First of all, we would like to thank the reviewer for his help improving the paper. Reviewer' comments are in italic, our answers are in bold.

Referee comments #1

General comments

The manuscript presents a study in which lab and numerical experiments were conducted to study the influence of rock fragments on soil hydraulic conductivity. It is interesting to use 2D numerical simulations to study the influence of rock size and shape on soil hydraulic conductivity. However, some conclusions in this research were not convincing or at least drawn rashly for the reasons below:

(1) Lab experiments have no sufficient replications: **4 more replications with rock fragments for Rv 0-20-40-60% were conducted. Results are slightly modified but the global trend of a linear increasing of Kse with Rv is confirmed (Kse-Rv60% significantly greater than Kse-Rv20% and Kse-Rv0%).**

(2) The authors knew that the influence of new created voids were not considered in numerical experiments but neglected this point when evaluating the effects of rock size and shape. **The numerical simulations aim at showing the shape and size influence only. In fact, shape and size could have a different impact on soil structure modification and so on hydraulic conductivity but since we – the research community – do not have information about the link between these two factors, it cannot be modelled. Besides, voids creation is a suggested phenomenon to explain Kse increase but it has not been observed directly here and can thus not be included in prospecting simulation. The text has been modified to express more clearly that shape and size are studied as individual factors even though they can have a different impact on soil porosity while comparing numerical simulations.**

(3) There are not enough comparisons between the results herein and those in literature, especially the contents about the soils with glass beads and the results on unsaturated hydraulic conductivity. **This will be addressed with text modifications**

The manuscript is not written concisely and logically. There are also some grammar errors. Therefore, I am not convinced that the manuscript can be published in its current form.

Specific comments

(1) Why not conducted evaporation experiments with more rock fragment contents? I think experimental results can be more convincing than the simulated data for the great influence of possibly new created voids by stones shown in Figure 1. **As mentioned in the text, with a Rv greater than 20% it is quite impossible to insert tensiometers in the samples. Indeed, given that small variations of the hydraulic gradient can lead to substantial changes in the hydraulic conductivity estimates, the tensiometers should be ideally positioned out of the direct influence of one particular stone in order to obtain generalizable results. This implies the need for relatively low stone contents (< 30% according to Zimmerman and Bodvarsson (1995)).** *Because only the effects of reducing cross sectional area for water flows and increasing the tortuosity of water flow paths were considered in the numerical simulations, I don't think the*

conclusion "Indeed, under unsaturated conditions, the models seem to represent the hydraulic behaviour of stones reasonably well" in abstract can be drawn from the results in this research. **We performed 2 replications of evaporation experiments at 0 and 20%, which can help observe a trend and draw some conclusions about unsaturated mechanisms. The fact is that for unsaturated experiments, the presence of inclusions tends to conduct to similar results than those predicted by models for both our replications. But as the reviewer points, we do not have enough measurements to conclude so drastically.**

(2) In the manuscript, there are no replications of the experiments to measure K_{se} with different R_v. I don't think the explanation ("We did not perform any replications since the setup was totally artificially controlled") in the manuscript is sufficient. Normally, the variation of the saturated hydraulic conductivity of stony soils is greater than other soils, and thus at least three replications are required to obtain the representative values of K_{se}. **Four more replications with rock fragments for Rv 0-20-40-60% were realized. Results are slightly modified but the global trend of a linear increasing of Kse with Rv is confirmed.**

(3) What is the size of glass bead used in experiments? Without replications, the reliability of the experimental data of soils with Glass Balls in Figure 1 is questionable. **Glass beads are 1cm in diameter. Glass beads were used to check rock shape and perviousness influence on our conclusions about Kse. Since results with glass beads show similar trend than the 5 replications with rock fragments, we can say that it is not the rock fragment itself that produces bigger Kse, but the presence of a certain volume of inclusions (and probably the sampling procedure and soil texture). The difference between these types of inclusions could indicate that shape has an influence. These elements are further investigate through numerical simulations.**

I am surprised the almost linear increase of K_{se} with R_v, even at the range of low R_v, for soils with glass beads, which is so different from the results of Peck and Watson (1979) and Ravina and Magier (1984) and the numerical results with circular inclusions in this research. Please explain it. **First, Peck and Watson (1979) used an analogy (based on heat flow theory) to express the variation of bulk hydraulic conductivity with stone fraction, but their results do not lie on hydraulic conductivity measurements. We can also explain the differences with other research results by the procedure of sampling, the soil texture and inclusions nature. Concerning Ravina and Magier (1984) results, it has to be noted that they got similar results for compacted soils with rock fragments. Their sampling procedure is not described in details, but we could suppose that our sampling procedure and the bulk density we reach induce a compaction of the soil and similar results than Ravina and Magier (1984). For the differences with numerical simulations, it seems quite logical to say that they come from the fact that inclusions have an impact on soil structure, which is not directly modelled. It can be seen as a supplementary clue for voids creation in rock vicinity.**

