
Anion = 50.4%

n = 32

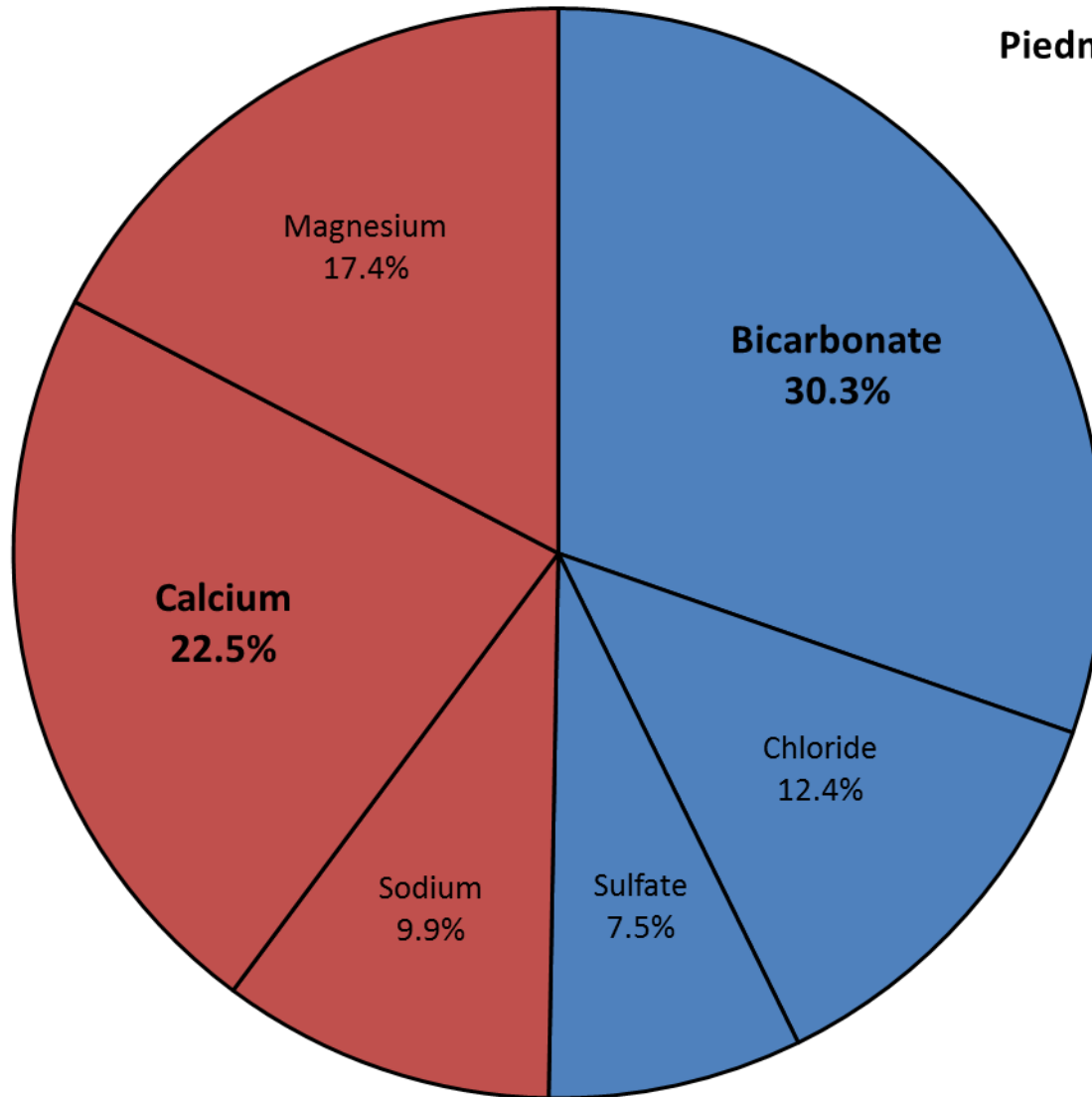
Ridge and Valley Province



Cation = 49.9%
Anion = 50.1%

n = 15

Piedmont Province



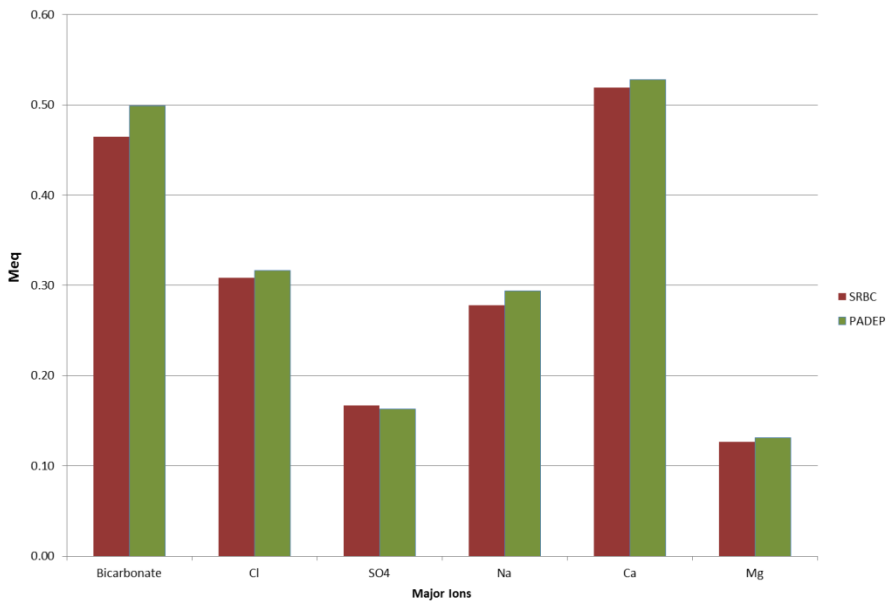
Cation = 49.7%
Anion = 50.3%

n = 9

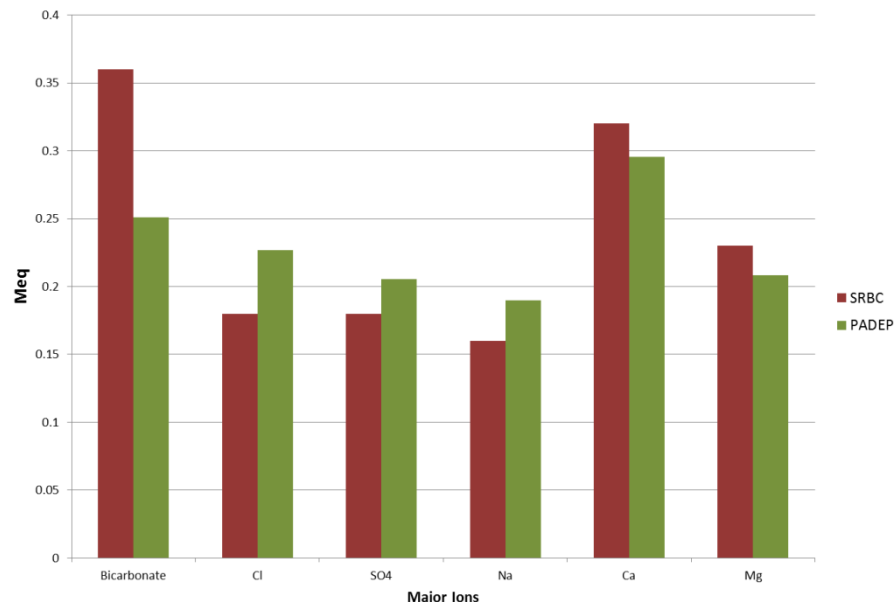
SRBC Ion Data

- Dataset includes:
 - samples collected between 1985 – 2013
 - All water quality types
- Calculated meqs and removed samples with charge imbalance $>10\%$
- Averaged based on physiographic provinces
- Handful of stations overlapped PADEP's
 - comparison

