Report of Radiocarbon Dating Analyses, Antelope Island South Quadrangle, Utah

by

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INTRODUCTION

This open-file report makes available raw analytical data from laboratory procedures completed to determine the age of sediment samples collected during geologic mapping funded or supported by the U.S. Geological Survey (USGS) National Cooperative Geologic Mapping Program and the Utah Geological Survey (UGS). The reference listed in table 1 and figure 1 provides additional information such as location, geologic setting, and significance or interpretation of the samples in the context of the area where they were collected. See table 2 for sample ages. The samples were prepared for analysis at Brigham Young University (BYU), Department of Geological Sciences under contract to the UGS, and ^{14}C analyses were performed for BYU by the Center for Applied Isotope Studies (CAIS) at the University of Georgia. These data are highly technical in nature and proper interpretation requires considerable training in the applicable geochronologic techniques.

Table 1. *Antelope Island South quadrangle sample numbers, depth, and location.*

Sample	Map unit	BYU sample name[1]	Depth to sample (inches)[2]	Reference
Ooid sample 1	Qlos	1	32	McKean and Hylland, 2013
Ooid sample 10	Qlos	10	22	McKean and Hylland, 2013
Bulk soil sample 11	Qlos	Bulk soil	21	McKean and Hylland, 2013
Ooid sample 12	Qlos	12	20	McKean and Hylland, 2013

Notes:
[1]See table 2
[2] All samples from a trench 32 inches deep, see figure 1
Waypoint SLCN2014-278, UTM 12 T 404602E, 4518044N; location data based on NAD83
Sample date 5/15/2014
GPS Elevation 4208 feet
2011 LiDAR elevation 4214.40 feet (1284.55 m)

METHODS

Sample Collection

Ooid and bulk soil samples were collected from a 32-inch-deep hand-dug trench in the Antelope Island South quadrangle on May 15, 2014. A single bulk soil sample and three ooid samples were collected; see table 1 and figure 1 for additional information on sample depth and the character of the deposit. The samples came from what is likely a delta barrier bar deposit (unit Qlos) along the outer edge of a lobate delta (unit Qdy) deposited at the mouth of the paleo-Jordan River (McKean and Hylland, 2013). The delta and barrier bar are located across the boundary between the Antelope Island South and Baileys Lake quadrangles.

Sample Processing

A bulk soil sample was placed in a disposable plastic 50 mL centrifuge tube and treated with an acid-base-acid wash of 10% hydrochloric acid (HCl) and 1.0 M sodium hydroxide (NaOH) to remove reactive carbonate and organic acids. The first acid wash was allowed to react to completion, which was assumed to have been achieved when visible bubbling ceased and took no longer than a few minutes. An additional small volume of acid was added to ensure that all carbonate had reacted. The sample was then rinsed once with deionized (DI) water to halt further reaction with the acid, spun for two minutes at 2500 RPM in a Damon IEC HN-S centrifuge, and the supernatant decanted. After this, 1.0 M NaOH was added to just cover the sample, the mixture was stirred with a glass rod, and left to react for less than one minute. DI water was again added to stop the reaction, the sample was spun at 2500 RPM, and the supernatant discarded. The final acid wash was done in the same manner as the first except it was allowed to react for less than one minute. This was followed by repeating the rinse step twice. The sample was screened to isolate the organic material from residual sediment. The resulting organic residue was collected and dried in an oven at 60°C. The dry sample was combusted to create CO_2 gas. This was done by placing the sample in a quartz glass tube along with a copper (II) oxide (CuO) and native silver metal (Ag). The CuO is used to provide oxygen for the combustion process while the Ag reacts with any sulfur to form silver sulfide. The tube was evacuated and the sample was combusted at 450°C. The resulting CO_2 gas was collected and analyzed for ^{14}C using the accelerator mass spectrometry (AMS) facility at the CAIS. Two splits were run from the same sample.

