

**PS Revise the Paleozoic North American Regional Time Scales
by Volcanic Ashes in the Midland Basin***

Hepeng Tian¹, Majie Fan¹, Lowell Waite², and Robert J. Stern³

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¹Earth and Environmental Sciences Department, University of Texas at Arlington, Arlington, TX, United States (hepeng.tian@mavs.uta.edu; mfan@uta.edu)

²Pioneer Natural Resources Company, Irving, TX, United States (Lowell.Waite@pxd.com)

³Department of Geosciences, University of Texas at Dallas, Dallas, TX, United States (rjstern@utdallas.edu)

Abstract

The correlation between the Paleozoic North American regional time scales (NARS) and International Geological Time Scales (IGTS) is problematic due to the lack of datable materials in the Paleozoic North American strata. Recent discovery of multiple volcanic ash beds in the Pennsylvanian and lower Permian strata of the Midland Basin provides a great opportunity to constrain the absolute ages and revise the chronostratigraphic correlation between the two scales. In addition to the correlation between the NARS and IGTS time scales, a precise chronostratigraphic framework of the Permian Basin will help improve the depositional model of the basin and better understand the tectonic background of the basin. Fundamental understandings to these aspects can help guide future hydrocarbon and mineral explorations in the basin. Here we present LA-ICPMS zircon U-Pb ages for the Leonardian, Wolfcampian and Atoka stages for the first time. We have total nine volcanic ash samples dated including one from Atokan, two from Leonardian and six from Wolfcampian stages (One in Wolfcamp A and five in Wolfcamp B). Estimated maximum depositional ages for each strata unit are calculated either by TuffZirc ages or Weighted Mean ages from the 3-5 youngest zircons. The results indicate that the best estimated depositional ages for Leonardian (lower Spraberry), Wolfcamp A, Wolfcamp B and Atoka are 273.6-282.1 Ma, 283.1 Ma, 284.8-297.6 Ma and 326.7 Ma respectively. Based on the zircon ages, the Leonardian, Wolfcampian and Atokan stages of the NARS could be correlated to the Kungurian, Artinskian to Asselian stages in the Permian and the Serpukhovian stage in the Upper Mississippian of the IGTS respectively. This chronostratigraphic column will be revised by more ash studies in the basin and more advanced dating tools like Thermal Ionized Mass Spectrometry (TIMS) in the future.

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Hepeng Tian¹, Majie Fan¹, Lowell Waite², Robert J. Stern³

1, Earth and Environmental Sciences Department, University of Texas at Arlington (hepeng.tian@mavs.uta.edu; mfan@uta.edu);

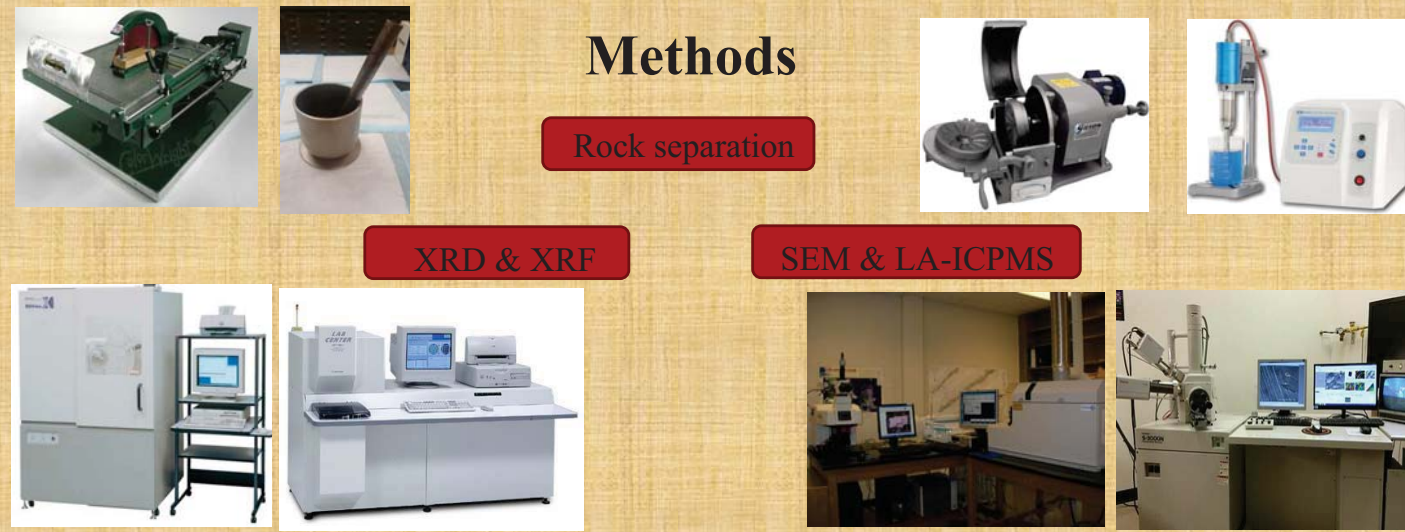
2, Pioneer Natural Resources Company (Lowell.Waite@pxd.com);

