Evaluation of Rocks found on Sargent Beach

By Peggy Romfh

Introduction

In February, 2018, we found several rock specimens in the shallows or on shore at Sargent Beach. We report on our observations and basic physical and chemical testing done on the rocks to determine whether or not they represented limestone, sandstone, or both.

In general the rocks were of two types:

Type 1: Heavy, dense rocks embedded with a large number of broken shell debris. Size varies but generally the rocks are 2-5 inches in diameter and length. The rocks have a rough surface with some porosity, as some air bubbles are formed when the rocks are placed in water. It takes several blows from a hammer to break a piece off of this type of rock.

Type 2: Smaller, medium dense rocks of weird shapes, often pitted with holes, with no or little shell debris embedded. Size and shapes vary but generally the pieces are 1-3 inches in diameter. The rocks have a fairly smooth, sand-like surface. Because the pieces are fairly small, a piece will break off with a few blows of a hammer.

Background

Sargent Beach is unique among Texas Mid-Coast beaches in that it is the fastest eroding beach along the Texas Coast. The soil underneath all the sand is clay, which may contribute to the erosion rate. The beach receives little or no replenishment sediment from the Brazos or San Bernard Rivers, and it has been an area in which a lot of dredging has occurred to support the building and maintenance of the Intracoastal Waterway. In nearby Matagorda Bay, there are remnants of dredge-spoil islands from old dredging operations. The islands are slowly eroding.

In addition, there have been ongoing beach replenishment projects to replace sand that has eroded. In 2013, there was a beach nourishment project that added approximately 80,000 cubic yards of sand starting at FM 457 and extending eastward. However, the rock specimens we found all represented lithified rock and were found on the beach west of FM 457. The sand was expected to last from one to two years after construction and less if the beach was impacted by a storm. The Sargent and Matagorda Bay areas were directly impacted by Hurricane Harvey in August of 2017, and the rocks we found were on the beach six months later, in February of 2018.

Per the Sargent web site, dredging of the Intracoastal Waterway has had a small impact on the beach. In areas where the dredge material has been deposited, the beach area is a little higher than the rest of the beach. This area tends to be muddy and full of seashells. [Source: http://www.sargenttexas.org/beach.html]

Given this history, it is possible that the rocks we found washed ashore from dredge spoil island erosion, were lithified sedimentary rocks from the ocean bottom that washed ashore after Hurricane Harvey, or represented sedimentary rocks that washed down from rivers and creeks. Note that we do not usually observe more than the occasional rock along this beach. In early spring of this year, large numbers of rocks were found.

These rocks were thought to be either limestone or sandstone sedimentary rocks (or a mixture of both). [https://geology.com/rocks/sedimentary-rocks.shtml]

- Limestone is a sedimentary rock consisting of more than 50% calcium carbonate in the form of calcite by weight. There are many different ways that limestone forms, including precipitation from water, secretion by marine organisms such as algae or coral, or cementation of sand by calcite (calcium carbonate). A key way that limestone forms is from the lithification of shells (clasts) of dead sea creatures such as bivalves.
- Sandstone is a sedimentary rock consisting of sand-size grains of mineral, rock, or organic material. The sand grains are formed from erosion and weathering of larger rocks and transported and deposited by the action of wind, water or ice. Sandstone also contains a cementing material that binds the sand grains together.

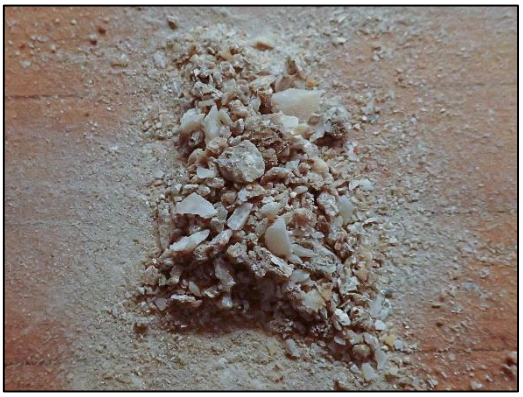
Testing [See additional test methodology notes at end of testing section.]

