BRIEF NOTE

Simplification of the Petz-Faure Graphic Procedure for Resolving Three Component Mixtures[1]

ROBERT R. BELLIVEAU[2], Department of Geoscience, University of Nevada – Las Vegas, 4505 S. Maryland Parkway, Las Vegas, NV 89154

ABSTRACT. A simplification of the Petz-Faure graphical procedure for resolving three component mixtures is presented which has the advantages of easier construction and more intuitive interpretation.

OHIO J SCI 106 (5):191-192, 2006

INTRODUCTION

Petz and Faure (1997) introduced the use of a graphical procedure for the interpretation of the concentrations of conservative cations contributed by three separate creeks at their confluence at the south end of the city limits of Columbus, OH. They indicated that this graphical procedure "may be used by practicing environmental geochemists and by students in laboratory exercises in environmental science courses at the college or even high school level." Faure and Mensing (2005) extended the utilization of this graphical representation beyond hydrogeology to "the formation of clastic sedimentary rocks composed of mixtures of grains of different minerals or rock types." An example of the procedure that Petz-Faure called a Mixing Triangle is depicted in Figure 1a. Points 1, 2, and 3 represent measurements of the Sr and Na content of the hypothetical creeks 1, 2, and 3 before they converged into a single creek. The waters of the three creeks define a triangle of mixing in coordinates of the concentration of Na and Sr. Point 4 represents the measurement of Sr and Na downstream of the triple confluence of streams 1, 2, and 3.

The Petz-Faure Graphical Procedure

First, a line starting at point 3 is drawn parallel to the line 1-2.

Then, a line starting at point 2 is drawn parallel to line 1-3.

Next, a line is drawn through point 4 which is perpendicular to line 1-2. This is line AC.

Then, a line is drawn through point 4 which is perpendicular to line 1-3. This is line DE.

The concentration of creek 3(S3) water in sample 4 is:

$$S3 = AB/AC$$

Likewise the concentration of creek 2(S2) water in sample 4 is:

$$S2 = DB/DE$$

The concentration of creek 1(S1) can be determined in the same manner or algebraically as:

$$S1 = 1 - (AB/AC + DB/DE) \text{ or stated differently}$$
$$S1 = 1 - (S2 + S3)$$

The values of the lines AB, AC, DB, and so forth, are determined by direct measurement in millimeters and reported as percent.

The Simplified Graphic Procedure

The simplified graphic procedure is depicted in Figure 1b and the measurements are made in the following manner:

The three points of the concentrations of Na and Sr of the three hypothetical creeks as well as point 4 which represents the measurement of the Na and Sr downstream of the triple confluence of streams 1, 2, and 3 are identical to those in Figure 1a.

First, a line is drawn from point 1 through point 4 to the line 2-3. This is line AC.

Then, a line is drawn from point 3 through point 4 to the line 1-2. This is line DE.

The concentration of creek 1(S1) water in sample 4 is:

$$S1 = BC/AC$$

Likewise the concentration of creek 3(S3) water in sample 4 is:

$$S3 = BE/DE$$

The concentration of creek 2(S2) can be determined in the same manner or algebraically as:

$$S2 = 1 - (BE/DE + BC/AC) \text{ or stated differently}$$
$$S2 = 1 - (S3 + S1)$$

The values of the lines BC, AC, DE, and so forth are determined by direct measurement in millimeters and reported as percent.

DISCUSSION

The simplified graphic procedure has the following advantages:

1) It is not necessary to accurately draw two lines parallel to two sides of the triangle, as is the case in the Petz-Faure graphic procedure.
2) It is not necessary to accurately draw two lines that are perpendicular to two sides of the triangle as is the case in the Petz-Faure graphic procedure.
3) It is more intuitive that a line drawn, for example, from point A to point C is involved in the contribution of point 1 to sample 4 in the simplified graphic procedure (Fig. 1b) than it is that a line drawn from point A to point C is involved in the contribution of point 3 to sample 4 (Fig. 1a).

[1]Manuscript received 10 May 2005 and in revised form 21 March 2006 (#05-09).

[2]The author is a student in the Department of Geoscience at the University of Nevada – Las Vegas.

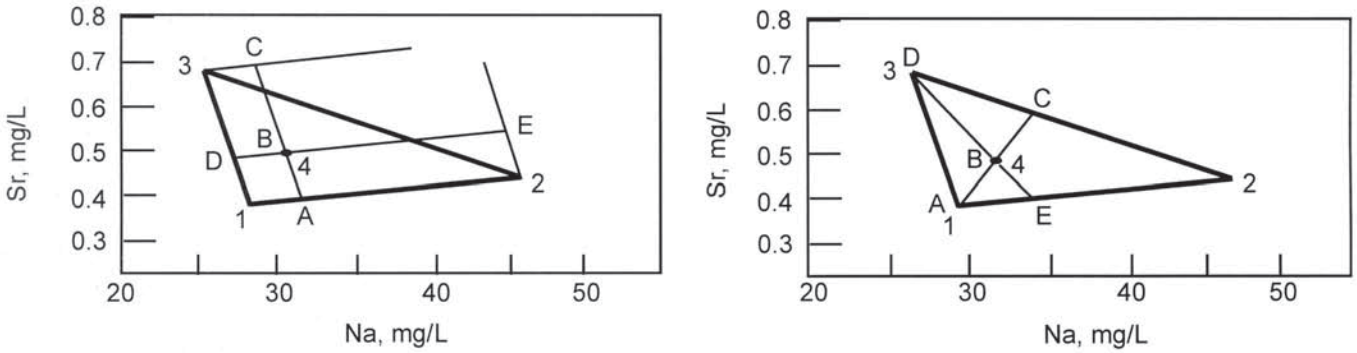

FIGURE 1. a) Modified from Petz and Faure 1997. b) Simplified graphic representation. a,b) The proportions of water in sample 4 derived from the three separate sources are explained in detail in the text.

LITERATURE CITED

Faure G, Mensing T. 2005. Isotopes – Principles and Applications, 3rd Edition. New Jersey: John Wiley. 897 p.

Petz TR, Faure G. 1997. Mixing of water in streams: Big Walnut Creek and its tributaries. Ohio J Sci 97(5):113-5.