(4) Which data were used in Figure 1 to represent numerical experiments? If the data from all the numerical experiments of soils with different sizes and types inclusions were used, why not show error bar in the Figure 1. **Results from numerical experiments in figure 1 are coming from numerical simulations with 12 circular inclusions. We'll add this information in the legend of the figure.**

Maybe we can confirm from Figure 2-4 that the shape and the size of inclusions have influence on K_{se}, but compared to Figure 1, I cannot draw the conclusion "the shape and the size of inclusions have a significant effect on K_{se}" on line 12 in page 1119. **The reviewer is right, we have no mean to say it has a significant effect. We can observe that these factors (could/fig 1.) have an impact (fig 2-4).**

(5) Generally, there is a problem when inserting a tensiometer into a stony soil with influence on soil structure as little as possible. I am interested of the size of the tensiometers used in evaporation experiments, when and how did the authors placed them in stony soils. It should be

explained in more details in the main text. **As now mentioned in the text, tensiometers are 6 mm in diameter and 24.9 mm long. Tensiometers are inserted when the soil is saturated. A pin with similar dimensions has been used to make a hole in the soil and facilitate tensiometer insertion.**

(6) Most of the stony soils in literature are coarse texture. However, the soils used in this research have high clay content (55%). Soil texture may considerably affect the relationship between soil hydraulic properties and Rv. The possible effect of soil texture on the surprising result in Figure 1 (if it is true) should be discussed. **We will develop a discussion about soil texture in the revised manuscript.**

(7) As for the influence of new created voids by stones, no new insights or explanations were given in this research. Whether in virtual evaporation experiments or in permeability test, the influence of new created voids was not considered. The authors mentioned to use X-ray CT to study the influence of new created voids. It is a good idea but unfortunately they did not conduct in this research. I suggest removing this part of contents and concentrating this research on the influence of rock size and shape, which may change soil tortuosity or influence zone area overlapped. It is better to add figures to show the rock arrangement in soils for each treatment of virtual experiments. **In fact, voids have not been observed directly in our experiments. But it has been observed by other researchers (Ravina and Magier, 1984). We think that it is a high plausible explanation considering our observations, but it is not presented as a truth. The text has been modified to better express author's opinion regarding voids creation.**

(8) Some sentences are difficult to understand and there are also some grammar errors such as:
Line 19 in page 1112, "permeameter tests" should be "permeability tests".
Line 23 in page 1115, "permeameter experiment" should be "permeability experiment".
The sentences on lines 5-12 in page 1114 are not clear.
Line 2 in page 1117, "Beibei et al. (2009)" should be "Zhou et al. (2009)".
Line 29 in Page 1118, "E.g." should be "For example" .
All these expressions will be modified following the reviewer comment.

(9) The size of soil columns used in lab experiments should be added. **The experiments were performed over cylindrical Plexiglas samples of 1 L (height: 65 mm, diameter: 142 mm)**

(10) The names in the references are wrong. The correct formats are
Zhou, B.B., Shao, M.A. and Shao, H.B.: Effects of rock fragments on water movement and solute transport in a Loess Plateau soil, Comptes Rendus Geosci., 341, 462–472, 2009.
Ma, D.H. and Shao, M.A.: Simulating infiltration into stony soils with a dual-porosity model, Eur. J. Soil Sci., 59, 950–959, 2008.
Ma, D.H., Zhang, J.H., Shao, M.A. and Wang, Q.J.: Validation of an analytical method for determining soil hydraulic properties of stony soils using experimental data, Geoderma,159, 262–269, 2010. **All these expressions will be modified following the reviewer comment. We'd like to precise however than in the paper "Effects of rock fragments…" it is indicated to cite it as Beibei et al. (2009). We are a little bit confused about the way to cite it eventually.**

(11) Normally, tortuosity factor l = 0.5 in van Genuchten model. In Table 1, the authors used l = -0.135. Why? **The parameter has been fitted on measurements. It is not rare for l to be negative when fitted to data (see Hunt A.G., Ewing R.P., Horton R., 2013. What's wrong with soil physics? *Soil Sci Am J* 77, 1877-1887).**

(12) The contents in Table A1 are repeated in Figure 2-4. I suggest removing it.

(13) The evaporation method is well known for measuring unsaturated hydraulic conductivity. I do not think it is needed to describe it with so many words in page 1111. **The text will be simplified.**