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Figure S1. Kootenai Formation measured section from Ziegler Gulch locality. This section is located to the west of the Sandy Hollow thrust, strikes at ~185° and dips ~45° W. (a) Aerial image of measured section; yellow line indicates measured path; coordinates are NAD83 projection; (b) stratigraphic column of measured section; (c) ZG-15m sample locality; (d) ZG-150m sample locality; (e) ZG-186m sample locality; (f) ZG-271m sample locality.

Dating lacustrine carbonate strata with detrital zircon U-Pb geochronology

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<u>Description of acid digestion of carbonate for detrital zircon extraction</u> *After Jeppsson, L., and Anehus, R., 1995, A buffered formic-acid technique for conodont extraction: Journal of Paleontology, v. 69, no. 4, p. 790-794.*

Step 1: Acid digestion of carbonate

Approximately 5-10 kg of limestone was collected and processed through a jaw crusher for reduction to gravel-size pieces that were generally <1/2" (1.25 cm) in size. No more than 1.44 kg of sample was placed onto an approximately 12"x"12" (30-30 cm) piece of 500 μ m mesh and tied up into a sachet; multiple sachets were required per sample. In a 5-gallon bucket, 20 g of calcium phosphate powder was dissolved in about 2 liters of water. Next, 1700 ml of formic acid and 20 g of calcium carbonate powder were added to the bucket, followed by about 10 more liters of water. An approximately 1-gallon bucket with holes drilled into it was hung by a hook inside the 5-gallon bucket (Fig. S2). One sachet was placed inside the 1-gallon bucket and water was added to fill the bucket to approximately 15.2 liters total solution. The samples remained submerged at least overnight and up to 2 days until the reaction ran to completion.

Step 2: Clastic particle recovery and traditional mineral separation

Two blank sieve rings were fitted with 32 μ m and 425 μ m disposable mesh and stacked with the coarser screen on top. The mesh sachet was removed from the acid bucket and the contents were placed onto the upper sieve screen. The sample was washed thoroughly with water and then the portion preserved between the sieves was dried in a low temperature oven. All sample aliquots from the individual sachets were recombined. Depending on the volume of sand recovered, samples were processed on the water table (e.g., for larger amounts) or taken directly to magnetic separation. Final heavy mineral separates were obtained with a methylene iodide separation.



Figure S2. Acid bucket and sachet recovery apparatus: a 1gallon bucket with holes drilled hanging inside of a 5-gallon bucket.