3, Department of Geosciences, University of Texas at Dallas (rjstern@utdallas.edu)

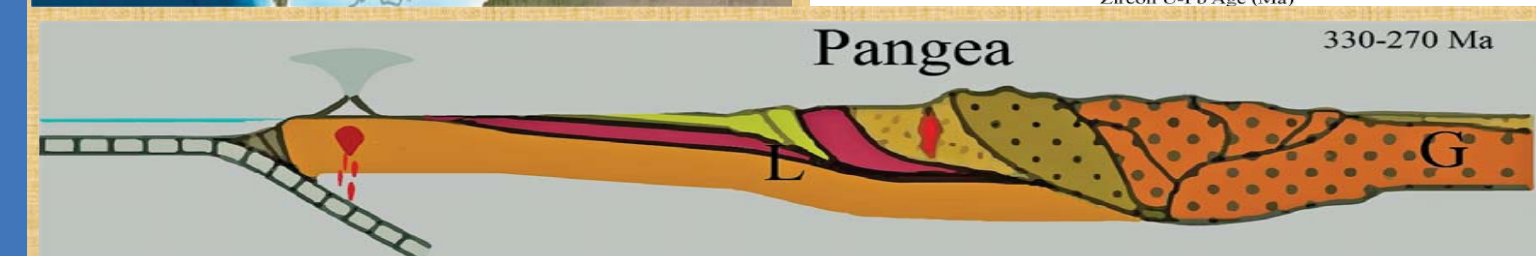
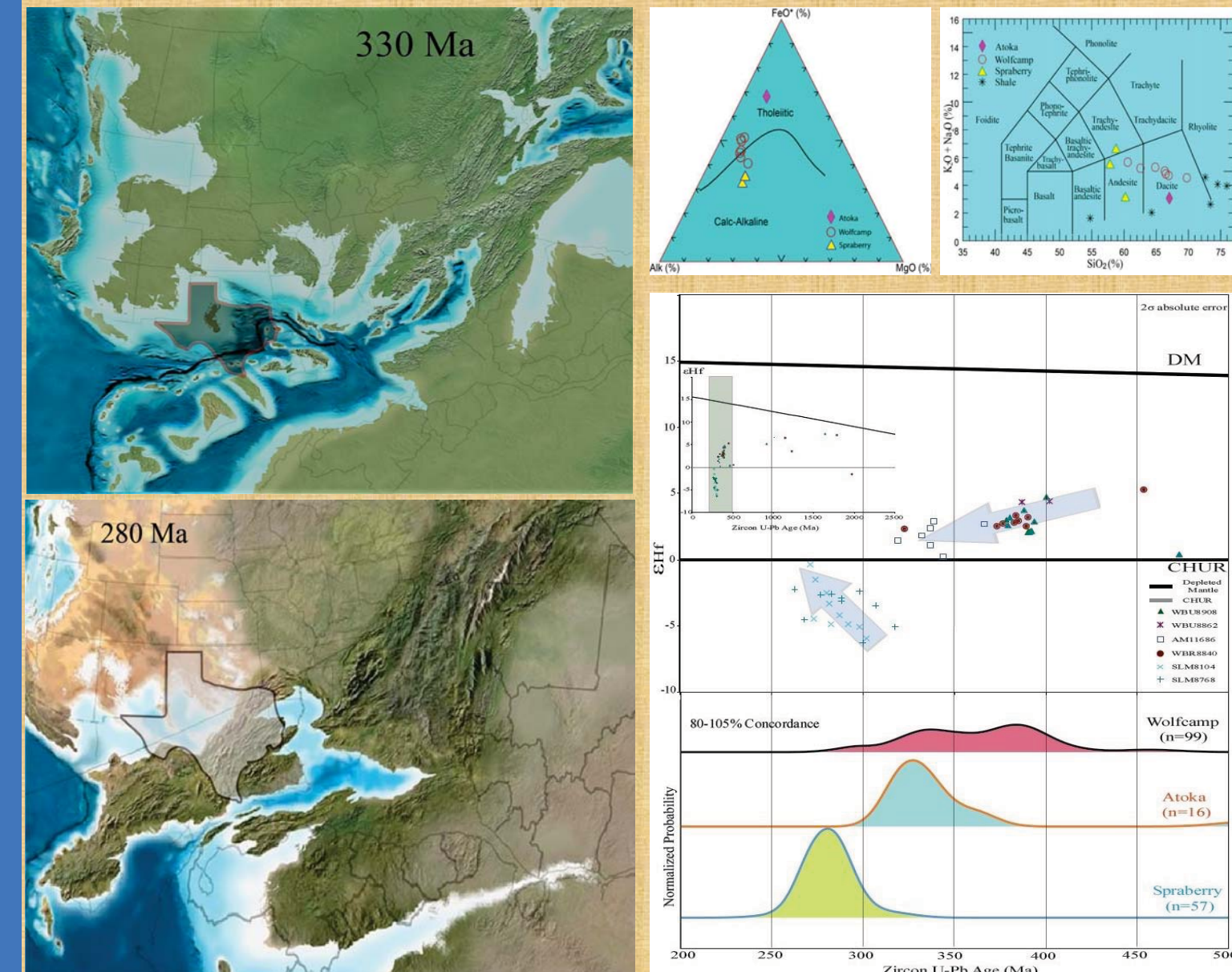
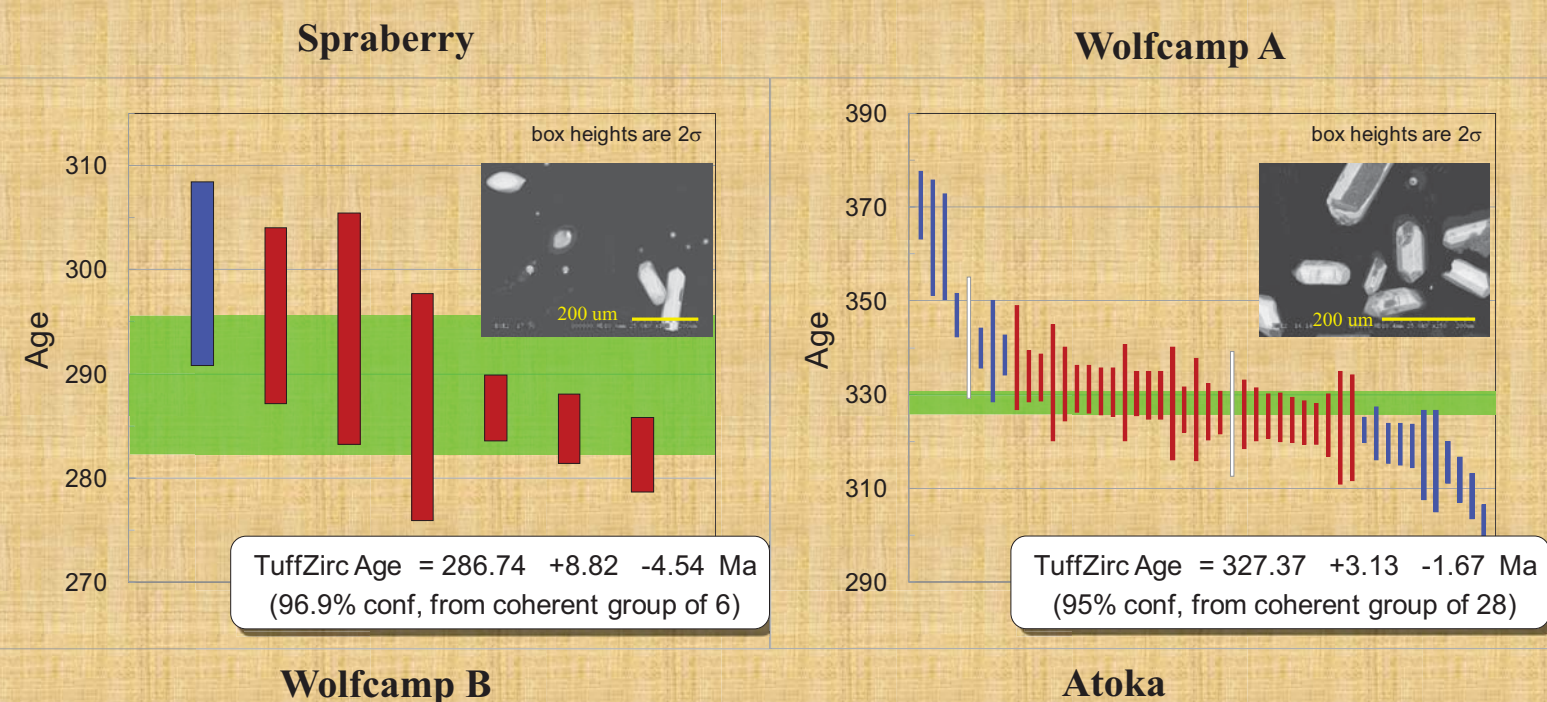
