

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

**Michael Gardosh (Referee)**

mikig@energy.gov.il

Received and published: 1 May 2020

General comments:

1. Unifying theories and generalized concepts form an essential part of our 'tool-box' as earth scientists and explorationists. Their predictive power is extremely important to our ability to reduce risks and increase the chances of success in looking for oil and gas reservoirs. The authors are doing a good job in highlighting the need for such concepts in the context of Inversion and the investigation of Inversion Structure with a petroleum system perspective in mind. Some of the principle relations between structural evolution and hydrocarbon accumulations in selected case studies are well presented and summarized in this manuscript, thus forming an excellent basis for the

C1

continuation of research in this highly important subject for the petroleum industry.

2. Although the goal of the manuscript is to provide a high-level view on the subject matter it is focused on the later, contractional phase of the Inversion story. The review can benefit from the addition of some more details on the potential source rocks and migration patterns of hydrocarbons associated with the case studies discussed, where available. Although these are typically more difficult to describe, their inclusion can clarify to the reader the relations between the extensional and contractional phases as shown in figure 12 or their lack of, in the various examples presented.

3. The authors selected the Syrian Arc structures of the Levant region as a principle case study for their review. This selection is understood, as these structures are important from the industry's point of view, hosting some of the largest accumulations of gas found in the last 12 years worldwide. However, it should be noted that while Syrian Arc structures were extensively investigated by many workers in Egypt, Israel, Lebanon and Syria the understanding of their overall tectonic evolution is still incomplete. The age of the extensional phase in various individual structures is ranging from late Paleozoic to Mid Jurassic and in some structures there seems to be negligible or no extension (e.g. southern Israel, Palmyrides), whereas the contraction is ranging from Late Cretaceous to Late Neogene; in both cases roughly 100 million years for each. In view of this complex geologic history it appears that lessons learned from a specific case study can be applied only to other structures with similar geologic characteristics and not to the entire fold system.

Specific Comments:

1. Line 123- Should be ...Hungary: Lovaszi and Budafa oil and Gas Fields.

2. Line 190- the age of Syrian Arc deformation cited from Walley (1998) is incorrect. Walley refers to a first phase of contraction during the Coniacian-Santonian, while its second phase is of Late Eocene to Late Oligocene. It should probably be added here also that later studies, particularly offshore Israel show the second phase to extend

C2

until at least the middle Miocene as described by Needham et al., (2017) and in chp. 5.2.

3. Line 214- ...are found predominantly in the offshore part. ...as there are other Syrian Arc structures inland (Israel and Syria) that were active during the late contraction phase.

4. Line 224- the recoverable reserves in the Tamar Field noted by Needham et al (2017) are ~11 TCF (for late 2016). In early 2019 the Israeli Ministry of Energy estimated the reserves as 8.5 TCF.

5. Lines 335-336 - The authors state, "closures typically cluster above the extensional depocenters which tend to contain source rocks providing petroleum charge. ....". This conclusion is not well supported by the case studies presented.

6. Lines 351-354 highlight the "importance of source rocks not being constrained to the syn-rift basins" in contrast to the previous statement (Lines 335-336). The ms will benefit from a more comprehensive discussion on the position of source rocks and their relation to the Inversion story in various cases. Two end-members may be described one with source rocks within the inverted system and one outside of it.

7. Chp. 8- This chapter is not a typical Conclusion chapter but rather an extension of the discussion. It is advised to re-write it summarizing the previously discussed issues.

Comments on Figures:

Fig. 3- The right-hand side of the map does not include any relevant information, if possible crop it out. Mark the location of Sava Folds and Budafa+Lovaszi Fields/Structures. Mark the location of seismic lines and sections in following relevant figures.

Fig 4- Add well names or field names in seismic section.

Fig 5- Indicate location of seismic line in map.

Fig 6- Indicate location of section in map.

C3

Fig 7- Label thickening/thinning geometries in seismic lines or describe in caption.

Fig 8- Correct misspelling in caption- Israek.

Fig 14- Add description to abbreviations and explain in the caption or in text the difference between the two methods of calculation.

A version of the text with additional minor corrections was sent in PDF file to G. Tari.

---

Interactive comment on Solid Earth Discuss., <https://doi.org/10.5194/se-2020-33>, 2020.

C4