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Interactive comment on "Influence of basement heterogeneity on the architecture of low subsidence rate Paleozoic intracratonic basins (Ahnet and Mouydir basins, Central Sahara)" *by* Paul Perron et al.

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Preliminary remarks:

Though I have been working on the Paleozoic of the Algerian Sahara for many years (1987-2006) I am only familiar with the Devonian and Carboniferous, but not with the older formations and the crystalline basement. Therefore, I can only judge these aspects of the above manuscript. Likewise, I feel not competent enough to consider some tectonic reconstructions. I hope that the other reviewer(s) are able to review these as-

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pects of the manuscript with a better competence.

The manuscript is an overview of the bio- and lithostratigraphic, sedimentologic, paleogeographic and paleotectonic evolution of the Ahnet-Mouydir area in southern Algeria based on field data from previous authors, well log analysis, satellite images and geophysical data. As such it is a good summary of the evolution of a marginal basin-and-ridge system which farther north in central Algeria has yielded enormous oil and gas reservoirs.

Detailed critical remarks

Title: The research areas covers a much larger area (including also the Reggane, Basin, Illizi Basin, Hoggar Shield) than expressed in the title. This should be made clear in the title.

Line 20: Pan-African orogeny. Strictly spoken this was around 600 MA, but including earlier phases it was 900-520 MA. What do you mean exactly?

Line 35: “Devonian compression”. I consider this as a mere speculation. According to all previously gathered data the Devonian was a period of tectonic quiescence accompanied by slight extension.

Line 52: 7 m/MA. Give reference.

Line 61: 16 million km2. Impossible! The entire Sahara occupies about 9 million km2.

Line 121 ff. and 133: It is not clear if the authors have ever been in the field; equivalent data seem to be based on previous published sources only. This should be made clear unequivocally.

Line 141: Please separate both calibration of well-logs by palynomorphs (which are poorly reliable biostratigraphic markers) and field sections by conodonts (which give by far the best time resolution), goniatites and brachiopods. Both biostratigraphic subdivisions can be only roughly be correlated.

Line 144 (and later): “Synsedimentary extensional and compressional markers”: This means during the Devonian and Carboniferous. On which evidence these important tectonic events are based? Apparently not on field data. During about 9 months of personal field work I followed typical marker levels (e.g. the upper Eifelian/Givetian limestone ridge) for tens of kilometers (walking from ridge into basin deposits), but I have never seen something like that. The observation of doubtless Hercynian faults does not automatically allow the conclusion that they are rejuvenated earlier structures.

Line 146: Outcrop sections O1- O12 cannot be detected in Figs 9 and 10. Are they personal field data? Position of well logs W1-W21 can only very roughly be located from Fig. 3A. Given the importance of these data (which apparently have never been published previously) it is absolutely necessary to indicate individual coordinates (best as an appendix) for both.

Line 152: add: major “depositional” unconformities, in order to avoid confusion with angular unconformities.

Lines 153-154: The top Pragian unconformity is diachronous (comprises also the lowermost Emsian in the Reggane Basin and on the Azel Matti ridge). Top Givetian and top mid-Frasnian are no unconformities over the entire study area. Top Quaternary is an unconformity worldwide, therefore omit. Or do you mean base Quaternary? But this would be trivial. In this list you have omitted the most important depositional unconformity, the transgression of the lower Eifelian (costatus-Zone).

Line 156: geological map is 1: 200.000, not 1:20.000.

Line 171: circular of oval shape of basins. This is pure imagination. Basins and ridges are capped by erosion in the south and by overlying Jurassic or Cretaceous in the north. Thus the second dimension of the paleogeographic units is unknown.

Line 174: major faults are all Hercynian. Eventual pre-Hercynian faults are inferred, but have never been documented in the field, thus are mere speculation.

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Line 178: “long” instead of “length”.

After line 178: Generally, at this point there is a paragraph entitled “Previous work”, but this is missing here.

Line 179: this chapter should be re-written avoiding speculations, even if they would fit well into a hypothetical and inferred depositional image. Regarding eventual “synsedimentary extensional markers” see above.

Line 191: Hercynian folding is restricted to the Reggane, Ahnet and western Mouydir Basins, but decreases markedly towards the east (eastern Mouydir and Illizi Basins) where Paleozoic strata are completely flat-lying.

Lines 205-207: synsedimentary horst and graben structures – see above (lines 174 and below). What is a “synsedimentary forced fold”? A slump?

Line 247: From Google Earth images it is possible to recognize faults, but it is impossible to determine their age. Please explain why the faults figures in Figs 4 and 6 are Silurian-Devonian and Middle to Late Devonian age.

Line 261: “Nine facies associations” cannot be detected in Figs 9 and 10. Do you mean the depositional environments? (these are 5). I also could not find the “supplementary data”.

Line 291: There is no clear horizontal (gAPI) scale in Fig. 8. Thus it is impossible to check the numbers.

Line 298: values range to 120, not 200 in Fig. 8D.

Lines 329-330: 30-60 gAPI are low, not high.

Line 346: 25-60 gAPI are low, not high.

Line 366: stromatoporoids, tabulate and rugose corals are not mentioned on Tab. 1.

Line 378: same as above.

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Line 382-83: same as above.

Line 395: HCS probably stands for hummocky cross stratification. If this should be the case, these structures indicate a shallow marine environment, not deep marine. The same interpretation refers to “influence of storms”, i. e. shallow, not deep.