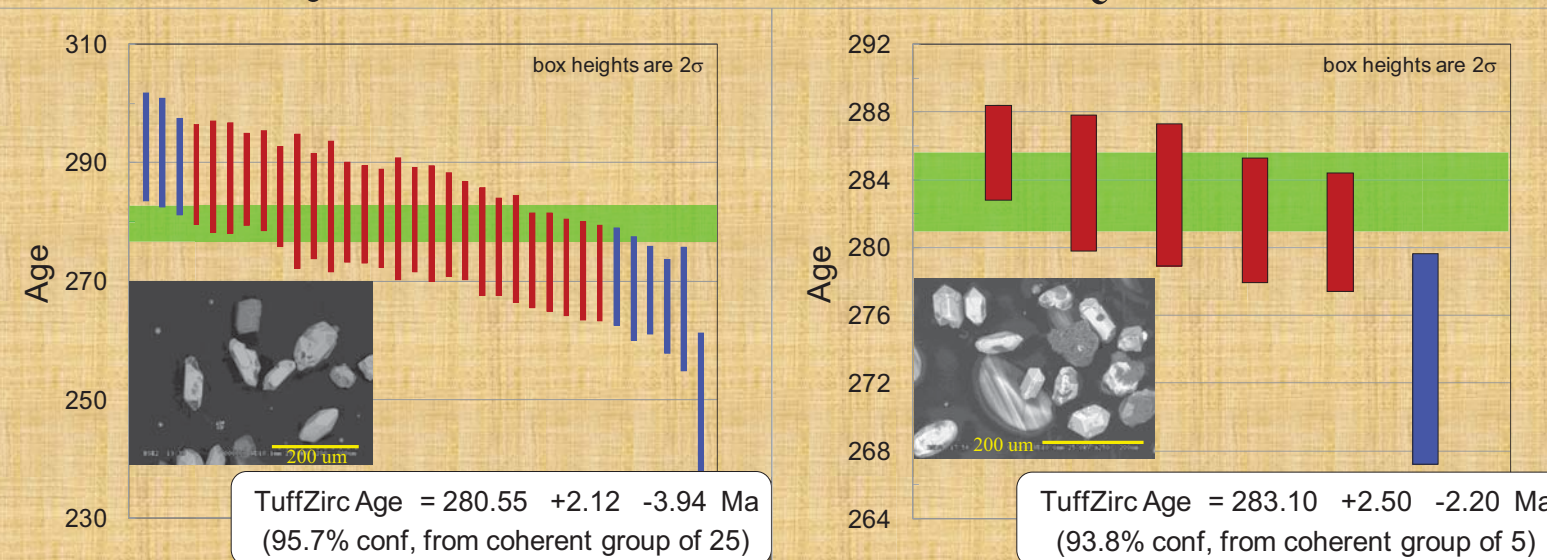
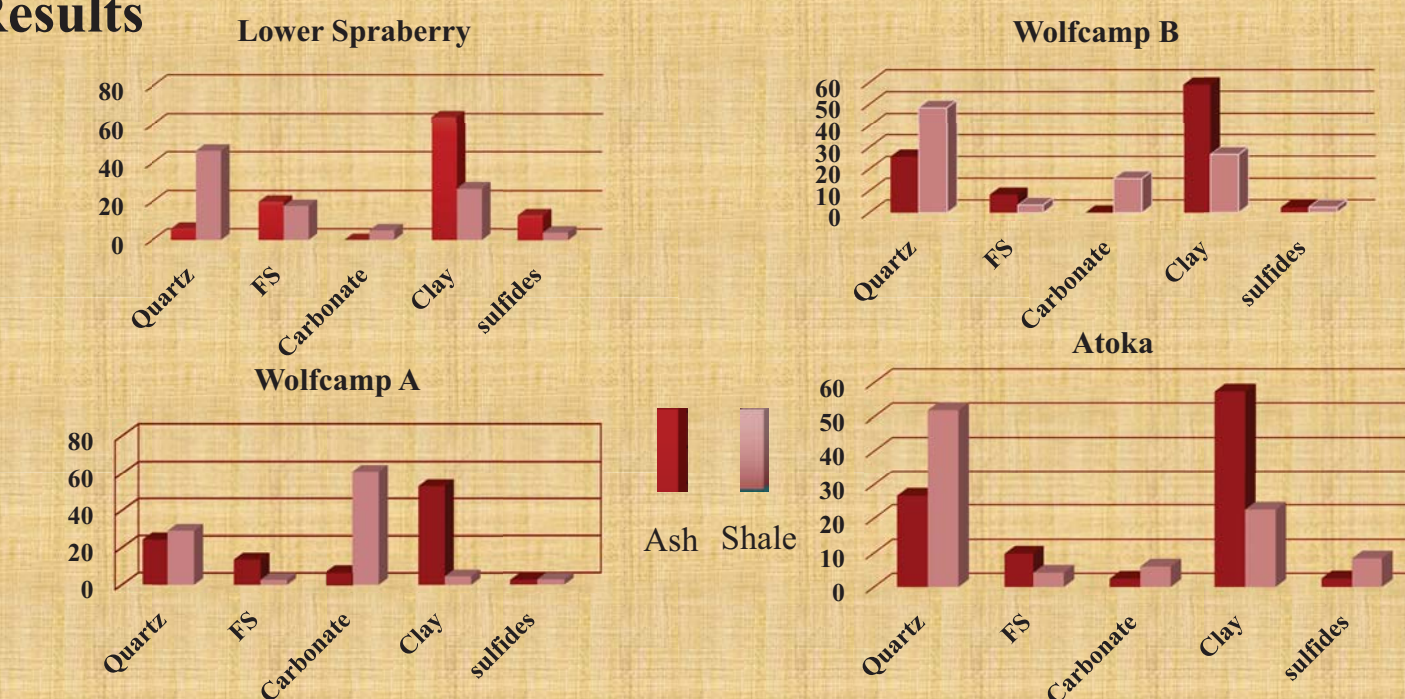
Abstract

