Report on Examination of *QAR* Concretion Debitage

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INTRODUCTION

On January 21, 2004, approximately 767 kg of residual debitage, removed from concreted artifacts over the past 7 years, arrived at the Queen Anne's Revenge Conservation Laboratory in Greenville from the Underwater Archaeology Branch at Fort Fisher for final assessment and processing. The debitage was previously grouped by QAR# in large plastic bags and 5-gallon buckets following air scribing at Fort Fisher, the Institute of Marine Sciences in Morehead City, and Gallant's Channel and was resorted upon arrival in Greenville. The size of pieces varied from 24" lengths of cannon concretion (QAR# 233.001) to bags of minute particles and dust (QAR#366.076). The aims of processing and examination were to quantify the concretion debitage by QAR#, size, and weight, and to determine if any more artifacts remained within the concretions for possible removal or casting.

The *QAR* conservation staff contacted various experienced conservators to ask how they examine and dispose of concretion debitage. Treatment options were discussed with Donny Hamilton, director of the Texas A&M Conservation Research Laboratory, Curtiss Peterson, conservator at the Mariners' Museum in charge of the *Monitor*, and Bradley Rodgers, conservator and professor at East Carolina University. The debitage should first be weighed, examined, and checked for artifacts or artifact molds. The concretion debitage should then be manually broken down with air scribes, hammers, dental picks, etc. until a small size is reached, usually 1" pieces. Metal detectors and X-Ray fluoroscopy may also be used. Upon the completion of these steps and on agreement that no more artifacts remain in concretion, debitage burial is a practical and ethical means of disposal. Hamilton, Peterson, and Rodgers employ debitage disposal at their respective labs and museums and suggest burying concretion debitage in buckets or bags in a known location if future recovery is deemed necessary. They also agreed that it is unreasonable for a laboratory to store thousands of pounds of debitage for an indefinite period.

PROCESSING AND EXAMINATION

Weighing

In order to quantify the weight of debitage associated with each concretion or artifact, the conservation team used OHAUS CD11 and OHAUS Scout II weighing scales. The 5-gallon buckets and largest bags of concretion debitage were measured with the OHAUS CD11, capable of weighing objects up to 226.8 kg (500 lbs). Smaller bags and individual pieces were measured with the OHAUS Scout II and appear in grams. The total weight of concretion debitage was 767.25 kg (1,691.5 lbs) and the majority was from concretions associated with cannon and other large iron objects. The weight of debitage from QAR232.001 (C2) = 119.79 kg, QAR233.001 (C3) = 67.97 kg, QAR366.001 (C4) = 40.94 kg, and QAR418.000 (Baby Ruth) = 175.22 kg. TABLE 1 in the Appendix provides artifact numbers, weights, and results of a metal detector scan.

Metal detector Scan

Each bucket and bag of debitage was thoroughly scanned twice with a Bounty Hunter Fast Tracker metal detector with 7.25" search coil and adjustable discrimination. The discrimination was set to "low" in order for the detector to provide feedback for any type of metal. This setting allowed for detection of lead, pewter, iron, copper, silver, and gold, rather than only silver and gold. Prior to scanning the debitage, the concrete floor was scanned for metallic anomalies in order to eliminate false returns. Once a clear surface was found, the debitage was spread thinly over a large plastic tarpaulin. The search coil was then swept repeatedly over the debitage in an arc-like pattern until the entire contents of the bucket or bag were examined. Each bucket or bag of concretion debitage was scanned twice to minimize user error and false returns. Any areas or pieces that registered on the metal detector were bagged, numbered, and set aside for X-Ray examination. Objects from the following bags, QAR351.000, QAR418.000, C2, C2/C3, C4, unidentified cannon concretion, and general site concretion, registered positive returns on the metal detector and are described in TABLE 2 in the Appendix. The provenience of debitage in each bucket or bag was known, mixed, in question, or unknown.

