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Standard Guide for Displaying the Results of Chemical Analyses of Ground Water for Major Ions and Trace Elements—Trilinear Diagrams for Two or More Analyses[1]

This standard is issued under the fixed designation D 5754; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This guide describes the category of water analysis diagrams that use two-dimensional trilinear graphs as a technique for displaying the common chemical components from two or more complete analyses of natural ground water (see Section 3) on a single diagram. This category includes not only trilinear-shaped diagrams but also the diamond- or parallelogram-, rectangular-, or square-shaped graphs that have trilinear subdivisions.

1.2 This guide is the first of several documents to inform professionals in the field of hydrology with the traditional graphical methods available to display ground water chemistry.

NOTE 1—Subsequent guides are planned that will describe the other categories of diagrams that have been developed to display ground water chemical analyses.

(*1*) A guide for diagrams based on data analytical calculations will include those categories of water analysis graphs in which one analysis is plotted on each diagram (for example, the pattern, bar, radial, and circle diagrams).

(*2*) A guide for statistical diagrams will include those categories of water analysis graphs in which multiple analyses are analyzed statistically and the results plotted on the diagram (for example, the box, etc.).

1.3 Numerous methods have been developed to display the ions dissolved in water on trilinear diagrams. These diagrams are valuable as a means of interpreting the physical and chemical mechanisms controlling the composition of water.

1.4 The most commonly used trilinear methods were developed by Hill **(1-3)**,[2] Langelier and Ludwig **(4)**, Piper **(5, 6)**, and Durov **(7-13)**. These techniques are proven systems for interpreting the origin of the ions in natural ground water and for facilitating the comparison of results from a large number of analyses.

NOTE 2—The use of trade names in this guide is for identification purposes only and does not constitute endorsement by ASTM.

1.5 *This guide offers an organized collection of information or a series of options and does not recommend a specific course of action. This document cannot replace education or experience and should be used in conjunction with professional judgment. Not all aspects of this guide may be applicable in all circumstances. This ASTM standard is not intended to represent or replace the standard of care by which the adequacy of a given professional service must be judged, nor should this document be applied without consideration of a project's many unique aspects. The word "Standard" in the title of this document means only that the document has been approved through the ASTM consensus process.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 596 Practice for Reporting Results of Analysis of Water[3]

D 653 Terminology Relating to Soil, Rock, and Contained Fluids[4]

D 1129 Terminology Relating to Water[3]

3. Terminology

3.1 *Definitions*—Except as listed as follows, all definitions are in accordance with Terminology D 653.

3.1.1 *anion*—an ion that moves or would move toward an anode; the term is thus nearly always synonymous with *negative ion.*

3.1.2 *cation*—an ion that moves or would move toward a cathode; the term is thus nearly always synonymous with *positive ion.*

3.1.3 *equivalent per million (epm)*—for water chemistry, an equivalent weight unit expressed in English terms and also expressed as milligram-equivalent per kilogram. When the concentration of an ion, expressed in parts per million (ppm), is multiplied by the equivalent weight (combining weight) factor (see *equivalent weight factor*) of that ion, the result is expressed in epm.

3.1.3.1 *Discussion*—

(1) For a completely determined chemical analysis of a water sample, the total epm value of the cations will equal the total epm value of the anions (chemically balanced). The plotted values on the water analysis diagrams described in this guide can be expressed in percentages of the total epm (although all

[1] This guide is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.21 on Ground Water and Vadose Zone Investigations.

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[2] The boldface numbers in parentheses refer to the list of references at the end of this guide.

[3] *Annual Book of ASTM Standards*, Vol 11.01.

[4] *Annual Book of ASTM Standards*, Vol 04.08.

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