

## Comments by Jon Smith

The manuscript is well written, well organized and would be of interest to many geoscientist, but If the authors are not able to address these concerns, I think it will be very skeptically received.

While I did not get a chance to fully review the manuscript, I did identify some very concerning issues regarding the vintage and accuracy of the geologic background information and the field methods and assumptions with respect to how rock samples were selected in the field. Despite my tardy reply, I list my concerns below.

1. Line 50 - References to the overall and specific geology composition of the Ogalla are very dated, which isn't necessarily a problem except that it not consulting more recent studies likely led to the additional lithostratigraphic concerns listed below. The authors should carefully read the more recent papers specifically addressing the lithofacies and calcrete stratigraphy of the Ogallala such as:
  - a. Joeckel, R.M., Wooden Jr, S.R., Korus, J.T., and Garbisch, J.O., 2014, Architecture, heterogeneity, and origin of late Miocene fluvial deposits hosting the most important aquifer in the Great Plains, USA: *Sedimentary Geology*, v. 311, p. 75-95.
  - b. Smith, J.J., and Platt, B.F., 2023, Reconstructing late Miocene depositional environments in the central High Plains, USA: Lithofacies and architectural elements of the Ogallala Formation: *Sedimentary Geology*, v. 443, p. 106303.
  - c. Korus, J., and Joeckel, R.M., 2023, Telescopic Megafans on the High Plains, USA Were Signal Buffers in a Major Source-To-Sink System: *The Sedimentary Record*, v. 21.
2. Line 52 - The concept of the Ogallala "cap rock" referring to a regionally persistent and ledge-forming terminal petrocalcic horizon is not supported by more recent stratigraphic studies (Swineford et al. 1958; Diffendal 1982; Gustavson and Winkler 1988; and Joeckel et al. 2014). Instead, these studies show that carbonate-cemented paleosols and petrocalcic horizons are present in numerous stratigraphic positions in Ogallala deposits. I understand that there is a very prominent calcrete at the contact between the Ogallala and the Blackwater Draw Formation in TX, but this should not be interpreted to represent a regionally persistent marker bed throughout the expanse of the Ogallala as was previously assumed (prior to the 2000s). See References above and Ludvigson et al. (2009), Review of the stratigraphy of the Ogallala Formation and revision of Neogene ("Tertiary") nomenclature in Kansas.
3. Line 68 - see earlier comment, while I agree Ogallala exposures are typically well indurated by carbonate, I would hesitate to refer to this characteristic as "its caprock", as its not a single bed.
4. Figure 1- giving the circles and squares different colors might help to distinguish them a bit better.
5. Line 175 – Some very interesting papers have recently been published on just this topic, see Korus, J., and Joeckel, R.M., 2023, Telescopic Megafans on the High Plains, USA Were Signal Buffers in a Major Source-To-Sink System: *The Sedimentary Record*, v. 21.
6. Line 182 – Additional publications with specific volcanic age data from Ogallala ash bed should be cited:
  - a. Swisher, C. C. III, 1992,  $^{40}\text{Ar}/^{39}\text{Ar}$  dating and its application to the calibration of the North American land mammal ages [Ph.D. thesis]: Berkeley, University of California, 239 p.
  - b. Smith, J.J., Turner, E., Moller, A., Joeckel, R.M., and Otto, R.E., 2018, First U-Pb zircon ages for late Miocene Ashfall Konservat-Lagerst tte and Grove Lake ashes from eastern Great Plains, USA: *Plos One*, v. 13.

7. Line 192 - This may be the case in some areas, but it is not a consistent feature. Calcretes are present in many Ogallala outcrops regardless of stratigraphic position as it is most like a result of exposure case hardening. See Joeckel et al. 2014 and Smith and Platt 2023 for more on modern interpretation of "cap rock".
8. Line 205 – “on the assumption that the caprock formed simultaneously across the Great Plains.” – we know this is incorrect. See references above.
9. Line 211 – See Smith and Platt (2023) for more on unconformities and the thorny issue of Ogallala calcretes...
10. Line 226 - The authors need to provide more information on their samples and sampling methods. There are many carbonate morphologies in the Ogallala, and its becoming increasingly clear most are not coincident with paleosol formation. The pics in Fig. 2 helps, but is also concerning. Carbonate nodules and burrows may be authogenic, but I have some reservations about the pictured root casts and am very skeptical of the "cap rock" calcrete. We strongly suspect that many of these calcretes and calcrete morphologies are primarily carbonate precipitation due to case hardening of the exposed surface and not syndepositional. This is a vitally important issue because this may be the primary reason you are getting a consistently modern signal from your d18O; you may be sampling carbonates that precipitated essentially in response to recent exposure and under essentially modern conditions. I'm not stating that is the case, but its impossible for me to tell without being more specific in how and what you sampled.
11. Line 317 – “this year” .... What year? 2016? Or an average of 1980-2016?
12. Line 421 – “also imprecision in the chronologies of the sections we sampled”... Not just the sections, but the sampled material itself, as in assuming the carbonate is in some respect syndepositional with the host sediments. I would be curious to see inter-area sampling differences. For example what is the variance in d18O between the 19 samples from the BV location? Are there patterns with respect to sample type (nodules that appear pedogenic vs calcrete vs rhizoliths)?

Again, I apologize for not completing my review. I have few concerns about the results of the geochemical analyses. The methodology and output is well communicated, and I would not be surprised by their findings in the slightest; in fact they align very well with my most recent publication using paleosols and trace fossils to interpret climate conditions (Platt, B.F., and Smith, J.J., 2023. Late Miocene paleoecology and paleoclimate in the central High Plains of North America reconstructed from paleopedological, ichnological, and stable isotope analyses of the Ogallala Formation in western Kansas, USA. *Evolving Earth*, <https://doi.org/10.1016/j.eve.2023.100019>.) But frankly, I am extremely skeptical of their interpretations and conclusions due to the lack of communicating exactly what was sampled, how or why they suspect the sampled carbonate is ancient, and the authors out dated understanding of the regional geology. I was not able to complete my review, so I will not make a final recommendation.