We thank Mr. Andersen and Mr. Vissers, for the attention they paid at reading our work. Their useful remarks surely help to improve the quality of the manuscript. Below are exposed the several point highlighted by the referees. We took the greatest care to satisfy those comments by changing, deleting and adding parts of the manuscript.

Color code:

Blue: referee's comment

Red: New portion of the manuscript in response of the referee's comments

Green: citation of the submitted manuscript

Black: Our Answers to the referees

Reply to the Interactive comments by R. Vissers (Referee)

- We agree with Mr Vissers that the manuscript could benefit from *"A clearer statement on the age of the rifting in the introduction".*
We added the following lines in the introduction:
"Triassic and Jurassic aborted rifting events predated the development of a major Cretaceous crustal thinning event, which culminated in the crustal separation between the Iberia and European plates [Puigdefabregas and Souquet, 1986; Vergés and Garcia-Senz, 2001]. Continental rifting in the Pyrenean domain occurred in response to the counterclockwise rotation of Iberia relative to Europe, coeval with the onset of oceanic spreading in the Bay of Biscay between Chron M0 and A33o (approximately 125–83 Ma) (Le Pichon et al. 1970; Choukroune and Mattauer 1978; Olivet 1996; Gong et al. 2008; Jammes et al. 2009). After an early rifting episode during the Late Aptian, narrow, nonconnected Albian basins opened north of the basement of the Pyrenean Axial Zone, along a wide domain opened between Iberia and Europe [Choukroune and Mattauer, 1978; Olivet, 1996; Jammes et al., 2009]. They connected together during the Cenomanian when the rift zone became wider and deeper. The main infills of the basins are dark-colored, pelites, sandstone, and breccias deposits, referred to as "Flysch noir" or "Flysch ardoisier" in the literature [Debroas, 1976, 1978, 1990; Souquet et al., 1985). The Black flysch is organized into three megasequences (I, II, and III), which are the records of three successive steps in the opening of the basins. Megasequence I corresponds to the opening of narrow half grabens, megasequence II registers the opening of en echelon 10 km wide basins, and megasequence III records the coalescence of the basins into a large trough with internal and external parts separated by central highs [Debroas, 1990)."

- Thirdly, there is current debate about the kinematics of Iberia motion with respect to Europe, in which the development of the margins and the metamorphism should in some way fit.
According to the suggestion of Mr Vissers, we added a paragraph to present the 3 main

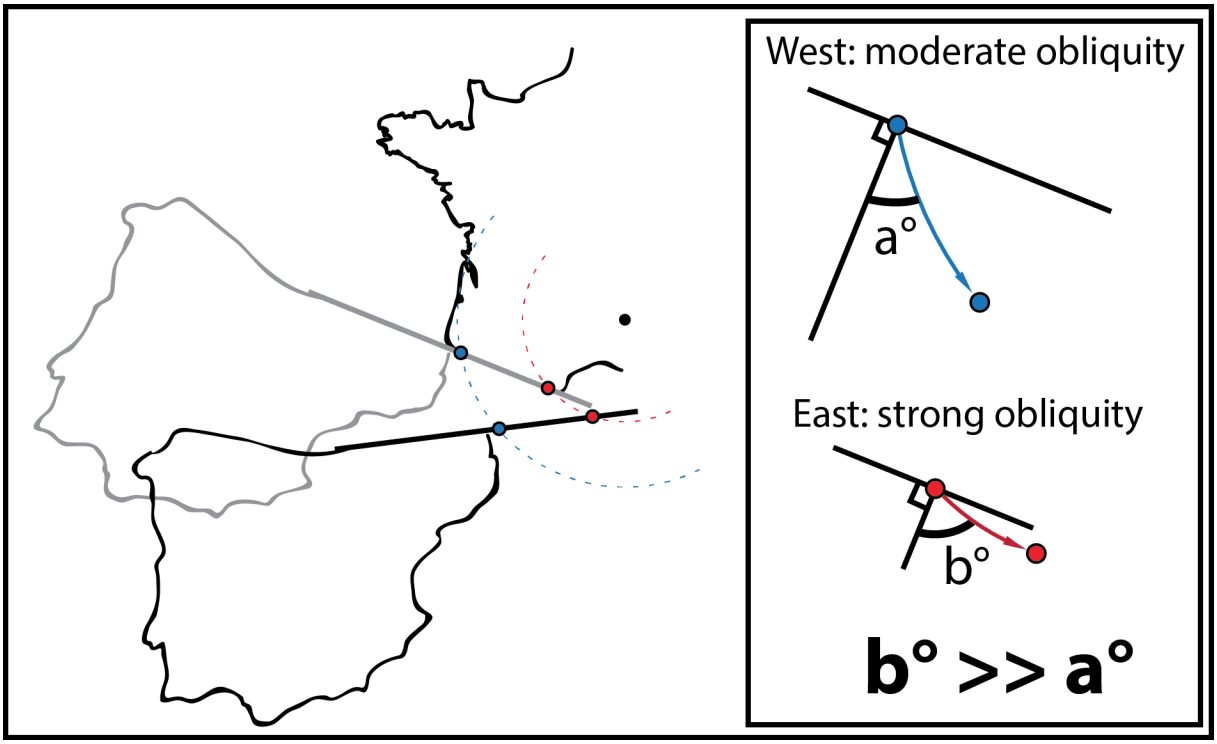
types of kinematic models debated for the Iberian plate:
"The Kinematic of the Iberian plate during Aptian-Albian and younger Cretaceous times is still strongly debated (Olivet 1996; Sibuet, Srivastava, et Spakman 2004; Jammes et al. 2009; Vissers et Meijer 2012b; Vissers et Meijer 2012a). Three main types are generally opposed: (i) the Transtensional rift model (Choukroune et Mattauer 1978; Olivet 1996), which involves a dominant left-lateral strike-slip along the NPF. (2) A scissor-opening model, which implies the existence of an important subduction beneath the Pyrenean belt (Srivastava et al. 1990; Sibuet, Srivastava, et Spakman 2004; Vissers et Meijer 2012b; Vissers et Meijer 2012a). (3) And a model implying most of the left-lateral movement during the Jurassic to Aptian times followed by orthogonal extension during Albian to Cenomanian times (Schettino et Turco 2010; Jammes et al. 2009)."

