Piper Plot and Stiff Diagram Examples

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This example demonstrates how to prepare data for a Piper plot and create a piper plot from those data. It also demonstrates the ternary plot, also called trilinear or triangular diagram. The Piper diagram replicates figure 37 in Hem (1989). The trilinear example uses a randomly generated set of data. **NOTE:** to use the piperPlot function, you must first call a function to set up the graphics environment like `setPage` or `setPDF`, but these are not included here to use the graphics tools in `Sweave`.

```
> # Load the smwrGraphs package
> library(smwrGraphs)
> # Generate a random sample for the ternary diagram
> set.seed(2727)
> # Ternary diagram data
> X <- runif(25, .1, 1.)
> Y <- runif(25, .1, .8)
> Z <- runif(25, .3, 1.)
> # Get the selected groundwqater quality date from Hem
> library(smwrData)
> data(MiscGW)
```

1 Piper Plot

The Piper plot assumes that the data are in similar units. The traditional units would be milli-eqivalents per liter. Each column in the data set must be converted from milligrams per liter to milli-equivalents per liter. This can be accomplished by the `conc2meq` function in the smwrBase package, loaded by default when the smwrGraphs package is loaded. The data provided to the `piperPlot` function do not need to sum to 1 or 100.

```
> # Transform the data. This example will ignore potassium, fluoride, and nitrate
> # (carbonate is either 0 or missing and will also be ignored).
> PD <- transform(MiscGW, Ca.meq = conc2meq(Calcium, "calcium"),
+                     Mg.meq = conc2meq(Magnesium, "magnesium"),
+                     Na.meq = conc2meq(Sodium, "sodium"),
+                     Cl.meq = conc2meq(Chloride, "chloride"),
+                     SO4.meq = conc2meq(Sulfate, "sulfate"),
+                     HCO3.meq = conc2meq(Bicarbonate, "bicarb")) # abbreviations allowed
> # The row name identifies the sample source, create a column
> PD$SS <- row.names(PD)
> # setSweave is a specialized function that sets up the graphics page for
> # Sweave scripts. It should be replaced by a call to setPage or setPDF
> # in a regular script.
> # The minimum page size for a Piper plot is 7 inches. No check is made,
> #  but the axis title spacings require a graph area of at least 6 inches.
> setSweave("piperplot01", 7, 7)
> # For this example, a separate graph area for an explanation is not needed
> #  because there are only 2 groups.
> AA.pl <- with(PD, piperPlot(Ca.meq, Mg.meq, Na.meq,
+                         Cl.meq, HCO3.meq, SO4.meq,
+                         Plot=list(name=SS, color=setColor(SS)),
+                         zCat.title = "Sodium",
+                         xAn.title = "Chloride",
+                         yAn.title = "Bicarbonate"))
> addExplanation(AA.pl, where="ul", title="")
> # Required call to close PDF output graphics
> graphics.off()
```

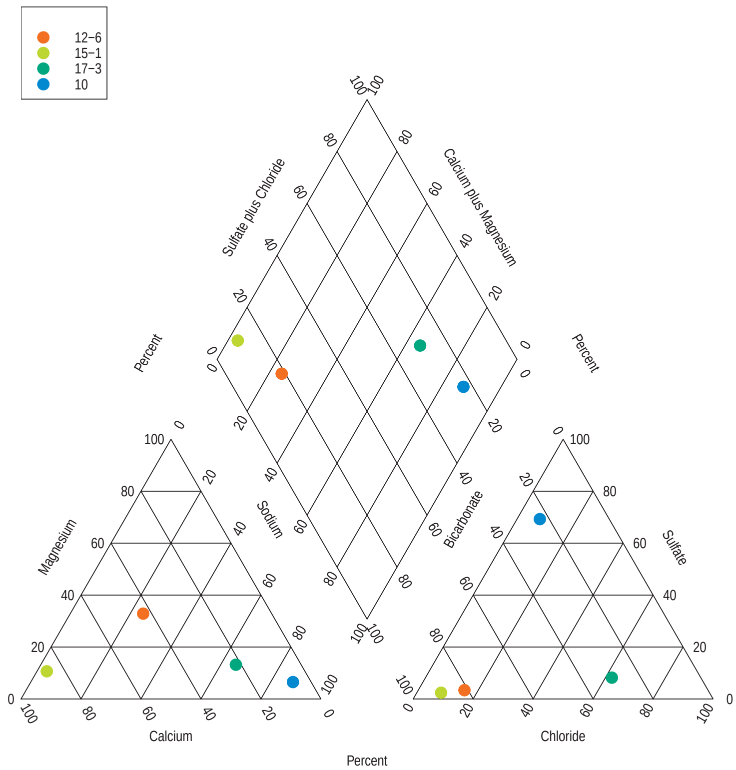

Figure 1. The Piper diagram.