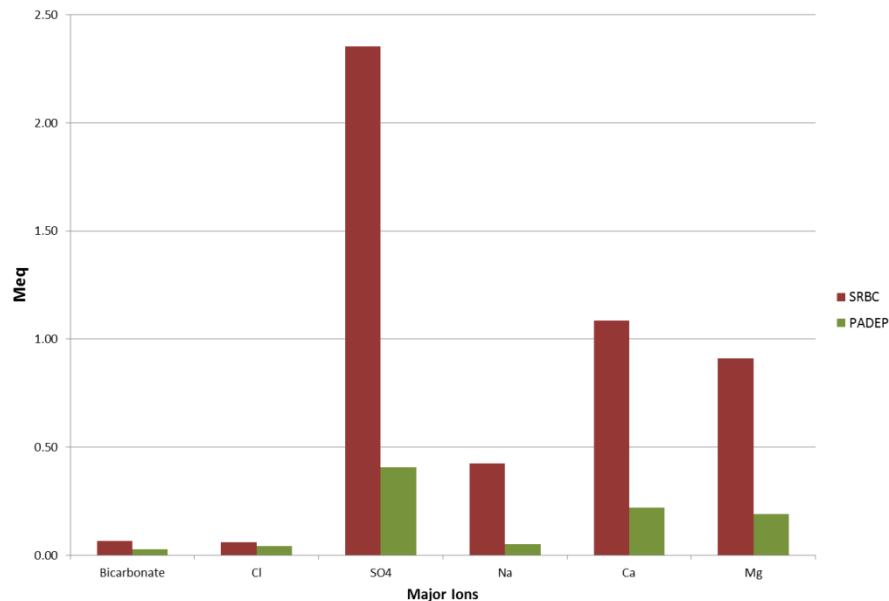
Blockhouse Creek



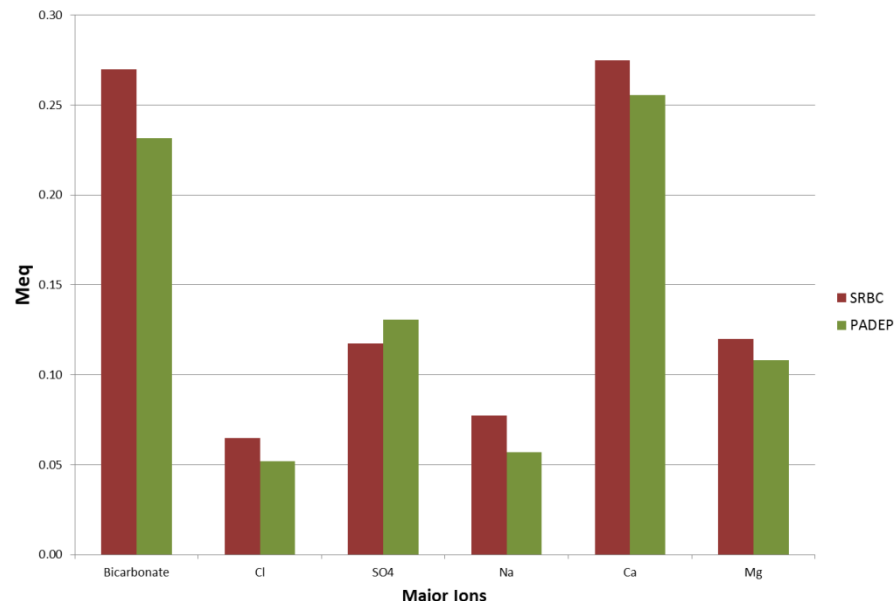
Bobs Creek



