Hydrol. Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/hess-2020-408-AC3, 2021
© Author(s) 2021. This work is distributed under
the Creative Commons Attribution 4.0 License.

Hydrology and Earth System Sciences
Discussions

Interactive comment on "Salinization origin of Souf Terminal Complex: Application of statistical modelling and WQI for groundwater management" *by* Hafidha Khebizi et al.

Hafidha Khebizi et al.

h.khebizi@ensh.dz

Received and published: 13 February 2021

Dear referee (RC2),

First, I should thank you for your precious remarks, which reflect your real interest in the new concept introduced despite the fact that you suggest to improve the presentation of the manuscript publication. I took a lot of time to discuss your remarks with the co-authors and I hope you will find more explanation in this response. Of course, I will take into account your remarks, which are very useful but some of them need just more details to clarify my idea.

For your first remark, as you know osmosis, which is a physical diffusion phenomenon, occurs when two solutions of different concentrations are placed on either side of a "semipermeable" membrane. The concentration difference causes a difference osmotic pressure, which causes the water to move through the membrane and a dilution of the most concentrated solution. The water diffuses in both sens but the most important flow (thus the net flow) takes place towards the solution more concentrated.

a- Case of Pontian groundwater Pontian groundwater hydrochemistry can be distinguished into two types as mentioned before (More concentrated zone and less concentrated zone) according to the host rock. A difference osmotic pressure occurs to dilute the most concentrated water. This can be observed in the Ca2+ and Mg2+ anions concentration in OS34-18 with respectively 240mg/l and 204,8mg/l compared the other water samples of group1 that are more enriched. For group 2, less concentration of Ca2+ and Mg2+ is mentioned in OS08-18 with respectively 205 mg/l and 153,6 mg/l. For Cl- and SO42- anions, OS21-18 presents the less concentrations with respectively 750 mg/l and 1050 mg/l. b- Case of Mio-Pliocene groundwater OS03-18 is the less concentrated on Ca2+ and Mg2+ with respectively 132,5 mg/l and 163,8 mg/l. For Cl- and SO42- anions, OS39-18 presents less concentration with respectively 700 mg/l and 1000 mg/l. In the two cases, it seems that water samples taken for analysis are situated in the limit zone of the lateral passage in the host rock from carbonate Eocene to evaporitic Senonian. In these zones the difference in the chemical element concentrations allows the osmosis phenomenon.

The osmosis formula (π=RT C/M) used by Vant'Hoff that depends on the pressure of the water is not used in this work. Our objective is limited to the qualitative interpretation of water chemistry by relating the concentration of the water samples to their geological context. For example, in the case of the dolomitic host rock, in the initial state (Time 0) at a point A: the mass concentration of Ca2 + and Mg2 + in water is due to the dissolution of dolomite by rock-water contact according to the formula Ca, Mg (CO3)2 (dolomite) + 2H2O + 2CO2 → Ca2++ Mg2++ 4HCO-3. The mineralization

includes much more Ca2+, Mg2+ and HCO-3. After a certain time (T1) and during the permanent underground circulation of water, other chemical elements appear in the water in the same point A such as Na+, K+, Cl- and SO42-. These chemical elements come from the dissolution of other evaporitic leached minerals as NaCl, KCl, MgCl, CaSO4 and MgSO4. These elements are not very dominant in point A. In the zones of the lateral lithological passage (transition zone) of the dolomitic host rock toward an evaporitic rock (Point B) the pressure difference is observed. It results by ion concentrations differences which are greater in Point B than those at point A and less important in water sample taken in the area where the host rock is evaporitic (Point D). The phenomenon of osmosis occurs in the the transition zone or the in the limit of the preferential dissolution corridors areas where the pressure difference is remarkable and intervenes for the homogenization in the chemical composition of the Pontian and Mio-Pliocene groundwater. For the quantitative linkage between the salinization and the groundwater level variation, it is important to mention the effect of the volume occupied by the evaporitic and saliferous minerals in the solid state. This volume on the scale of the host rock reflects the roof thickness, which is in direct contact with the groundwater. The permanent Water-rock contact allows the mineral dissolution and their departure, which make vacuoles in the contact zone. By the load of sand subsidence can occur simultaneously with a rise in the groundwater static level. For the introduction, I should clarify that the linkage between groundwater quality and the processes of interest (osmosis, and the associated groundwater level change) are discussed as a new result of the lithological evolution interpretation and its relation with the underground water circulation while the other indicators are introduced as a result of the classical statistical analysis methods (PCA).

Also, I think that it will be more significant as you said to organize the results and discussion tightly around each of the questions such that the readers are clear about how the scientific questions are addressed by the technical results. However, I may address your attention that at this stage of research, osmosis phenomenon and watertable static level rising are discussed as chemical and physical results of the com-

bined effect of the water- rock contact. For fig. 5 in the line 92, I may inform you the map is done by a co-author when realizing this work.

For line 107. We can list first the processes that are investigated in the introduction. For processes listed as mineral dissolution, precipitation, reverse ions exchange and anthropogenic process I should inform you that these are the systematical result of the statistical method (correlation matrix) however osmosis is introduced as a new result as I said before. For Line 109. We can briefly clarify what “standardized” refers to. For section 2.3 we will clarify the rationale of employing WQI in this study and briefly clarify how WQI is calculated in this study. To give you more detail here I may draw you attention that WOI is used to evaluate the water quality and to relate it to the geographical context. This aims by the end to make a water management recommendations. Section 3. the measurements from the sampling analysis will be shown and the uncertainties of these measurements will be clarified. for Line 236. Osmosis phenomenon is not quantified at this stage of research as I said but it is introduced as a new result in the new concept introduced (Preferential dissolution corridors) and more detail will be introduced in the final correction. For line 240-256 I will remove generalities and add the reference results/figures that support the argument in the discussion. For Fig 12, I should draw your attention that this area is not a lake. In the past water did not appear and figure shows the abnormal static level of the watertable done by the lithological subsidence. Hope my explanation is useful. Best regards.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2020-408, 2020.