We performed the following tests on a specimen of each type of rock:

Type 1: Fossiliferous Limestone and/or Coquina Limestone

- **Positive Acid test**: strong, immediate, foaming and bubbles with 5% HCl, indicating calcium carbonate presence.
- **86% Carbonate Rock** based on destructive acid testing with HCl
- **2.29 g/cm^3 Density** [medium density limestone is 2.16; high density limestone is 2.56]
- Moh's Hardness: **relative hardness between 3.0-5.0 H**
- **Conclusion:** Type 1 rocks are either fossiliferous limestone, with variably sized shells and other fossils in fine-grained matrix or coquina limestone, composed almost entirely of abraded shell hash and little matrix.

Original specimen: 350 g; shell fragments visible in rock matrix.



Tested specimen: 7 g; specimen was coarsely pulverized prior to testing.

Acid test: 5% HCl was added to the specimen. Foaming and effervescence were strong and immediate.

Post-acid test: specimen was filtered, rinsed and allowed to dry. Specimen residue weighed 1 g. A small amount of sand remained.

Type 2: Carbonate Sandstone

- **Positive Acid test**: steady fizzing but no large bubbles with 5% HCl, indicating calcium carbonate presence
- **50% Carbonate Rock** based on destructive acid testing with HCl [rock must contain a majority of carbonate chemical to be called limestone.]
- **2.0 g/cm^3 Density**
- Moh's Hardness: **relative hardness between 3.0-5.0 H**
- **Conclusion: rock is probably carbonate sandstone.** It appears to contain both types of sedimentary rock (limestone and sandstone.)

Original specimen: 67 g; shell fragments visible in rock matrix. Rock shows pitting but no visible shell debris.

Tested specimen: 4 g; specimen was coarsely pulverized prior to testing. Pulverized specimen has appearance of fine sand.

Acid test: 5% HCl was added to the specimen. Foaming occurred immediately but no large bubbles occurred.

Post-acid test: specimen was filtered, rinsed and allowed to dry. Specimen residue weighed 2 g. Considerable sand remained after the acid test was done.

Notes on Experimental Testing:

1. Acid Test – room temperature HCl (hydrochloric acid) was used. To distinguish between calcium and magnesium carbonate, a drop of cold acid vs. warm acid should be used. If you place cold HCl on calcite, it will erupt with bubbles and a vigorous fizz. There is little or no reaction with cold HCl and magnesium carbonate. However magnesium carbonate will dissolve slowly in the presence of warmer acid. Since vigorous fizzing and bubbles from carbon dioxide release occurred with both types of rock, the test did show the presence of calcium carbonate rock but did not rule out the additional presence of magnesium in the rock.

   $$CaCO_3 + 2HCl \rightarrow CO_2 + H_2O + Ca^{++} + 2Cl^-$$

2. Density – a postal scale was used to measure weight of the rock. It is accurate to one gram. A graduated cylinder was used to measure the displaced volume. The density was calculated as weight in grams/volume in mL (i.e., cc). A scale that reads to 0.1 g would give greater accuracy in the measurement.
3. % Carbonate by weight was done by breaking a piece of rock off the original larger rock, then coarsely pulverizing it with a mallet. The pulverized specimen was placed on a coffee filter and weighed on a postal scale. Then 5% HCl was added to the specimen in incremental amounts until no more foaming or effervescence was seen. The sample was allowed to sit about 4 hours to make sure the chemical reaction was complete. The specimen reaction mixture was then poured into a funnel containing the coffee filter. The reaction container was rinsed twice with water and all material in the reaction container was added to the funnel. The filter paper containing the residue was allowed to dry overnight before the post-acid weight measurement was done.
4. Hardness Test – Moh's hardness test done with reference standard rocks. The Type 1 rocks (likely fossiliferous limestone or coquina limestone) were difficult to test because of the rough surface of the rocks. For both rocks, a relative hardness level between 3.0 and 5.0 was observed.

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