X-Ray Inspection

On March 8, 2004, Krop and Nordgren examined a wide variety of concretion debitage with a TORREX 120D X-Ray Fluoroscope Inspection System at the ECU Maritime Studies Conservation Laboratory in Greenville. Pieces of debitage were selected for X-Ray analysis based upon the presence of metals indicated by the thorough metal detector scans. These fragments were examined with the fluoroscope at a range of 100 to 120 kV. One piece (? Cannon) was approximately 1' long and 2" thick while others (QAR#418.000) were less than 0.5" long and wide. Despite the variety of size and thickness, the X-Ray provided little if any penetration into the debitage. The lack of data obtained could be the result of many factors. First, the TORREX X-Ray has a limited range of kilovolts and a max voltage of approximately 130 kV, too low to provide a clear image of the material. Second, the concretion contains large amounts of iron corrosion products, calcium carbonate ($CaCO_3$), and debris, which are difficult to penetrate without increasing the kV to approximately 300, a capability not possessed by the TORREX machine. The outer layers of iron concretions contain high proportions of "calcium and magnesium carbonate and hydroxide which precipitate from the surrounding seawater, and also siderite ($FeCO_3$), but inside they consist almost entirely of the oxides and hydrated oxides of iron" (Cronyn 1990: 181). Third, the debitage in question may not contain artifacts despite positive returns when scanned in late February with a metal detector. The metal detector used to select viable candidates for X-Ray examination is an older, cheaper model and sometimes gives false returns. Despite these factors, a single piece of debitage (C2) measuring 1.5" long and 0.5" thick showed significant contrast in the X-Ray. The outline of a fastener/nail shank was clearly visible in the X-Ray and a small portion of the highly corroded nail was visible with a simple visual inspection. The concretion should be manually removed from the artifact to allow further treatment and analysis.

Although we identified only 1 new iron artifact and faced certain limitations regarding equipment capabilities, the exercise in the use of X-Ray fluoroscopy in the examination of concreted material proved valuable and may be of benefit in identifying iron fasteners in wooden planks and frame ends from the *Queen Anne's Revenge*. The results from the TORREX 120D X-Ray Inspection System are summarized in TABLE 2 in the Appendix.

DISCUSSION

Metal vs. Glass, Ceramics, and Organics

While it is possible for an X-Ray machine to detect glass and ceramics inside of a concretion, it is not very probable due to their low density, which results in a lack of contrast with the surrounding concretion. Metals, on the other hand, like the nail shank discovered in debitage from C2, are more dense and will appear on an X-Ray depending on the strength of the machine. The TORREX X-Ray Fluoroscope Inspection System is an older, weaker model and had difficulty penetrating the iron corrosion products in the concretion. It is possible that very small pieces of glass, ceramics, and organics went undetected, but the uncertain numbering on the buckets on arrival at the conservation lab would lead to questionable provenience if any minute artifacts were found. The conservation team's main goal during X-Ray analysis was to determine the presence of metals.

OPTIONS

Further Processing vs. Disposal

Following the aforementioned examination, the *QAR* project team faced a decision. The debitage could either be processed further or disposed in an ethical manner. Further examination and processing would involve breaking the remaining debitage into smaller and finer pieces and sifting and filtering the remains for any remaining artifacts. Processing would be time consuming and result in more waste products for the conservators to manage. And if smaller artifacts were found in buckets lacking specific provenience, the resulting data would be questionable. Disposal of debitage, on the other hand, is both practical and ethical. Disposal would allow the conservators to focus their efforts on more urgent and time-sensitive treatments. Disposal would involve burying the concretion debitage in sealed containers in a known location. Should future examination be deemed necessary or new techniques in concretion examination be developed, the debitage could be easily recovered and re-analyzed.

CONCLUSION

After extensive processing and discussion on the merits of concretion debitage storage vs. disposal, the material was transferred March 29, 2004, from the *Queen Anne's Revenge* Conservation Laboratory in Greenville, NC, to the North Carolina Underwater Archaeology Branch at Fort Fisher. The debitage will be stored at Fort Fisher and will be available for future research if required.

Appendix

TABLE 1 – QAR #, Weights, and Metal Detector Results (Bold/italicized rows indicate positive return with metal detector)