Line 396: The ichnofauna of AF5a does not necessarily indicate a deep marine environment, but could also be much more shallow, as indicated by the “influence of storms”.

Line 406: The Grès de Mehden (not “Meden) Yahia and the Temertasset (not “Termatasset) shales were deposited during a regressive phase and should be discussed in one of the preceding paragraphs.

Line 410: not “Paleozoic” but “Devonian”. Fig. 7 shows almost exclusively Devonian.

Line 421: The major flooding surface is not MFS5 but MFS4 (Eifelian transgression).

Line 423: same error. Moreover, you have omitted the gap in the Emsian.

Lines 433-436: This is highly exaggerated. The facies variations between the Ahnet Basin and the adjacent ridges are very weak.

Line 442: MFS5 is not a major flooding surface. The corresponding black shales are diachronous (earliest ones in the Givetian, latest ones in the upper Frasnian), and their occurrence depends mainly on paleogeographic factors. It is true that there is an evident gap between the Givetian and the Frasnian, but this occurs only on the ridges, not in the basins, and it is caused by non-deposition, not by transgression.

Line 451: not a maximum flooding but regression (see above). Line 514: an “early Eifelian” hiatus does not exist. Or do you mean the partitus Zone which in fact has not been documented? But I did not check the other references which appear to depend on palynomorph stratigraphy which, compared to conodont stratigraphy, is much less reliable.

Line 660: Which are the “Three different periods of tectonic compressional pulses”? I am aware only of one, the Hercynian.

Lines 668-1266: References:

The reference list occupies almost the same space as the preceding text and should be drastically reduced, at least to one half. In order to avoid the impression that the article is nothing but a general review paper. Only articles referring to the study area should be included in the reference list. Unfortunately, the latter in its present length shows many incomplete citations (missing volume, missing pages, missing dots in abbreviations, missing editor, missing town (for books), missing capitalizing, wrong spelling), such as in lines 673, 676, 681, 685, 690, 696, 699, 740, 743, 745, 755, 762, 764, 765, 777, 814, 828, 830, 844, 863, 873, 893, 900, 902, 938, 957, 963, 979, 982, 1001, 1003, 1013, 1018, 1033, 1037, 1041, 1075, 1081, 1082, 1095, 1099, 1112, 1124, 1129, 1158, 1160, 1162, 1169, 1176, 1181, 1185, 1186, 1195, 1221, 1222, 1226, 1244, 1253, 1255, 1257, 1260. This list, however, is not complete.

I did not check, if every reference in the text does also appear in the reference list and vice versa. This can be done much more accurately by a simple computer program (which I do not have). On the other hand, important local works are not cited.

Remarks to figures:

Fig. 1: line 1275: 1: 200.000.

Line 1281: where are the supplementary data?

Map and reference of Monod (1931-1932) are missing.

Fig. 2: Illizi Fm. Is missing in the Illizi column.

Fig. 3: give exact coordinates for wells (W1- W21) and for outcrops (O1 – O9). What are the latter? Own data or previously published ones? Why there is no cross section along the O1-O9 line?

Fig. 7: larger lettering is required. (I had to use a 3x magnifier to read it). What are the tiny arrows in the left gamma-ray-column?

Tab. 1: Please add a column with the equivalent individual formation names. In the present form this table is rather theoretical and shows no relation to the Devonian depositional areas.

Fig. 8: Because of its tiny lettering this figure is almost unreadable. Stages and formation names should be added for each sub-figure. The accompanying sections are unreadable. I could not check the source because the equivalent reference is incomplete. In the present form this figure appears rather useless. Gamma-ray-curves often do not correspond to their interpretation in the text (see above). It would make a certain sense, if there were a comparison with equivalent well logs in each sub-figure, but it would better to omit this figure completely.

Fig. 9: Needs larger lettering! In Fig. 2 the Emsian is a gap (which is correct), but in

Fig. 9 this stage is represented by strata, which is an obvious contradiction.

Fig. 10: same as Fig. 9.

Fig. 11: “K” is missing on A and B. (line 1486).

Fig. 12: larger lettering, the smallest ones are illegible.

Conclusion

As a whole the paper is well written, rather concise and accompanied by good illustrations (apart from the above remarks). It is an example of a modern interpretation of a basin and ridge paleogeography using all available techniques. An important contribution is the representation of well data which are difficult to obtain by non-oil geologists. Nevertheless, it cannot be overlooked that as a whole the paper appears to be based almost exclusively on pre-existing data. The personal contribution to the subject is difficult to distinguish Thus, in several aspects and conclusions the interpretations of

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the data are not or only poorly compatible with well-established field data. Some of them are highly speculative. It should also be made clear that the depositional units (basins and ridges) are nothing else than the southern prolongation of the same (but more accentuated) ones farther north. It should also be clearly expressed that the basin-and-ridge paleotopography in the Ahnet and Mouydir is of relatively short duration (early Eifelian to early Famennian). The depositional pattern of the late Famennian and the Carboniferous Is totally different from the Devonian one. A Devonian sea-level curve would be highly desirable. Absolutely necessary are several block diagrams to show the basin-and-ridge configuration at various stages.

I recommend publication of the manuscript after major revision, but I would be glad to receive the revised manuscript once more before its final acceptance.

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