

Interactive comment on “Inversion tectonics: a brief petroleum industry perspective” by Gábor Tari et al.

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Response to the comments made by Gábor Bada (Referee) We really appreciate the positive and constructive comments made. We will make all the required changes to produce a final version. Here are the specific responses to the comments. Specific comments in italics and answers: "The paper needs a somewhat better definition of scope and rationale. What is the focus: more descriptive or process oriented or covers both?" We will try to spell this out better in the introduction. It is a more like a descriptive and practical approach what we aimed for in this decidedly brief overview. "The authors' definition for inversion (lines 73-74) is inevitably a bit loose which is inescapable. What is the scale of anticlines? Would fault-bend anticlines qualify whereby main deformation is taken up my reverse faulting rather than 'pure' folding? Where is

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the boundary between complete basin inversion and onset of (over)thrusting and nappe formation in former extensional settings (passive margins becoming active margins to the extreme). Little chance to get to a generally accepted definition though." We want to stick to the original definition, so a fault-bend fault anticline cannot be regarded as an inverted feature as typically the thrust fault plane does not have an earlier extensional movement on it. The second part is a good question, i.e. where to draw the line between regional and "complete" inversion and development of a folded belt. This is beyond our discussion as it involves other issues as well, such as reverse faults versus nappe contacts, etc. We will not be able to address these in this paper. "The authors present the seemingly surprising statistics of underreported inversion cases for trap forming mechanism using the IHS Markit database. This goes back to the practical value of its definition. Compression is generally easy to recognise but applying the definition of inversion, whatever that is, is another matter. Support with data the statement that "inversion tectonics appears to be somewhat overrated in exploration" (lines 115-117)." A similar point was made by another referee. We cannot quantify this statement with the IHSMarkit data base as it would require pre-drill versus post-drill analysis. In our experience, In our experience, inversion is generally used as a positive "selling point" in the prospect evaluation process. Our IHSMarkit data does not capture assumed overall positive effects of structural inversion by explorationists, but rather the disinterest by development geologists and petroleum engineers who inherit the subsequent appraisal and development project. "The Pannonian case studies are well presented and discussed. Large-scale uplift of Transdanubia deserves some more details. Is it due to lithospheric/crustal buckling as a result of horizontal compression, or perhaps isostatic adjustment due to lateral variation of preceding extension? In addition, as shown in several cases in a hot yet thermally disturbed lithosphere a few hundreds meters of uplift has a significant footprint on maturation. What is the impact of 800 to 1,000m estimated uplift at the Lovászi field? How do inverted extensional faults and newly propagating reverse faults behave in terms of fluid migration and subsequently what is their seal capacity? These aspects may merit a few paragraphs of

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additional discussion. Figure 7a needs visual improvement. Highlight with colour the main stratigraphic units so that "... the thickening/thinning geometries within the Upper Pliocene (Pannonian) strata in the apex of the anticline show the switch from extension to compression" (lines 175-177) hits the eye and hence becomes more apparent for the reader." Good points, we will extend the discussion on this. But, admittedly, we do not have quantitative results as it would require proper basin modelling studies on the Lovaszi Field... We are not aware of such a study to date. We believe that this situation illustrates our general point, i.e. since it is an existing field, development experts probably did not see the value of trying to address the issues revolving around the inversion-caused origin of the accumulation. "The East Med case studies are also educative – well written with sufficient details. Figure 9 is hard to read, increase resolution (presumably, printed version will be clearer) and find more distinct symbols for depicting the two inversion phases." "Sections 6 and 7 provide an excellent summary on the implications of inversion on petroleum systems and exploration. A couple of specific discussion points to consider further: Negative impact of inversion tectonics: even significant uplift, if reservoirs sealed properly, or self-sealed, may have positive impact such as enhancing reservoir energy (overpressure) and dewatering (tight gas in the Rockies), gas segregation in biogenic setting (see examples in PanBas), etc. Good points, we will extend the discussion on this. Extend discussion on the impact of thickness difference of syn-rift vs post-rift sediments. Good point, we believe that this is an original observation in this paper, so we will extend the discussion on this. Inversion often results in anticlines high above blind reverse faults within the 'basement' – clarify further how charge occurs in such unfaulted traps. Good point, we will extend the discussion on this, i.e. vertical migration, sub-seismic faulting, etc. Elaborate further the role of the trend of inverted structures vs regional dip as per Tari and Jabour (2011). The current paper presents only a brief summary of this relevant topic without explaining the causes." Indeed, we will extend this part of the paper, perhaps even adding some illustrations from Morocco.

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