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Letter to the Editor

Reply to Iannicelli's (2012) Letter to the Editor

We welcome the opportunity to discuss the ideas set forth in our research paper on the DeKalb mounds in northeastern Illinois (Curry et al., 2010). Our ongoing field research on these features has led us to ask new questions about their origin and ontogeny beyond what is discussed here, perhaps providing future graduate students with intriguing research opportunities (Petras, 2010; Curry and Petras, 2011).

The primary aim of our paper was not to deconstruct earlier work, but to highlight new field and laboratory data from seven co-authors from five institutions. These data include:

1) Detailed mapping of ice-walled lakes (e.g., Curry, 2008a) aided in part by hillshade maps of high-resolution elevation data (such as LiDAR),
2) Sediment cores and subsequent analyses of particle-size distribution and mineralogy of the <2 μm fraction,
3) High-resolution electric-earth-resistivity soundings across one mound, augmented with sediment cores sampled every 100 m (which provided us with new detailed information about the architecture of the lacustrine facies),
4) Plant macrofossil identification and radiocarbon ages (Curry and Yansa, 2004), and
5) Ostracode identification and biogeochemical analysis of their valves ($\delta^{18}O$, $\delta^{13}C$, Mg/Ca_m and Sr/Ca_m).

We fail to see merit in the contention that there are significant differences between "combinatorial dead-ice landforms and ice-walled lake plain/plateaus as magnificently shown in Parizek (1969)" (Iannicelli, 2012). Ice-walled lake plains are formed in association with dead ice. Many ice-walled lake plains tracts were formed in ice-marginal areas characterized by hummocky topography (Ham and Attig, 1996; Clayton et al., 2008) attributed, in some cases, to the melting-out of in-glacial structures of controlled moraines (Gravenor and Kupsch, 1959; Colgan et al., 2003; Evans, 2009).

Flemal et al. (1973) maintained that the mounds were formed adjacent to or on outwash, an observation they felt upheld the pingo theory. Our collective experience, however, indicates that sediment forming the DeKalb mounds is nestled in and above deposits of dense diamicton, likely till, and do not occur above outwash (e.g., Curry, 2008b). Curry et al. (2010) describe a basal facies of sand and gravel in the DeKalb mound sediment successions which they attributed to a lag deposit in the lacustrine succession. This deposit is likely what Flemal and his colleagues sampled, probably with a Giddings rig. Their coring was likely halted by artesian water pressures in the coarse, saturated sediment. In contrast, we have used PowerProbe and CME drill rigs, and were able to penetrate and sample the lag deposit with no problems advancing (and sampling) the subjacent diamicton. We tactfully omitted Flemal et al.'s overinterpretation because it was based on poor information gathered with inferior equipment.

Iannicelli (2012) remarks on a nuance in terminology that revolves around the question: at what point does dead ice become dead-ice permafrost? Iannicelli (2003) offers the ACGR (1988) definition for permafrost, which by its imposition of a 2-yr time limit, renders it nearly useless in the Pleistocene record since only very rarely can events be resolved at that detail, especially when age errors are considered. We believe that the rhythmically bedded silt and very fine sand of the DeKalb mounds provides indirect support of seasonal freeze–thaw cycles. Additional evidence of an active layer is the fossils of tundra plants which grew in the catchments of the ice-walled lakes.

In his point 4, Iannicelli (2012) appears to limit the origin of pingo ice to ruptured ground ice without considering an origin from dead ice. We believe that it is likely that hydraulic forces that operate in open-system pingos (that might form in dead-ice situations) also operate in ice-walled lakes. Basic hydrological principles require an upward component to water flow into a lake with a topographically closed basin.

We will grant that Flemal et al. (1973) did not support an ice-walled lake interpretation of the DeKalb mounds. We would point

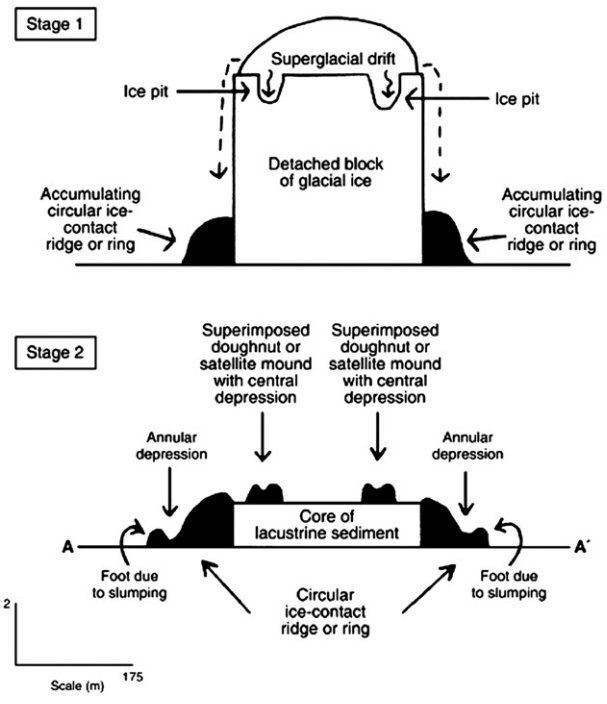


Figure 1. The mechanism of Dekalb mound formation: stage 1 shows a cross-section of the combinatorial process during immaturity; stage 2 shows a cross-section of the resulting conglomeration of relief features.
Figure from Iannicelli (2003; p. 178); used by permission of Bellwether Publishing.

