

Review of HESS paper entitled: Tracing groundwater salinization processes in coastal aquifers: a hydrogeochemical and isotopic approach in Na-Cl brackish waters of northwestern Sardinia, Italy  
By: Mongelli et al. doi:10.5194/hessd-10-1041-2013

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This paper discusses the occurrence of saline groundwater- brackish waters in a coastal Mediterranean area (North-western Sardinia – Italy). The authors provide hydrochemical and mineralogical data upon which the origin of salt is discussed and related to potential hydrogeochemical reactions. Such information allows differentiating different flow path and, with them, the origin of salt in groundwater is related to distinct recharge areas, sea water intrusion and/or water rock-interaction factors. The paper is concise, correctly organized and their discussions are sound and convincing. In my opinion, the hydrogeological context will be better clarified. Its understanding in the appropriate geological context may provide criteria for water management in the area and to reduce desertification risk/processes. 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) Pg 1042, line 6: consequence of bore hole exploitation. Change in: *consequence of aquifer exploitation*.
- 2) Pg 1042, line 10: What is Nurra aquifer??? Perhaps it is better “*The aquifer present in the Nurra Region*”. Otherwise, use the correct terms for the aquifers of the study area (Ghiglieri et al. 2009)
- 3) Pg 1042, line 16: Water or groundwater?
- 4) Pg 1042, line 26: Of the Nurra or of some specific aquifer. Clarify.
- 5) Pg 1043, lines 3 and 5: The same: please clarify.
- 6) Pg 1043, line 17: change in: aquifer exploitation.
- 7) Pg 1045, line 14: Porto Torres Basin: where is in fig. 1? Perhaps, the Porto Torres Basin is referred to a geological structure.
- 8) Pg 1046, line 4: are in the cretaceous host only perched aquifer? Are you sure?
- 9) Pg 1046, lines 8-10: This period is not clear. Perhaps, it is better to define the aquifer (hydrogeological unit) with the terminology used in Ghiglieri et al. 2009.
- 10) Pg 1046, lines 12-14: where is Jurassic aquifer? Where is Calich basin? Please, define better.
- 11) Pg 1046, line 19: not clear: where is Baratz lake basin? I think that you have to better explain the hydrogeological setting.
- 12) Pg 1047, line 25: not only groundwater!!!
- 13) Pg 1048, line 19: In the legend of figure 1 are reported: sampling site and code of water sample. But in the text you write also rock sample: please add in legend of fig. 1.
- 14) Pg 1050, line 12: should also considered (Directive 98/83/EC).
- 15) Pg 1052, line 27: What is Nurra waters? Please, specify the aquifer.
- 16) Pg 1053, line 1: Please, define better the aquifer/river/lake with brackish water.
- 17) Pg 1053, lines 9, 24, 15 and 26: See comment 13.
- 18) Comments to figures:

Fig. 1 – Revise the limit and presumed limit of hydrogeological basin: it is not clear! Revise the arrow that show the groundwater flow direction. Specify better the aquifer: in the study area there are different aquifers!

Fig 2 – Reading Fig. 1 and Fig. 2, I find some difficult. I think that it will better to use the same color or fill for the geological formations. Are you sure that the groundwater flow directions reported in the sections are correct? If not, I think that it is better to delete this information from the Fig.2.

#### REPLY

As suggested by the reviewer we have modified throughout the text the terminology related to aquifers of the study area referring to the paper of Ghiglieri et al. (2009). We agree with reviewer that in Nurra different aquifers are present and correspond mostly to different hydrogeological units. In order to satisfy most of the reviewer requests and to specify the studied aquifers, we are going to insert in the manuscript the following considerations:

*Within this geological frame, several hydrogeological units as many aquifers have been distinguished by Ghiglieri et al. (2009). In particular, in the study area, the main aquifers develop (1) in a thick Jurassic carbonate sequence (corresponding to the Jurassic Aquifer proposed by Ghiglieri et al. 2009), and (2) within a carbonate and evaporitic succession of Triassic age (corresponding to the Triassic Aquifer of Ghiglieri et al. 2009). An hydrogeological unit represented by the metamorphic basement rocks is located on the west coast of Nurra district and partially acts as recharge area for the above described aquifers.*

Regarding the Porto Torres Basin, we do not refer to a hydrogeological basin but to a sedimentary basin, namely the Porto Torres half graben (Funedda et al. 2000). Therefore, in order to avoid any misleading, we'll replace the "Porto Torres basin" with "Porto Torres half graben" .