2 Ternary Diagram

The ternary diagram also assumes that the data are in similar units. The traditional use would be milli-eqivalents per liter for water-cheistry data, but other units are possible. The data provided to the `ternaryPlot` function do not need to sum to 1 or 100.

```
> setSweave("piperplot02", 6, 6)
> # Accept all defaults
> ternaryPlot(X, Y, Z)
> # Required call to close PDF output graphics
> graphics.off()
```

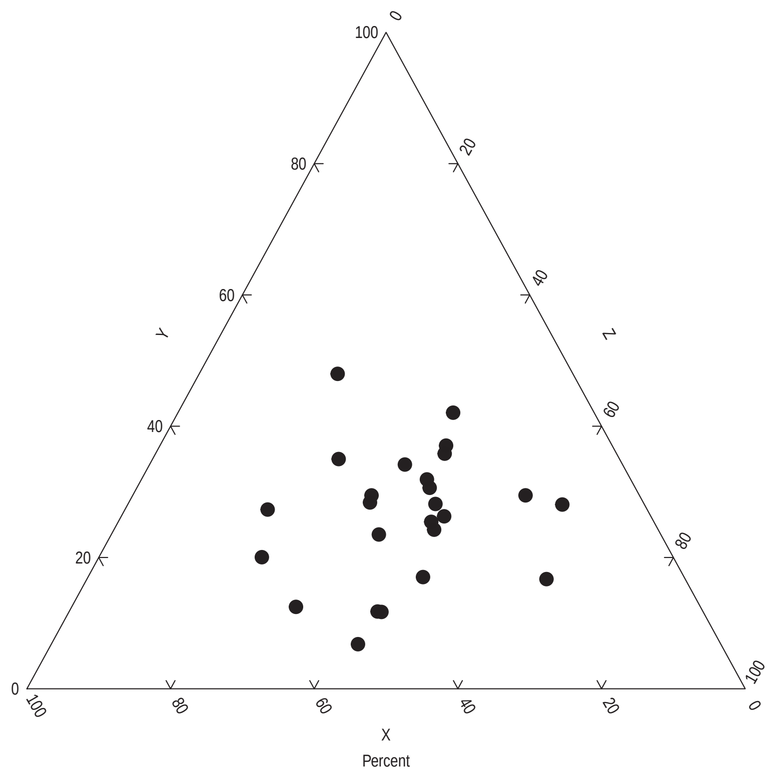

Figure 2. A very simple ternary diagram.

3 Stiff Diagram

The Stiff diagram also assumes that the data are in similar units. The traditional use would be milli-eqivalents per liter for water-cheistry data, but other units are possible.

```
> setSweave("piperplot03", 6, 6)
> AA.lo <- setLayout(height=3.5, explanation=list(bottom=1.1))
> setGraph(1, AA.lo)
> # Accept all defaults, but subset the data for the small graph size
> AA.pl <- with(PD, stiffPlot(cbind(Ca.meq, Mg.meq, Na.meq),
+          cbind(Cl.meq, SO4.meq, HCO3.meq), ylabels=SS))
> setGraph("explanation", AA.lo)
> addExplanation(AA.pl)
> # Required call to close PDF output graphics
> graphics.off()
```

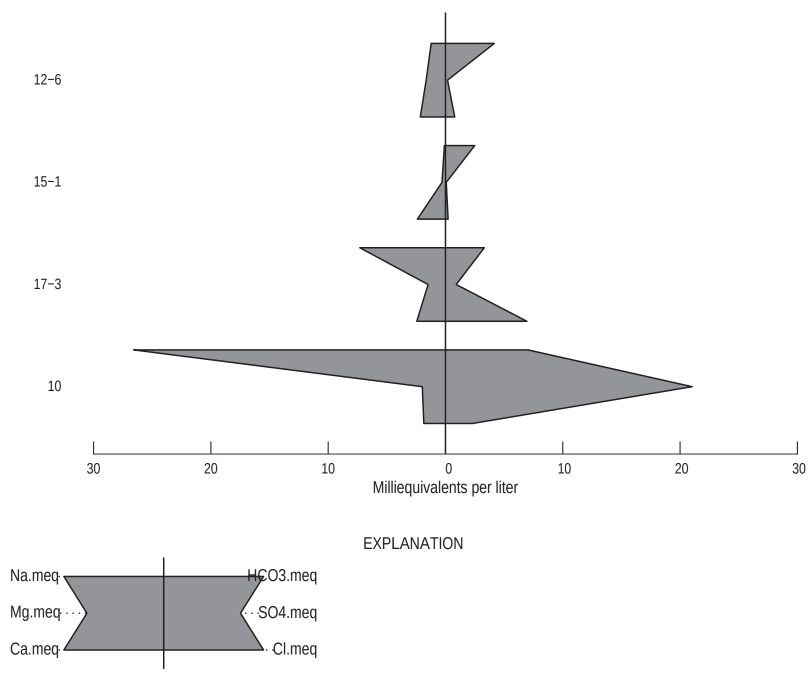

Figure 3. The Stiff diagram.

References

[1] Hem J.D., 1989, Study and interpretation of the chemical characteristics of natural water: U.S. Geological Survey Water-Supply Paper 2254, 263 p.