- I suggest that the concept of heating during hyperextended margin formation might benefit from a reference to a recent modelling study by Huismans and Beaumont 2011, in particular of their type I margins inspired by the west Iberia-Newfoundland conjugate margin system. Their modelling of this type of margin development suggests some but not extensive heating, hence suggests that hyperextension is not a necessary requirement for the metamorphic conditions observed.
I am not sure to understand properly that comment. One of the points of this paper is to put forward the existence of "hot margin" that oppose to the rather "cold" Alpine and West-Iberian margin. So yes, we do agree with Mr. Vissers that HT-LP metamorphism is not systematically associated to hyperextension. However, in the Pyrenean case, there is a convergent bunch of arguments in favor of an important extensional event (numerous basins filed with thick catastrophic sedimentation, alkaline magmatism, mantle exhumation) coeval with the HT-LP metamorphism.
To clarify our point about "cold" versus "hot" margins already introduced by Clerc et al., 2014, we added a new paragraph:
"7. Hot versus Cold margins ?
Direct acces to the present day passive margin is limited by thick sedimetary deposits and information about the thermal history of the margin are hardly gathered. The use of fossil margins exposed in mounbtain belts offers a unique opportunity to study the metamorphic imprint of the extension. However, when not overprinted by the subduction metamorphism, the Alpine analog indicates only low grade metamorphism. At present, very few examples of hot passive margin presenting evidences of exhumed subcontinental mantle or deep crust have been reported. In the Zagros mountains, mapping reveals that pre-rift cover and mantle have been early superposed in the Kermanshah ophiolite (Wrobel-Daveau et al. 2010), where high temperature are recorded in the Mesozoic sediments along their contact with the peridotites (Hall 1980). In the Zagros of Iraq (Jassim et al. 1982) described a similar metamorphism affecting sediments close to exhumed ultramafic rocks with temperatures up to 750°C over 2,5 km thickness. In the light of our results, we propose a distinction between "cold" Iberian or Alpine-type passive margins and "hot" Pyrenean – type margins The cause of this thermal variability along passive margins is still unclear. I could be explained by several factors such as the kinematic context (transtension versus extension), the mantle dynamics (hot versus cold mantle), the sedimentary input or the extension rate."
To push forward the discussion initiated by Mr Vissers, we would like to highlight the results of the recent seismic tomography obtained by Chevrot et al. (2014a, 2014b) that discard the existence of a slab below the Pyrenean range. If confirmed, these results are

in opposition with the model proposed by Vissers and Meijer 2012a, 2012b). Furthermore, and since the work we propose in this manuscript is based on field geology, I shall insist on the fact that absolutely no field evidences have yet been reported that would indicate convergent motion during the Albian-Cenomanian times.

