

Review of HESS paper entitled:

Hydrogeology and hydrochemistry of an alkaline volcanic area: the NE Mt. Meru slope (East Africa Rift – Northern Tanzania).

By: Ghiglieri, G et al. DOI: 10.5194/hessd-8-8255-2011.

This paper discusses the occurrence of fluoride as a potential human health threat in a volcanic area in Northern Tanzania. The authors provide hydrochemical and mineralogical data upon which the origin of fluoride is discussed and related to potential hydrogeochemical reactions. Such information allows differentiating different flow path and, with them, the origin of fluoride in groundwater is related to distinct recharge areas.

In general the paper is concise, correctly organized and their discussions are sound and convincing. In my opinion, it constitutes a fair discussion of a hydrochemical. Its understanding in the appropriate geological context may provide criteria for water management in the area and to reduce human exposure to dissolved fluoride in drinking water.

Therefore, this paper has a high scientific level because of the amount of data presented, the complexity of the hydrogeochemical discussion and, last but not least, its potential application to water resources management.

Nevertheless, there are some details that, in my opinion, may improve the quality of the presented data as well as the clarity of the text. Those are the following:

1.- Point 2.2, pg. 8258, line 23. See reference to “cone group complex Nvm”. What does Nvm means? I have not been able to read it anywhere else in the manuscript. It is mentioned in Fig.1. Maybe it should be mentioned.

2.- Point 2.2, pg. 8258, line 24. “groundwater is characterized by a multidirectional flow”. Is this “multidirectional flow” controlled by the cone morphology of the volcano slope, or to large-scale geological heterogeneities, as geological contacts, faults, gravitational processes that alter the underground geological structure, ...? Please, provide a detailed opinion.

3.- Point 3.1, pg. 8260, line 20-24. The fluoride content is described in this paragraph. I would suggest to add a histogram showing the number of samples per rang of fluoride content, i.e., every 5 mg/L. Looking at Table 1, it looks like most of the samples are below 0.3-0.4 meq/L, and that those large values only correspond to very few samples. Since, later on in the paper, fluoride content is related to two major hydrogeological environments, I suggest differentiating them using a stacked vertical bar chart. Moreover, I see no problem on using meq/L in Table 1, and mg/L in the text, since meq/L unit are useful for plotting hydrochemical relationships, and mg/L are more understandable units for readers.

4.- Point 3.1., pg. 8261, line 5-8. Those lines provide an early conclusion of the paper. As a reader, when I reached this statement I thought: how? I suggest the authors to add something as: "as we will show later on, the presence of bicarbonate and sodium ions ..." or similar.

5.- Point 3.3, pg. 8262, lines 13-28. There are several questions regarding the discussion of isotopic data. Those are.

- The most common GWML is given by  $dD=10 + 8d^{18}O$ , however the authors use a similar one ( $dD= 10.793 + 8.130d^{18}O$ ) in Fig 6. Could they provide the reference for such a line?
- Why waters show dilution by infiltrated rain water? Do isotopes show this? How?
- In line 22, the authors claim that "some groundwater samples (which ones?) show higher  $^{18}O$  and  $2H$  content, and this is thought to reflect stronger influence of evaporation ...". Later on, line 26, they state that "those samples (are those the same ones as in line 18?) plot below the LMWL, indicating the importance of evaporation.... Well. Data do not show a trend of samples that move along an evaporation line of appropriate slope that support some evidence. Just a few samples have a smaller  $d$ -excess than the rest of the other ones. Moreover, if those were evaporated samples, the original water would show depleted isotopic content, i.e.  $d^{18}O < -6\%$ , so from waters recharge at great altitude. Does this make sense? Could we expect evaporation from waters recharged in the volcano summit? Please, contrast this to support, or neglect, potential evaporation processes.
- The LMWL equation been plotted from a previous reference. Why do not estimate a LMWL from your own data? I think however that samples that could represent isotopic processes should not be included. How your LMWL compare with that of Dettman et al 2005?
- About Figure 6, please add a legend. I guess that colors may refer to the geological map in Figure 1, but it should be clearly stated.

6.- Point 4.1, pg. 8264, line 11-13. Correlation shown in Fig 9 seems obvious as it compares the major anions with respect to the sum of the major cations. So a perfect correlation must appear! Nevertheless, it could be interesting comparing de relationship of alkalinity (mainly as  $HCO_3$ , I guess) with  $Ca+Mg$ , and separately, with  $Na+K$ , to point out potential geochemical differences of the cation origin.

7.- Point 4.2, pg. 8264, lines 20. Even though I also use the plot in Fig. 10 to look for exchange processes, I have always wondered if the y-axis value  $(Ca+Mg)-(HCO_3+SO_4)$  is meaningful when we deal with igneous rocks, and  $Ca + Mg$  derive from hydrolysis of feldspars and plagioclases. The plot obviously works for groundwater data in sedimentary formations; however ... it is not obvious to me that it will be adequate for igneous environments. May the authors go through my doubt (in case I was right) ?

8.- Comments to Figures:

General comment: please, include a full legend in ALL plots!

Figure 2 (pg. 8276). This ternary plots are somehow a simplification of the usual Piper-Hill diagram; nevertheless, the authors plot sodium and potassium separately as they are the major ions. It sounds good. However, could they state it in the text? Why do not put (Ca+Mg) in the third component? There are some equal-signs (=) in the legend that are difficult to understand.

Fig 3 and so on, claim that legend is as in Fig. 3. It should be Fig. 2, however ... include a full legend in ALL plots!

Fig 8.- I would suggest moving the right vertical axis (that of fluoride) to the top of the graph, and have a real Fluoride-Altitude plot in this figure. In that way, you can substitute the label with the fluoride concentration by the sample code.

Fig. 12.- Will it be possible to draw the equilibrium line Ca-F in this graph? It will be helpful to indicate fluorite saturation, and support some of your discussion.