Mosquito Creek

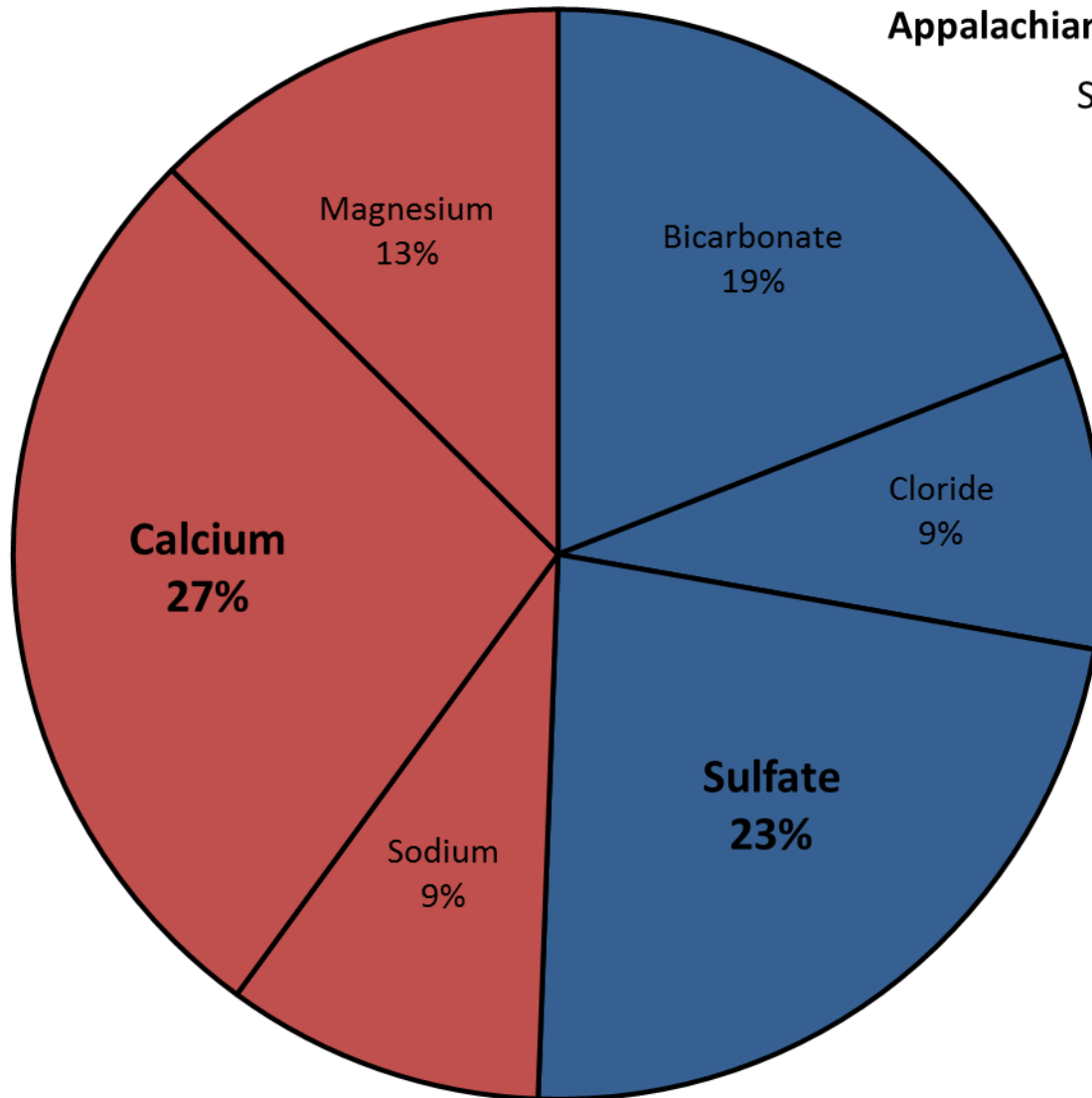


West Branch Pine Creek



Appalachian Plateau Province

