Solid Earth Discuss.,
https://doi.org/10.5194/se-2020-33-RC1, 2020

Solid Earth Discussions

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

William Bosworth (Referee)

bill.bosworth@apacheegypt.com

Received and published: 18 April 2020

General Comments:

The differentiation between basin-scale and prospect-scale inversion structures is of fundamental importance to both hydrocarbon exploration and the interpretation of a region's tectonic and local structural histories. The manuscript does an excellent job of highlighting and explaining these differences. Documenting the relationships between the extent of inversion and the associated exploration risks and rates of success is of paramount interest to the petroleum industry. Both general themes will be of broad international and cross-disciplinary interest. The authors identify and discuss the bias in industry reporting of "inverted" versus "folded" structures and corresponding hydro-

carbon accumulations. This is an extremely interesting and important observation.

The figures are all very well done, informative and necessary. The referencing is quite extensive and up-to-date.

Specific Comments:

Section 3; circa line 115: Perhaps another contributing factor to the shift in terminology from the exploration to production domains is the nature of the geoscience and engineering teams involved. Explorationists are typically stronger in subjects such as regional geologic synthesis, tectonics, paleogeography, etc. Development and production teams focus on detailed fault patterns, reservoir connectivity, fluid flow, etc. Whether a structure originated via straight-forward contraction or inversion might not even be part of a development geologist's everyday working vocabulary, nor critical to how they develop and produce a field.

Section 6: another positive aspect of inversion features relates to intra-basinal folds that form during inversion events early in a rift basin's structural history. The authors have described inversion structures that formed after a major phase of extension (the classic geometry). But most of the basins of North Africa are actually multi-phase in origin. This has resulted in the formation of inversion-related traps that were subsequently covered by later generations of syn-rift strata. Hence, these old anticlines pre-date any migration, were covered by later top seal even if initially breached, lie above the first phase of source rock deposition, and are perfect exploration targets. The best example of this in North Africa's petroliferous basins is the "Cimmerian" event, discussed briefly by Lucic and Bosworth 2019, although they don't go into trapping details or specific examples. So for multi-phase extensional basins intervening periods of inversion can be a very good thing.

Figure 8; the "limit of Syrian Arc structures" is perhaps a bit misleading. Very nice folds and reverse faults and an associated unconformity have been documented in the southern Gulf of Suez (late Santonian main phase shortening; Bosworth et al., 1999,

Geology v. 27). Since that paper was written we have found several other even larger examples (wavelengths 100's of meters), previously attributed to other deformation mechanisms/events. But all of these are of course much smaller than the classic features on your map. Your limit is for kilometric scale structures; it makes sense that the amount of deformation gradually declines to the south and not abruptly. The smaller central and southern Gulf of Suez features are not necessarily "inversion" structures sensu stricto, but they are Syrian Arc structures in the broader sense of the term.

Minor Technical Corrections:

Line 34: "lots of work" might be replaced with "significant work" or "numerous studies". Line 77: this is a half graben not a graben in the figure, both b and c. Line 116: I don't think "overrated" is appropriate. "Overstated" would be better. Line 135: change "from the W" to from the west. Line 153: "oriented perpendicular". Line 157: change "enough the properly" to "enough to properly". Line 238: "which was deposited". Line 244: change "there are lots of publications are devoted" to "numerous publications are devoted". Line 301: "their view might also be somewhat". Line 302-303: "there is plenty of evidence".

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