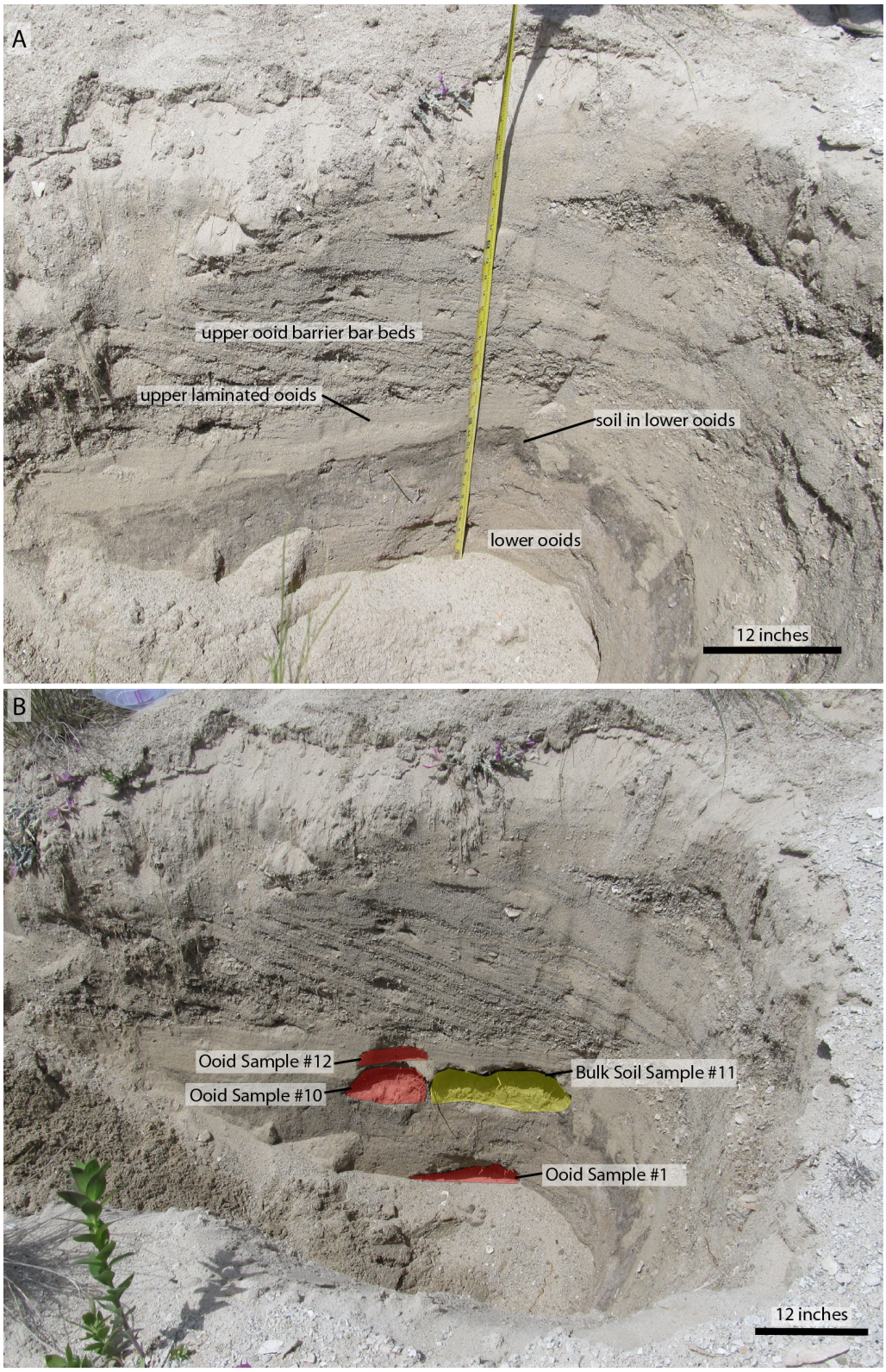

Figure 1. *North view of the sample trench located within the lobate delta barrier bar of the Antelope Island South and Baileys Lake quadrangles (see McKean and Hylland, 2013). (A) The lower ooids are darker gray than the upper ooids and have a soil developed on the upper surface; the upper ooids overlie the soil with fine-grained laminate deposition, followed by higher angle beds that are coarser grained with angular to rounded carbonate grains (both spherical and flat in nature). (B) The red highlighted areas represent the ooid samples and the yellow highlighted area represents the bulk soil sample. Ooid Samples #1 and #10 are from the lower ooids and represent the bottom and top, respectively, of the cut; Bulk Soil Sample #11 is from the same horizon as Ooid Sample #10, but was collected for bulk soil analysis of the soil developed on the lower ooids; and Ooid Sample #12 was collected from the lowest part of the upper ooids in the laminated ooids directly above the soil developed on the top of the lower ooids.*