SRBC data



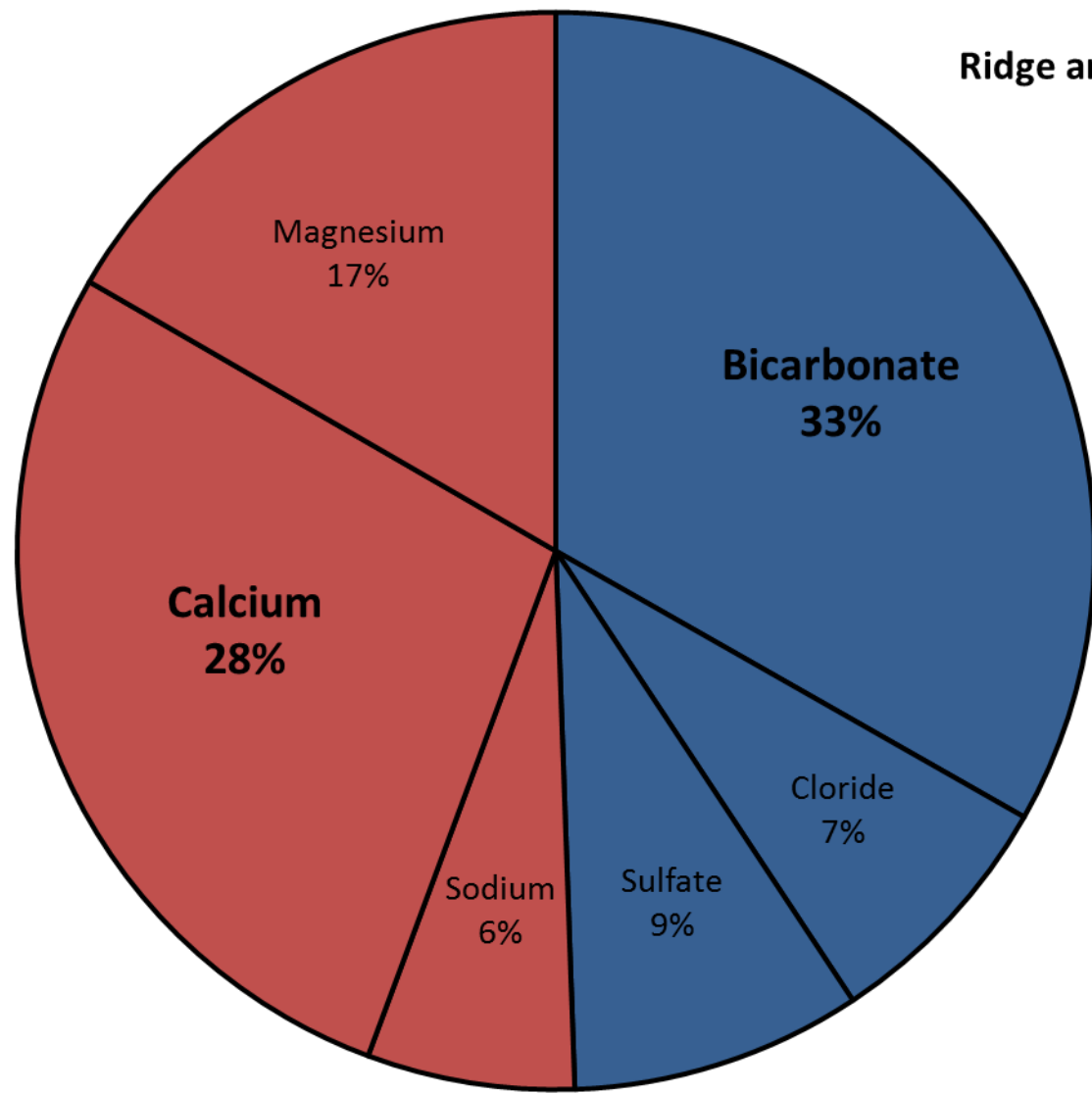
Cation = 49%

Anion = 51%

n = 409
(1985-2013)

