

CHALLENGES IN THE ANALYSIS AND INTERPRETATION OF ACIDIC WATERS

D. G. Wondolow, E. B. MacIsaac, and J. W. Ball



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Chemical analyses

- Perform a variety of functions
 - Address regulatory requirements
 - Establish risk
 - Site characterization
 - Monitoring discharges
 - Geochemical modeling

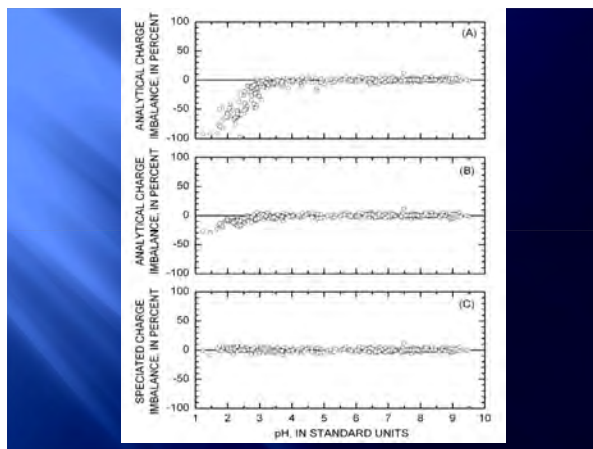
The question is, if analyses are required to be complete for some of these tasks, why not for all of them? The extra costs are generally trivial and the benefits are substantial.

What is complete?

- All major ions (Na, K, Ca, Mg, Cl, SO₄, F, alkalinity, plus anything > 10% of equivalents)
- Redox species of Fe (II/III) and As(III/V)
- pH (field and lab); cannot be measured for a few acid geothermal samples; must be bracketed by standard buffers at field temperature; for pH values below 1 sulfuric acid standards must be used in conjunction with the Pitzer method
- Water isotopes (H-2, O-18)
- Any trace elements likely to be present

QA/QC Charge balance

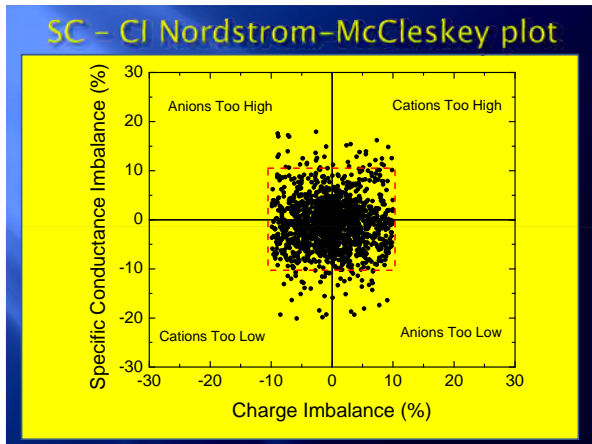
- Helps to determine the quality of the major ion determinations
- Must include H⁺ for pH values < 3; must be speciated if H⁺ > Fe or > Al
- Cannot be determined whether the error is in a cation or anion



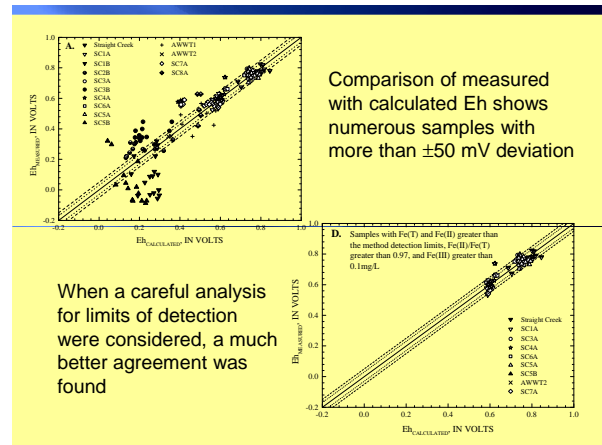
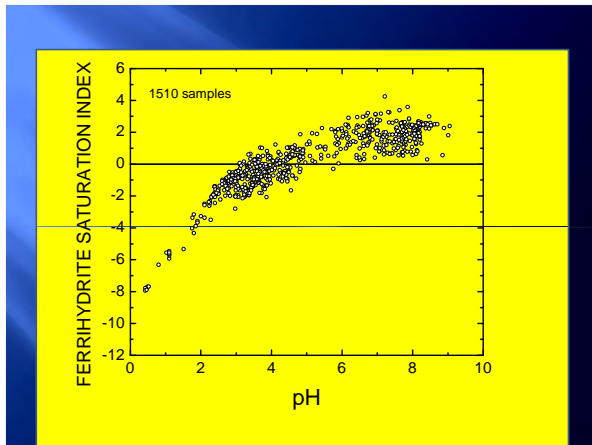
New addition to QA/QC: Calculated specific conductance

- Given an analysis for the major ions, SC can now be computed for most any composition for 0-100°C.
- With this constraint, the determination of whether an analytical error is with a cation or an anion can now be made utilizing the specific conductance imbalance,

$$SCI\% = \frac{SC(\text{measured}) - SC(\text{calculated})}{SC(\text{measured})} \times 100$$



- ### Other QA/QC checks
- Standard Reference Water Samples of similar composition to those being analyzed
 - Alternate methods
 - Spiked recoveries; standard additions
 - Correlating SC with major anion (sulfate)
 - Checking saturation indices
 - Checking temporal data
 - Checking measured with calculated redox potential for $pH < 4$ and $Fe > 10^{-5}m$



- ### Typical analytical issues for AMW
- Unfilterable Fe colloids, typically happens for $pH > 4$; results in apparent dissolved Fe concentrations that are too high; no easy solution but if the saturation index for $Fe(OH)_3$ is high by an order of magnitude or more then colloids are likely the reason
 - Sulfate determinations are occasionally biased by IC; can be checked by ICP-AES
 - Fluoride by IC and ISE can be biased; ISE is usually better but must be checked for the right ratio of TISAB to sample
 - Colorimetric methods are often affected

