Detrital zircons from fluvial Jurassic strata of the Michigan basin: Implications for the transcontinental Jurassic paleoriver hypothesis: REPLY


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We lack the expertise to address issues of palynology in the Michigan basin, but offer the following responses to specific points raised by Benison and Knapp (2010) in their comment.

(1) For usage of “Ionia Formation,” we followed Cross (1998), noting that our critics used the term in an abstract (Knapp and Benison, 2005) and that Swezey (2008) assigned Bajocian–Bathonian (Middle Jurassic) strata of the Michigan basin to the Ionia Formation.

(2) We accepted judgments that the Ionia Formation is dominantly fluvial (Fisher et al., 1988; Burgess, 2008), deposited in stream-eroded palaeovalleys incised into Pennsylvanian strata, but associated eolian and sabkha deposits may well be present (Cross, 1999; Benison et al., 2009).

(3) We did not use ages of detrital zircons to establish the depositional age of strata, because the youngest ages for detrital zircons can define maximum, but not actual, depositional age.

(4) Our Ionia sample came not from a building in Ionia but from a quarry at or near Ionia from which a residue of building stone was donated to Western Michigan University by Bruce Arndt. We studied a block of the building stone because it was the only sample available to us of sufficient size (~20 kg) to provide an adequate assessment of the age spectrum of detrital zircons.

(5) For the age of Michigan basin “red beds” (Ionia Formation), we followed the interpretation of Cross (1987) that the spores and pollen of the paleoflora are Middle Jurassic (Bajocian–Bathonian), rather than Kimmeridgian (Late Jurassic), as discussed by Fisher et al. (1988, p. 377).

(6) We relied upon the conventional wisdom that “red beds” of the Ionia Formation are Jurassic, containing a profusion (Cross, 2001) of five species (Cross, 1987) of Classopolis, a form restricted to post-Paleozoic strata. Cross (1987, 1999) interpreted the rich accompanying palynoflora of at least 30 genera (Cross, 1999) as Bajocian–Bathonian in age. Some fraction of the fossil assemblage came from quarry sites along the Grand River near Ionia (Cross, 1998).

Unpublished palynological data now apparently indicate that some of the Michigan basin “red beds” are actually of Pennsylvanian rather than Jurassic age (Knapp et al., 2007). Perhaps, some consideration should be given to the alternate possibility that Paleozoic palynomorphs were reworked locally into Jurassic strata from unconformably underlying Pennsylvanian strata. Cross (1999) noted the presence of recycled Pennsylvanian spores and pollen in some of his Ionia samples, and reworking of palynomorphs can be difficult to detect (Traverse, 1988, p. 427–428).

If our sandstone sample from Ionia proves to be Pennsylvanian rather than Jurassic in age, then a comparison of its detrital-zircon age spectrum with Permian eolianites of the Colorado Plateau (Fig. 1) is more appropriate than a comparison with Jurassic eolianites. Figure 1 shows the close similarity of Permian eolianite and Ionia age spectra, and is consistent with a Paleozoic age for our Ionia sample rather than a Mesozoic age. Because Permian and Jurassic eolianites of the Colorado Plateau had a similar provenance (Dickinson and Gehrels, 2003), a Paleozoic age for the sample would not necessarily spoil our test of the transcontinental paleoriver hypothesis. A Pennsylvanian–Permian paleoriver connection from the Colorado Plateau to eastern Laurentia would be as satisfactory a test of overall provenance relations as a Jurassic paleoriver connection.

REFERENCES CITED


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Figure 1. Age-distribution curves (normative probability plots) of detrital-zircon populations in the Ionia Formation (bottom) and the eolian Coconino Sandstone (top) of Permian age exposed in the Grand Canyon. N—number of samples; n—total number of U-Pb ages for detrital zircons.

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