Ridge and Valley Province

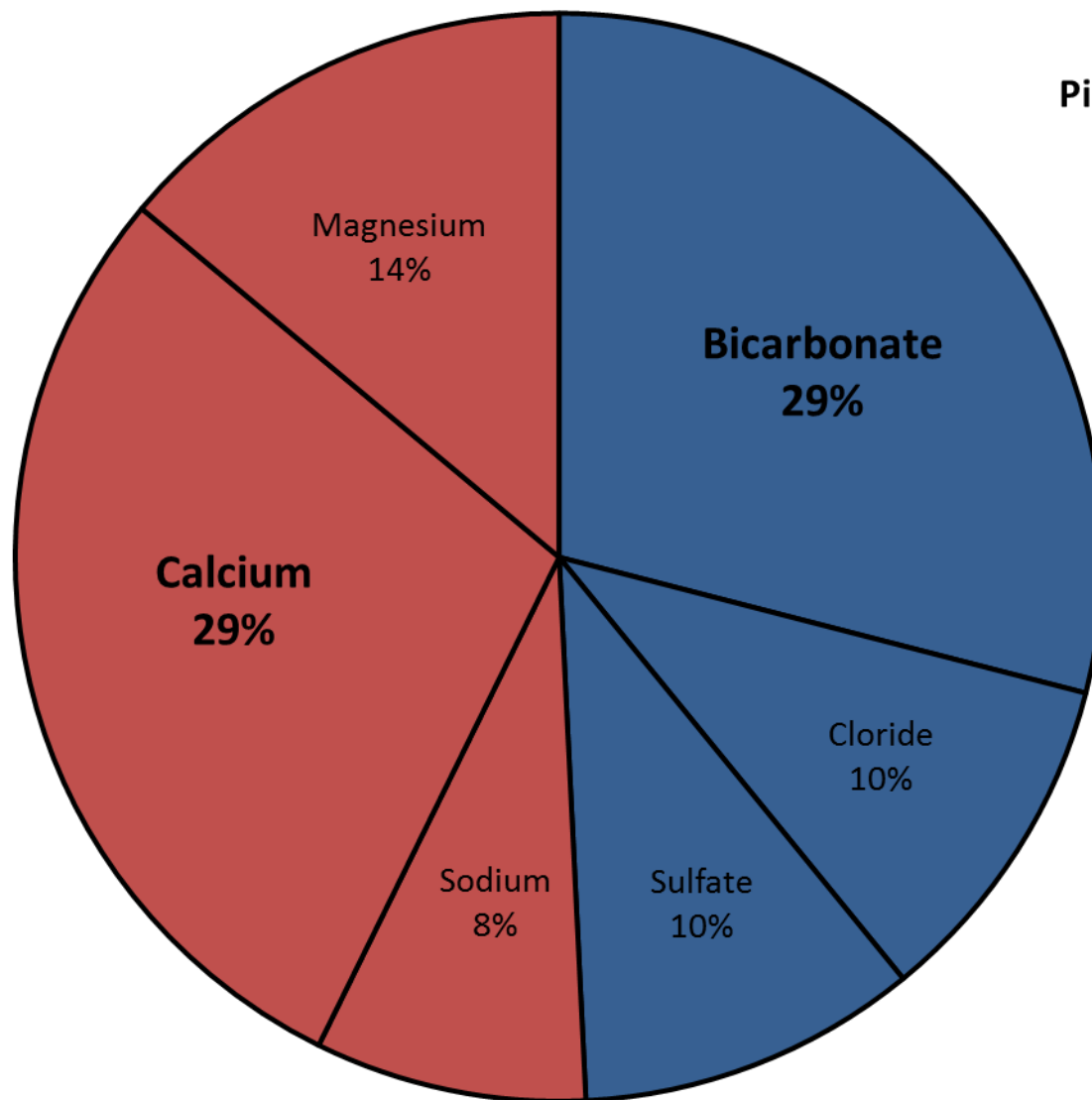
SRBC data



Cation = 51%
Anion = 49%

n = 360
(1985-2013)

Piedmont Province
SRBC data



Cation = 51%
Anion = 49%

n = 41
(1985-1996)



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