Recent discovery of multiple volcanic ash beds in the Pennsylvanian and lower Permian strata of the Midland Basin provides a great opportunity to constrain the absolute ages and revise the chronostratigraphic correlation between the Paleozoic North American regional time scales (NARS) and International Geological Time Scales (IGTS). In addition to the correlation between the NARS and IGTS time scales, a precise chronostratigraphic framework of the Permian Basin will help improve the depositional model of the basin and better understand the tectonic background of the basin. Fundamental understandings to these aspects can help guide future hydrocarbon and mineral explorations in the basin.

Here we present LA-ICPMS zircon U-Pb ages for the Leonardian, Wolfcampian and Atoka stages for the first time. We have total nine volcanic ash samples dated including one from Atokan, two from Leonardian and six from Wolfcampian stages (One in Wolfcamp A and five in Wolfcamp B). Estimated maximum depositional ages for each strata unit are calculated either by TuffZirc ages or Weighted Mean ages from the 3-5 youngest zircons. The results indicate that the best estimated depositional ages for Leonardian (lower Spraberry), Wolfcamp A, Wolfcamp B and Atoka are 273.6-280.55 Ma, 283.1 Ma, 284.8-297.6 Ma and 326.7 Ma respectively. Based on the zircon ages, the Leonardian, Wolfcampian and Atokan stages of the NARS could be correlated to the Kungurian, Artinskian to Asselian stages in the Permian and the Serpukhovian stage in the Upper Mississippian of the IGTS respectively. Zircon Lu-Hf isotope signatures indicate that these ash beds might come from two arc systems, one is from west Laurentia and the another one is from a missing east Laurentia arc.



Results



Discussions

- ❖ Volcanic ash samples show higher Al_2O_3 , Fe_2O_3 , MgO , K_2O and lower CaO , indicating volcanic origin;
- ❖ Spraberry and Atoka samples show compact zircon clusters, indicating pure ash input and relatively stable depositional environment;
- ❖ Wolfcamp samples contain many inherited zircons with spreading ages, indicating relatively unstable depositional environment;
- ❖ Sudden gap of ϵHf value at 320 Ma might indicate two arc systems.

Conclusions

- 1, Lower Spraberry corresponds to the Kungurian Stage;
- 2, Atoka stage corresponds to the Late Mississippian;
- 3, Wolfcamp A corresponds to Artinskian;
- 4, Wolfcamp B corresponds to Artinskian-Asselian;
- 5, There might be two arcs during early Permian, east Laurentia arc close at final collision while west arc is active until about 272 Ma. years ago

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