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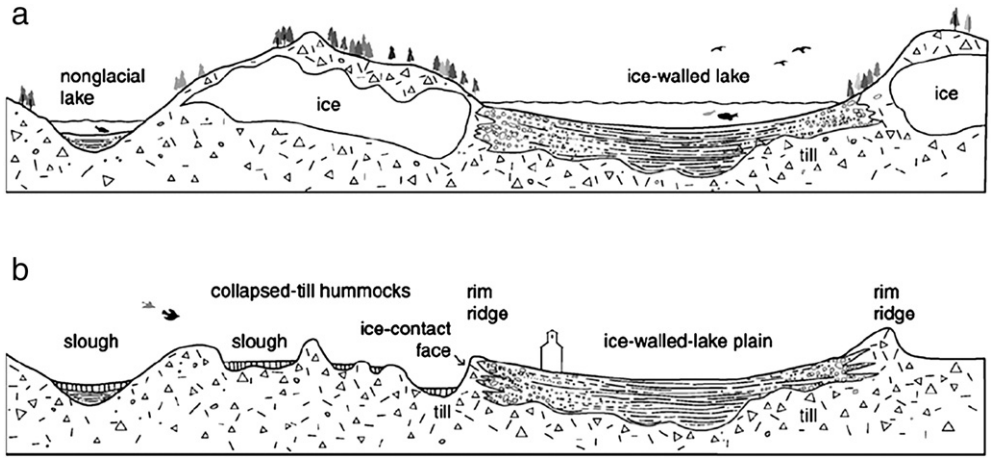


Figure 2. Schematic cross sections of ice-walked-lake plain while still confined by ice (a) and after melted. (b) Vertical ruling in sloughs represents faintly bedded Holocene sediment; horizontal ruling in non-glacial lake represents latest Pleistocene and earliest laminated fossiliferous Holocene sediment.
Figure from Clayton et al. (2008, p. 239), used by permission from Elsevier Scientific Publishing.

out, however, that the title of their paper states their case less forcefully ("DeKalb mounds: a *possible* Pleistocene (Woodfordian) pingo field in north-central Illinois", our italics).

Iannicelli (2003) offers no new field evidence for its rejection of Flemal et al.'s pingo theory, but rather, favors the block diagrams of Parizek (1969), advocating a dead-ice origin. Because Iannicelli's (2012) comments on our collective work are based on Iannicelli (2003), we offer these comments on his proposed mechanisms for development of the DeKalb mounds. We do not see how it is physically possible to form a sub-supraglacial debris lake (Fig. 1; Iannicelli, 2003). The lake would have to form by unlikely geothermal heat exchange to the ice at the glacier bed in excess of ambient (atmospheric) temperature exchange with the supraglacial debris. Further, if the lake were able to exist, the supraglacial debris would fall into the lake leaving no opportunity for debris to collect in icepits to eventually become superposed doughnuts. Our new data indicate other reasons to reject Iannicelli's model.

First, terrestrial plant macrofossils preclude a "lid" of supraglacial drift above the lake; the fossils must have originated from the watershed of the ice-walled lake, requiring a completely different geometry of an active layer above stagnating ice and lake water, such as the model of a stable perched ice-walled lake by Clayton et al. (2008; Fig. 2, above). Second, our data show that the sediment successions of ice-walled lake plains fill depressions formed on the till bed, not passively on a flat surface as suggested by Iannicelli's (2003) Fig. 7, or in linear troughs in the till bed as indicated in his Fig. 5 (borrowed from Parizek, 1969). Third, the "heavy" $\delta^{18}O$ values of ostracode valves indicate that the source of water was precipitation derived from the Gulf of Mexico (Curry et al., 2010). Iannicelli's (2003) model, in contrast, suggests the lake is filled with meltwater with anticipated negative $\delta^{18}O$ values. Fourth, our particle-size determinations have shown that the rhythmically bedded facies of the sediment succession of the DeKalb mounds contain little or no particles coarser than coarse sand, and are enriched with respect to silt. Iannicelli's (2003) model would not allow for sorting of sediment; the lake sediment would likely have chaotic bedding, contain a range of grain sizes from clay to boulders and be poorly sorted.

In closing, we do not claim full understanding of the ontogeny of the DeKalb mounds or other low-relief ice-walled lake plains (sensu Clayton et al., 2008), particularly their genesis and late-stage modifications. We believe that our primary contribution has been establishment of deglacial history of the Lake Michigan lobe through radiocarbon ages determined from fossil plants archived in ice-walled lake plains (such as the DeKalb mounds) (Curry and Petras, 2011; Curry et al., 2011a). These results, and our conclusions regarding the sedimentology and genesis, have been presented in numerous open forums such as the Midwest Cell of the 2008 Friends of the Pleistocene field trip (Curry, 2008a), and meetings of the American Geophysical Union, the Geological Society of America, the International Quaternary Association, and elsewhere (e.g., Curry, 2009; Petras et al., 2010; Curry, 2011; Curry et al., 2011b).