In the map of the study area (Fig. 1), we'll also indicate the position of the Porto Torres half graben and hydrogeological basins to which we refer throughout the manuscript (ie Calich and Baratz hydrogeological basins). Furthermore, we'll revise the hydrogeological boundary of the Calich basin using the limit proposed for this basin by Ghiglieri et al. 2009.

As concerns Fig. 1 and Fig. 2, therefore, we agree with the reviewer and we believe that after the corrections, the map and the related sections will be better readable.

In detail, we are going to revise the manuscript as follows:

- 1) Pg 1042, line 6. **The text will be corrected as suggested by reviewer.**
- 2) Pg 1042, line 10 **We'll use the corrected terms for the aquifer referring to the paper of Ghiglieri et al. (2009).**
- 3) Pg 1042, line 16. **As suggested by the reviewer, we'll modify the text specifying with the following sentence: "brackish groundwater and water (crop out water and lake samples)"**
- 4) Pg 1042, line 26. **We agree that in Nurra different aquifers are present, hence we modified the text as suggested by the reviewer clarifying the hydrogeological setting of the studied area.**
- 5) Pg 1043, lines 3 and 5. **See comment to point 4.**
- 6) Pg 1043, line 17. **The text will be corrected as suggested by reviewer.**
- 7) Pg 1045, line 14. **In this case we does not refer to an hydrogeological basin but to a sedimentary basin, namely the Porto Torres half Graben. In order to avoid any misleading we deleted Porto Torres basin, which was evidently though as an hydrogeological basin by the reviewer. In this way, the sentence results as follow: Porto Torres half Graben.**
- 8) Pg 1046, line 4. **The text does not affirm that within Cretaceous host rocks are only perched aquifer.**
- 9) Pg 1046, lines 8-10. **See comment to point 2**

- 10) Pg 1046, lines 12-14. **We'll consider the Calich basin as the hydrogeological basin proposed by Ghiglieri et al. (2009) and we'll indicated it on the map of the studied area.**
- 11) Pg 1046, line 19. **We'll indicate the Baratz hydrogeological basin on the map and will modify its hydrogeological boundary.**
- 12) Pg 1047, line 25. **The text will be correct removing the "groundwater" word.**
- 13) Pg 1048, line 19. **As suggested by the reviewer, we'll modify the legend of Fig. 1.**
- 14) Pg 1050, line 12. **As suggested by the reviewer, we'll also consider the directive of the European Council concerning the quality of water intended for human consumption (Directive 98/83/EC).**
- 15) Pg 1052, line 27. **The aquifer will be specify according to the paper of Ghiglieri et al. (2009).**
- 16) Pg 1053, line 1. **We will use the corrected terms referring to paper of Ghiglieri et al. (2009).**
- 17) Pg 1053, lines 9, 24, 15 and 26. **See response to point 16.**
- 18) Comments to figures:
  - Fig. 1 – **We'll erase in the map the arrows showing the groundwater flow direction. As required, the aquifers and the boundary of the hydrogeological basins will be specify referring to the paper of Ghiglieri et al. (2009). We also consider a new hydrogeological basin (the Baratz hydrogeological basin), whose limit will be redrawn.**
  - Fig 2 – **We have accepted the reviewer suggestions and therefore we'll use the same color for the geological formations of map and sections. Finally, we'll erase the groundwater flow directions reported in the sections.**

Reference cited:

Funedda A., Oggiano G., Pasci S. (2000) The Logudoro basin: a key area for the Tertiary tectono-sedimentary evolution of North Sardinia. *Boll. Soc. Geol. Ital.* 119, 31–38.