SANDCRACKS & SANDCHIPS: EXPERIMENTALLY PRODUCED SEDIMENTARY FEATURES IN OOID SAND & GLASS BEADS


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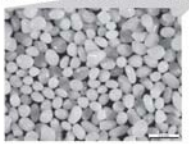
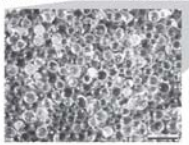



OBJECTIVE: to examine formation of unusual sedimentary features in mud-free sandy materials.

POLYGONAL SANDCRACKS in OOID SAND (from Glumac et al.)

Polygonal fractures were produced by drying of mud-free beach sand from Cat Island, Bahamas that is fairly well sorted and composed mainly of well rounded, fine to medium sand size (100-400 µm), spherical to elliptical ooids.

Moist sand:

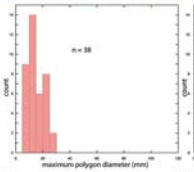
Dry sand:

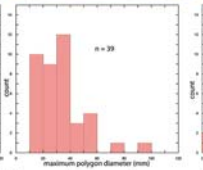
Layers made of cohesive, moist ooid sand had abundant large irregular pores, similar to those common in beach deposits. When left to dry at room temperature, the porosity was reduced due to loss of cohesion, gravitational collapse and repacking of grains. During this process the sand surface cracked and the resulting polygonal sandcracks resembled desiccation mudcracks.

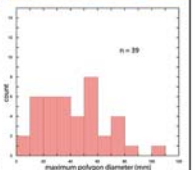
Dry sand: 1 cm thick

3 cm thick

5 cm thick







The relationship between layer thickness and polygon size was examined by measuring the longest polygon diameter for 1, 3 and 5 cm thick layers. The observed positive relationship is similar to the relationship documented in muddy deposits with desiccation mudcracks.

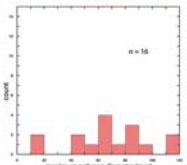
POLYGONAL SANDCRACKS in GLASS BEADS

The same results were obtained in experiments with glass beads of similar texture as ooid sand. Beads made of commercial glass (soda-lime glass) were moistened with DI water.

Moist glass beads:

Dry glass beads:

Dry glass beads: 5.5 cm thick



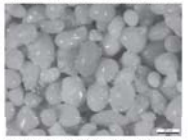
Polygons produced in glass beads were smaller and fewer than in ooid sand of similar thickness.

SANDCHIPS

We also produced sandchips, similar in origin and morphology to muddy intraclasts or clay chips, by disturbing the surface of moist or cracked sand and glass beads.

in OOID SAND

Aggregates or chips on the surface of moist ooid sand.



Cohesion within dried sand-chips is caused by any remaining capillary moisture and precipitated cements.

SEM image and EDS spectrum of halite that precipitated on and between ooids. Salt was naturally present in beach sand and aided in lithification and preservation of sandchips.

in GLASS BEADS

Aggregates or chips on the surface of moist glass beads.

Chips made of dried glass beads were surprisingly hard.

Aggregates of dried beads.

SEM image of a bead to bead contact suggesting that some dissolution and precipitation may have occurred.

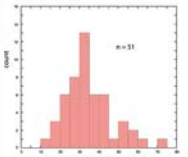
FIELD EXAMPLE (from Glumac et al.)

4- to 6-sided polygons with jagged edges were observed on bedding planes of ooid grainstone deposits in a modern beach backshore setting and in the Holocene Rice Bay Formation on Cat Island, Bahamas (Mylroie et al., 2006: images from GoogleEarth):

Older Holocene North Point Mb Eolianite

Polygons are present in the North Point Member eolianite, but are not as common nor as obvious as in the overlying Hanna Bay Member deposits.

Most polygons have tightly fitting and jagged sides (see above), but some have been displaced, with the resulting cracks filled with sediment.

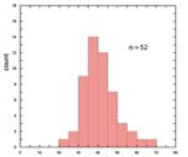


Representative histogram showing the range and distribution of maximum polygon sizes along a bedding plane of North Point Mb deposits.

Younger Holocene Hanna Bay Mb Eolianite

Polygonal cracking is common in Hanna Bay eolianite. The presence of wind ripples supports eolian deposition of this carbonate sand.

Some of the bedding planes in the Hanna Bay eolianite are characterized by nested polygons: many smaller polygons are present within a larger one.

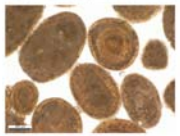


A comparison between the North Point Mb eolianite (to the left) and the Hanna Bay deposits reveals a similarity in the range and distribution of polygon sizes.

Modern Beach Backshore Deposits

Polygons were observed in poorly lithified ooid-rich sand from the backshore beach and its transition into eolian dune deposits.

Polygons produced by cracking of poorly lithified ooid-rich backshore beach sand are very friable and crumble easily.



Thin section photomicrograph of a polygon in backshore beach sand reveals the abundance of ooids barely held together by a small amount of meniscus carbonate cement.

IMPLICATIONS

- Although polygonal desiccation cracks and intraclasts are usually associated with muddy deposits, our experiments demonstrate that such features can be produced in homogenous, mud-free, relatively fine-grained, well-sorted, round, spherical to elliptical sand-size material of various compositions.
- Uniform size and regular shape of such material appear to provide homogenous distribution of liquid bridges between grains so that sand can contract and crack polygonally due to stresses generated by surface tension when continuous films of interstitial water break into isolated capillary films during desiccation.
- While texture seems to control the formation of sandcracks and sandchips, the composition of sand and interstitial fluids influence their preservation by rapid lithification. The presence of salt and carbonate cements favors preservation in eolian and beach carbonate sand as supported by field examples from Cat Island, Bahamas.
- The apparent paucity of these features in the geological record suggests that generally they are not easily produced and/or preserved.

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