VERTEBRATE MICROFOSSILS FROM THE SHIELD WOLF QUARRY, LANCE FORMATION (MAASTRICHTIAN), CARBON COUNTY, MT, USA

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Background

The New Jersey State Museum (NJSM) has been prospecting in Montana's Bighorn Basin since 2001, as a part of the Bighorn Basin Dinosaur Project. In 2014, NJSM had collected surface material from Shield Wolf Quarry (SWQ). The quarry is located in southern Montana's Lance Formation, dated to the Maastrichtian stage (Late Cretaceous), about 66 to 69 million years ago. Some of the surface collected material was examined by NJSM staff prior to Temple University's acquisition of the remaining material. An extraction protocol was devised by Temple University to recover and identify microfossils and fossil productivity from the remaining 3.05kg of sediment collected. If the quarry exhibited high fossil productivity, then SWQ would be visited in subsequent years. The protocol would serve to recover microfossils efficiently and as effectively as possible for future collections from SWQ. The lithology of the sandstone pebbles was examined to determine the paleoenvironment.

Figure 1: Location of Shield Wolf Quarry in south central Montana.

Figure 2: Sediment was weighed and placed into 100mL or 250mL labeled beakers before acetic acid solution was added.

Figure 3: Sandstone pebbles being screen washed in a sink to recover microfossils.

Figure 4: Each microfossil was weighed on a scale after being recovered to find the percent yield from 3.05kg of sediment.

Methods and Materials

1. Dissolution - Sediment was weighed between 25 to 40g in 100mL or 250mL plastic beakers and dissolved with 0.15M acetic acid solution for 5 to 7 days. A second dissolution was carried out to see if more calcritic matrix could be dissolved using 4 beakers, 2 250mL and 2 100mL beakers, with 0.15M acetic acid solution for 5 days.
2. Handwashing - Dissolved sediment was neutralized with distilled water and manually picked to recover microfossils.
3. Sieving - Sediment was screen washed with water using sieve sizes 5, 10, 35, 60, 120 and 230 mesh and dried in a lab oven between 40-44°C for 1-5 days.
4. Identification - Recovered microfossils were weighed, measured, and identified using a binocular microscope. They were then stored in labeled small plastic specimen bags.

Results

- A second dissolution was carried out for 4 beakers with the same parameters, with an average loss of 14.6% matrix dissolved.
- The manual pick yielded the highest amount of microfossils with over 358 microfossils collected. The first, second and third screen washes yielded 28, 5 and 21 microfossils respectively. Microfossils collected from the sieves were an average size of 3.3mm and were frequently rounded and broken.
- Over 627 microfossils were recovered by NJSM and Temple University, of which 198 were teeth, 80 were scales, 345 bones, 3 petrified wood and 1 snail shell. Temple University yielded over 414 microfossils, or 1.18% out of the 3.05kg of sediment.
- There was a high amount of indeterminate skeletal elements, compromising 26.6% of the microfossils recovered, which showed a high degree of roundedness.
- A high fossil content of aquatic and semi-aquatic taxa were indentified. Osteichthyes (mostly gars), Chondricthyes, Testudines and Crocodilia comprised over 77% of identified material. There was a high diversity of turtles indentified, including genera *Adocus*, *Basilemys* and *Compsemys*.

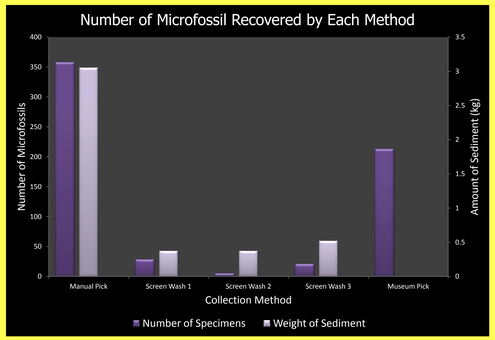

Figure 5: Figure shows the number of microfossil examined relative to the weight of sediment analyzed for each preparation method. Screen washes 1, 2 and 3 found significantly less material than the manual pick. The museum pick did not record weight of sediment during their analysis.

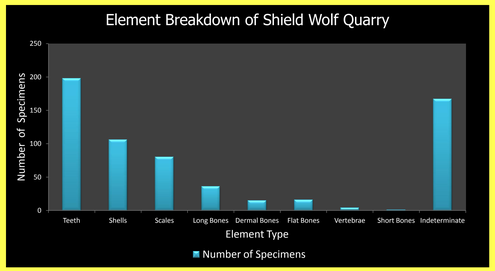

Figure 6: Element breakdown of vertebrate microfossils found at SWQ. Teeth were the most frequent element found followed by turtle shell fragments. There was a total of 167 unidentifiable element fossils.

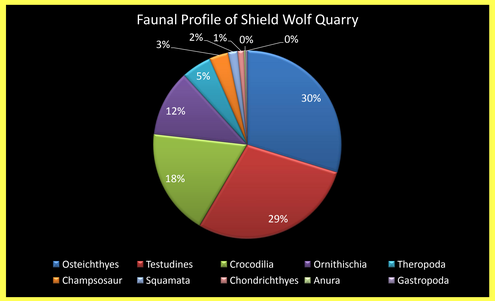

Figure 7: A faunal profile of the 364 microfossils identified to a taxon at Shield Wolf Quarry. The remaining 258 microfossils could not be identified to a taxon and were not included in this profile. Osteichthyes, Testudines and Crocodilia constitute over 77% of the fossils identified.

Discussion

- Future analyses of SWQ should sieve after the acid dissolution is preformed. Hand picking fossils was tedious and time consuming. If dissolution and sieving are combined, it would reduce time spent on recovering fossils instead of looking for fossils after each method.
- Only one acid dissolution is necessary. The second acid dissolution performed on a few beakers showed that the calcritic matrix lost was negligible.
- Paleoenvironment was determined to be an ancient meandering river channel due to lithology of coarse sandstone chunks, roundedness of indeterminate bone fragments, and taxa recovered. This is consistent with the facies found throughout the Lance Formation, which was an ancient coastal plain with many streams that bordered the Western Interior Seaway. All microfossils recovered were disarticulated and broken indicating that they were transported by water from their original source.
- Future excavations will continue to take place at SWQ in future field seasons. Remaining material from the 2014 season continues to be analyzed. Microfossils recovered from the remaining 2014 material does not include new taxa and many of the bone fragments are abraded.

Acknowledgements

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