References

Clayton, L., Attig, J.W., Ham, N.R., Johnson, M.D., Jennings, C.E., Syverson, K.M., 2008. Ice-walled-lake plains: implications for the origin of hummocky glacial topography in middle North America. Geomorphology 97, 237–248.
Colgan, P.M., Mickelson, D.M., Cutler, P.M., 2003. Ice-marginal terrestrial land-systems: southern Laurentide Ice Sheet margin. In: Evans, D.J.A. (Ed.), Glacial Landsystems. Arnold, London, pp. 111–142.
Curry, B.B., 2008a. Surficial geology of Hampshire Quadrangle, Kane and DeKalb Counties, Illinois. Illinois State Geological Survey, Illinois Geological Quadrangle Map, IGQ — Hampshire SG. 1:24,000. Two sheets.
Curry, B.B., 2008b. Deglacial history and paleoenvironments of Northeastern Illinois. In: Curry, B.B. (Ed.), 54th Midwest Friends of the Pleistocene Field Conference, May 16–18, 2008, DeKalb, Illinois, Illinois State Geological Survey Open File 2008-1. 175 pp.
Curry, B.B., 2009. The deglacial history of the Lake Michigan lobe in Illinois, USA, fleshed out by chronologies from ice-walled lakes. Annual Meeting of the American Geophysical Union, San Francisco, Abstract 722814. .
Curry, B.B., 2011. Forensic reconstruction of sediments and environments at the termini of prairie ice streams. Abstracts with Programs: Geological Society of America Annual Meeting, vol. 43. Minneapolis, MN, October 9–12, 2011.
Curry, B.B., Yansa, C.H., 2004. Evidence for stagnation of the Harvard sublobe (Lake Michigan lobe) in northeastern Illinois, USA, from 24 000 to 17 600 BP and subsequent tundra-like ice-marginal paleoenvironments from 17 600 to 15 700 BP. Géographie physique et Quaternaire 58, 305–321.
Curry, B., Petras, J., 2011. Chronological framework for the deglaciation of the Lake Michigan lobe of the Laurentide Ice Sheet from ice-walled lake deposits. Journal of Quaternary Science 26, 402–410.
Curry, B.B., Konen, M.E., Larson, T.H., Yansa, C.H., Hackley, K.C., Alexanderson, J.H., Lowell, T.V., 2010. The DeKalb mounds of northeastern Illinois as archives of deglacial history and postglacial environments. Quaternary Research 74, 82–90.
Curry, B.B., Grimley, D.A., McKay III, E.D., 2011a. In: Ehlers, J., Gibbard, P.L., Hughes, P.D. (Eds.), Quaternary Glaciations in Illinois. : Developments in Quaternary Science, 15. Elsevier, Amsterdam, The Netherlands, pp. 467–487.
Curry, B., Grimley, D., Wang, H., Dorale, J.A., McKay, D., Berg, R., Stumpf, A., 2011b. Quaternary Glacial–interglacial Cycles in Illinois, U.S.A. XVIII International Quaternary Association Congress, Bern, Switzerland. Abstract 2472.
Evans, D.J.A., 2009. Controlled moraines: origins, characteristics and palaeoglaciological implications. Quaternary Science Reviews 28, 183–208.
Flemal, R.C., Hinkley, K.C., Hesler, J.L., 1973. DeKalb mounds: a possible Pleistocene (Woodfordian) pingo field in north-central Illinois. In: Black, R.F., Goldthwait,

https://doi.org/10.1016/j.yqres.2011.11.010 Published online by Cambridge University Press

R.P., Willman, H.B. (Eds.), The Wisconsin Stage: The Geological Society of America Memoir, 136, pp. 229–250.
Gravenor, C.P., Kupsch, W.O., 1959. Ice disintegration features in western Canada. Journal of Geology 67, 48–64.
Ham, N.R., Attig, J.W., 1996. Ice wastage and landscape evolution along the southern margin of the Laurentide Ice Sheet, northcentral Wisconsin. Boreas 25, 171–186.
Iannicelli, M., 2003. Reinterpretation of the original DeKalb mounds in Illinois. Physical Geography 24, 170–182.
Iannicelli, M., 2012. Discussion of "The DeKalb mounds of northeastern Illinois as archives of deglacial history and postglacial environments". Quaternary Research 77, 331.
Parizek, R.R., 1969. Glacial ice-contact ridges and rings. Geological Society of America Special Paper 123, 49–102.
Petras, J., 2010. Genesis and sedimentation of an ice-walled lake plain in northeastern Illinois. Unpublished MS thesis, University of Illinois at Urbana-Champaign, 171 p.
Petras, J., Curry, B.B., Best, J., 2010. Sedimentation and radiocarbon dating of an ice-walled Lake Plain in Northeastern Illinois. Abstract, 40th International Arctic Workshop, Winter Park, CO.

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