- « *One explanation (ii on page 814) for the regionally higher metamorphic grade seen in the eastern Pyrenees supposes different kinematics (transtensional) in the east as opposed to orthogonal extension in the west, and again this relies heavily on the overal tectonic setting and kinematics of the Iberian plate. I find it difficult to visualize this scenario without further explanation, because the adjacent continental domains of Iberia and Europe do themselves not significantly deform. So why are the kinematics in the east and west different?* »

To make it clearer, we added a few lines in the text and added a new figure (in replacement of previous fig.6). « *As exemplified on fig. 6, a rotation pole for the Iberian plate located anywhere on the Northeast of the NPZ leads to differential movement with the strike-slip to transtensional extention in the Eastern domain and orthogonal to oblique extension in the western domain.*"



An other process that could account for the discrepancy between eastern transtension dominated system versus western orthogonal extension dominated system is the possible partition of the regional strain into several opening basins (future NPZ,Parentis, Cameros, Le Danois, Basque-Cantabrian and Organya-Pedraforca) separated by small rigid blocks (Landes High, Ebro Block).

In the text, we made our description more precise:

"*Regional strain partitioning of a transtensional kinematic into orthogonal extension and transcurrent movement within the future NPZ, the Parentis, Cameros, Le Danois, Basque-Cantabrian and Organya-Pedraforca basins may explain the localization of the HT-LP metamorphism in the basins dominated by transtensive movements (central and eastern*

NPZ, Nappe des Marbres, fig., 4) whereas extension under cooler conditions is registered in the basins undergoing a dominant orthogonal extension (Mauléon basin, (Jammes et al. 2009; Jammes et al. 2010; Masini et al. 2014; Masini et al. 2014).

- "Again, with my previous comments in mind, the question arises in how far the inferred rifting and development of a hyperextended margin is conclusively confirmed by the metamorphic data. In my view the metamorphism may be consistent with extensional scenarios, but as mentioned before, one might consider alternatives that can possibly not be discarded on the basis of the observed "metamorphism and its timing. »

The HT-LP metamorphism on its one does not constitute an argument confirming the existence of an Albian to Cenomanian hyperextension. The extension at this age is suggested by the coeval manifestation of i) the opening of deep Albian-Cenomanian basins infilled by catastrophic sedimentation; ii) the alkaline magmatism well distributed over the NPZ; the exhumation and sedimentary reworking of ultramafic sub-continental peridotites (e.g. reworked in Cenomanian sediments at Urdach).

In opposition, the first convergent movements observed in the Pyrenean domain are not identified before the Santonian, which corresponds to the very end of the HT-LP metamorphism recorded in the NPZ. (section 2. *"Considering that the onset of the convergence in the Pyrenean realm is estimated to occur during the Santonian (Garrido-Megias & Rios 1972; McClay et al., 2004) the pre-Santonian radiometric ages obtained for the HT metamorphism are in agreement with a pre-convergence event (figure 3)."*)

Our different conception of the tectonic signification of the HT-LP metamorphism with the Mr Vissers may resid in the different ages retained for the onset of the metamorphic event in the NPZ. e.g.: in the fig.9 of Vissers and Meijer, 2012; the authors consider a short metamorphic event starting during the Cenomanian. However, in the present study, we report earlier ages (early Albian) and suggest that this metamorphism is related to the even older metasomatic alteration of the Paleozoic basement (Aptian-Albian)

Technical corrections:

- We added a sentence referring to our age dating work in the introduction: "We provide 18 new ^{40}Ar-^{39}Ar (amphibole, micas) ages and 1 U-Pb (titanite) age from metamorphic and magmatic rocks of the North Pyrenean Zone".

- Figure 3: There seems to be a misunderstanding about the fading orange color field. As stated by the small number "12" written on it, this orange field refers to the ages obtained by U-Pb (titanite in albitites) by Fallourd et al. 2014. We agree that it was not clear enough. We now specify it in the caption.

- Figure 4: Yes ! We now present the data in stereoplots.

- Figure 6 did not bring any essential information for the paper. We decided to replace it by a figure that gives an example of the variability of tectonic motion along the future NPZ. In this figure, we show that with a single pole of rotation for the Iberian plate, one may coevally observe a limited obliquity in the Western domain and a strong obliquity in the Eastern domain.

- Figure 7 and 8: Yes! We corrected this mistake.

- We corrected and added the missing co-authors of Sibuet 2004.

Chevrot, S., et al. (2014a), High resolution imaging of the Pyrenees and Massif central from the data of the PYROPE and IBERARRAY portable array deployments, J. Geophys. Res. Solid Earth, 119, 6399–6420, doi:10.1002/2014JB010953.

Chevrot, S., Sylvander, M., Diaz, J., Ruiz, D., Paul, A., and the PYROPE Working Group (2014b), The Pyrenean architecture as revealed by teleseismic P-to-S converted waves recorded along two dense transects, in revision to Geophys. J. Int.