Table 2. *Radiocarbon ages for a bulk soil and ooid cortex and cores from the Antelope Island South quadrangle, Utah.*

Date	Sample ID	Percent modern carbon (PMC)	±	1 σ error	Radiocarbon age (YBP)	±	1 σ error	δ13C	δ13C Corrected Radiocarbon Age (YBP)	±	1 σ error	Calibrated Age*	±	1 σ error
3/31/2016	1-ooids cortex	52.58	±	0.16	5163	±	25	1.7	5381	±	25	6223	±	16
3/31/2016	10-ooids cortex	47.35	±	0.15	6006	±	25	1.1	6218	±	25	7090	±	25
3/31/2016	12-ooids cortex	49.71	±	0.16	5614	±	25	2.4	5837	±	25	6655	±	22
2/17/2016	1-ooids core	47.995	±	0.156	5897	±	26	3.8	6132	±	26	6986	±	35
2/17/2016	10-ooids core	46.949	±	0.156	6074	±	26	3.8	6308	±	26	7195	±	17
2/17/2016	12-ooids core	46.781	±	0.155	6103	±	26	3.9	6338	±	26	7277	±	25
4/14/2016	Bulk soil	95.36	±	0.27	382	±	22	-26.6	369	±	23	343	±	10
4/14/2016	Bulk soil	95.5	±	0.27	370	±	23	-26.6	357	±	22	344	±	15

*Calibration by Kevin Rey with CALIB version 7.0.4 using Reimer and others (2013)

Ooid samples were processed following a modified method from McGuire (2014). Ooids were screened to 40, 50 and 60 mesh. The 50 mesh fraction was used for radiocarbon analysis as these ooids were the greatest fraction by weight and volume and exhibited the most uniform spherical shape. Two splits of each ooid sample, one for outer cortex and one for inner core, was separated from the 50 mesh fraction under magnification until a suitable amount was obtained, typically about 100 mg each. Each split was reacted under vacuum with 85% phosphoric acid in a sealed vessel. Samples for the outer cortex were allowed to react for 30 seconds while simultaneously collecting the resulting CO_2 gas. Samples for the inner core followed a similar procedure as the outer cortex samples except the inner core samples were reacted with 10% HCl for two minutes and rinsed with DI water prior to placing them in a sealed vessel with 85% phosphoric acid. The resulting CO_2 gas from all ooid samples was collected and analyzed for ^{14}C using the AMS facility at the CAIS.

RESULTS

See table 2 for the radiocarbon ages from the ooid (cortex and core) and bulk soil samples. The ooid ages represent an ooid formation age and a possible maximum age for the deposition of the unit, in this case the deposition of the delta barrier bar deposit (unit Qlos) along the outer edge of the lobate delta (unit Qdy) (McKean and Hylland, 2013). The young bulk soil radiocarbon age may accurately represent the age of the soil, but could also be too young due to contamination by modern rootlets.

ACKNOWLEDGMENTS

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REFERENCES

McGuire, K.M., 2014, Comparative sedimentology of Lake Bonneville and the Great Salt Lake: Provo, Utah, Brigham Young University, M.S. thesis, 34 p.

McKean, A.P., and Hylland, M.D., 2013, Interim geologic map of the Baileys Lake quadrangle, Salt Lake and Davis Counties, Utah: Utah Geological Survey Open-File Report 624, 18 p., 1 plate, scale 1:24,000.

Reimer, P.J., Bard, E., Bayliss, A., Beck, J.W., Blackwell, P.G., Bronk Ramsey, C., Buck, C.E., Cheng, H., Edwards, R.L., Friedrich, M., Grootes, P.M., Guilderson, T.P., Haflidason, H., Hajdas, I., Hatté, C., Heaton, T.J., Hoffmann, D.L., Hogg, A.G., Hughen, K.A., Kaiser, K.F., Kromer, B., Manning, S.W., Niu, M., Reimer, R.W., Richards, D.A., Scott, E.M., Southon, J.R., Staff, R.A, Turney, C.S.M, and van der Plicht, J., 2013, IntCal13 and MARINE13 radiocarbon age calibration curves 0-50,000 years cal BP: Radiocarbon, v. 55, no. 4, p. 1869-1887.