QAR#	Weight (kg)	Metal Detector Scan (+/-)
5.001	0.6 (g)	Negative
14.000	1.26	Negative
15.000	8.88	Negative
36.000	2.46	Negative
37.000	2.66	Negative
39.000	0.88	Negative
41.000	2.16	Negative
51.000	1.46	Negative
53.000	0.98	Negative
54.000	0.58	Negative
58.000	0.28	Negative
60.000	40.7	Negative
66.000	0.14	Negative
70.001	0.28	Negative
110.000	3.325	Negative
112.000	0.18	Negative
113.000	0.54	Negative
114.000	0.34	Negative
115.000	0.34	Negative
116.000	0.4	Negative
117.000	0.361	Negative
118.000	1.36	Negative
119.000	0.84	Negative
120.000	0.56	Negative
121.000	0.36	Negative
122.000	0.3	Negative
123.000	0.625	Negative
124.000	0.72	Negative
150.000	0.84	Negative
192.000	0.36	Negative
196.000	0.56	Negative
204.000	0.24	Negative
214.000	2.3	Negative
217.000	9.9 (g)	Negative
232.001	***119.79***	***Positive***
233.001	***67.97***	***Positive***
245.000	1.3	Negative

247.000	5.68	Negative
247.005	0.82	Negative
248.000	0.625	Negative
249.000	0.64	Negative
277.000	0.4	Negative
278.000	0.18	Negative
280.000	1.94	Negative
283.000	0.38	Negative
284.000	0.39	Negative
286.000	0.8	Negative
287.000	12.2 (g)	Negative
292.005	0.4 (g)	Negative
293.000	0.42	Negative
310.000	0.26	Negative
311.000	0.42	Negative
326.000	1.3	Negative
327.000	1.22	Negative
340.000	7.38	Negative
340.006	5.52	Negative
341.000	24.12	Negative
342.000	17.58	Negative
343.000	9.7	Negative
344.000	2.12	Negative
345.000	4.4	Negative
347.000	3.62	Negative
348.000	0.45	Negative
349.000	0.985	Negative
350.000	2.94	Negative
351.000	***93.6 (g)***	***Positive***
352.003	0.34	Negative
353.000	3.36	Negative
354.000	0.7	Negative
355.000	0.7	Negative
360.000	1.32	Negative
360.001	1.18	Negative
365.000	5.4 (g)	Negative
366.001	***40.94***	***Positive***
366.076	10.28	Negative
366.077	7.8	Negative
366.078	2.04	Negative
366.092	0.26	Negative
376.000	1.88	Negative
387.000	4.11	Negative
409.000	4.2 (g)	Negative

418.000	***175.22***	***Positive***
418.042	1.4	Negative
418.043	2.42	Negative
418.052	0.6	Negative
418.053	0.16	Negative
418.054	0.16	Negative
418.062	0.86	Negative
418.063	0.28	Negative
418.069	0.7	Negative
418.082	1.1	Negative
418.084	0.44	Negative
418.109	0.58	Negative
418.134	0.1	Negative
418.135	29.8 (g)	Negative
418.136	34.7 (g)	Negative
418.137	13.5 (g)	Negative
418.138	7.8 (g)	Negative
418.139	5.6 (g)	Negative
418.140	9.4 (g)	Negative
461.000	1.4	Negative
462.000	4.28	Negative
463.000	1.36	Negative
464.001	0.3	Negative
470.000	1.84	Negative
471.000	2	Negative
477.000	0.46	Negative
478.000	0.24	Negative
478.003	0.16	Negative
479.000	17.56	Negative
491.000	15.5	Negative
492.001	0.16	Negative
496.000	16.84	Negative
497.000	2.12	Negative
498.000	8.9	Negative
499.000	8.32	Negative
General Site	***1.74***	***Positive***
General Site	22.62	Negative
"	26.78	Negative
TOTAL	**767.25(kg)**	

TABLE 2 – X-Ray Inspection

Artifact #	KV	mA	Description
351.000	103.8	0.9	Insufficient penetration of concretion
418.000	120.3	0.9	Insufficient penetration of concretion
418.000	104.0	0.9	Insufficient penetration of concretion
418.000	120.4	0.9	Insufficient penetration of concretion
C2	119.4	0.9	Insufficient penetration of concretion
"	113.2	0.9	Same piece as above, possibly shank of iron fastener
C2/C3	100.1	0.8	Insufficient penetration of concretion
C2/C3	102.7	0.9	Insufficient penetration of concretion
C2/C3	108.9	0.8	Insufficient penetration of concretion
C4?	104.3	0.9	Insufficient penetration of concretion
Unidentified Cannon	118.0	0.9	Insufficient penetration of concretion
General Site	105.8	0.9	Insufficient penetration of concretion

Work Cited

CRONYN, J.M.
1990 *The Elements of Archaeological Conservation*. Routledge, London.