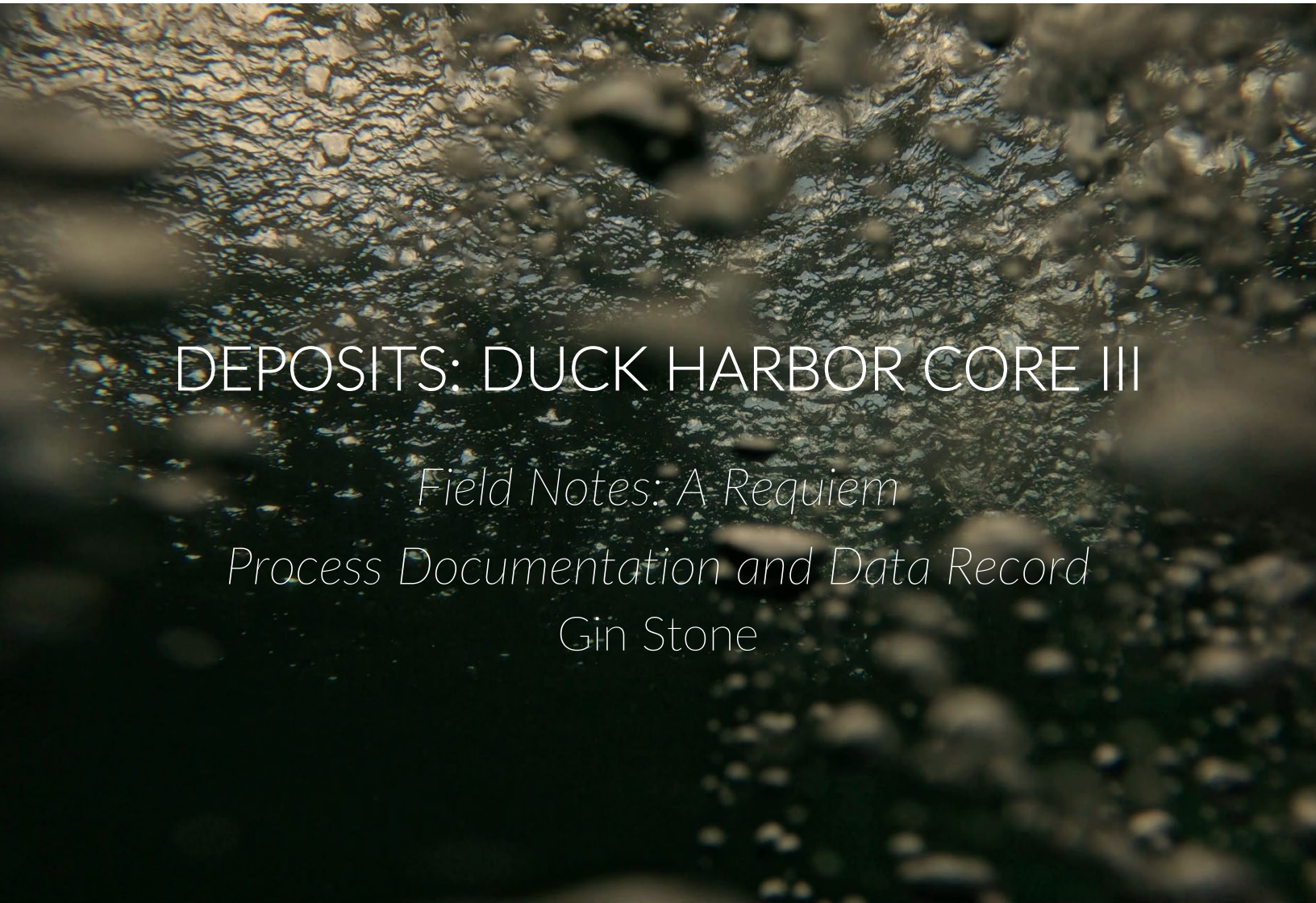




DEPOSITS: DUCK HARBOR CORE III

Field Notes: A Requiem

Process Documentation and Data Record

Gin Stone

OVERVIEW

Deposits: Duck Harbor Core 3 is a sound work that translates 1,200 years of sediment core data from Duck Harbor saltmarsh, Wellfleet, Massachusetts into music. It is the first completed piece in the Deposits commission, itself the first work in the ongoing series *Field Notes: A Requiem*. The piece was completed in September 2026 using custom Python code to generate a six-track MIDI file from scientific datasets, subsequently realized in Reaper with instrument samples from the G-Town Church Sampling Project. Presented duration is approximately 3 minutes 10 seconds, reflecting the natural decay of sustained instruments beyond the last MIDI note at 3:08.

[LISTEN](#)



SITE CONTEXT

Duck Harbor is a saltmarsh located within the Herring River watershed in Wellfleet, Massachusetts. The site is central to one of the largest tidal marsh restoration projects in New England, a multi-agency effort to restore tidal flow that was cut off by the construction of the Chequessett Neck Dike in 1909. The dike blocked tidal exchange for over a century, fundamentally altering the marsh ecology. The restoration project is ongoing.



SCIENTIFIC COLLABORATION

Primary Scientist: Dr. K. Castagno, Geologist, Center for Coastal Studies, Provincetown, Massachusetts.

Dr. Castagno collected five vibracores from Duck Harbor (DH_VC_3.1 through DH_VC_3.5) and provided all sediment analysis data including loss-on-ignition organic percentage measurements, grain size analysis, Munsell color classification, and Bacon age models. Core 3 (DH_VC_3.3) was selected as the first piece in the series because it is the deepest of the five cores with reliable dating, extending to 140cm and recording approximately 1,200 years of marsh history.

A public talk presenting the completed *Deposits* series is scheduled for June 2027 at the Center for Coastal Studies, Provincetown, Massachusetts.

Funding: The Arts Foundation of Cape Cod.



SOURCE DATA FILES

1. DH_VC3_3_42_ages.txt - Bacon Age Model

A tab-delimited text file containing the Bacon age model for Core 3. Contains 201 depth points from 0cm to 200cm. Years before present are converted to calendar years using the formula: calendar year = 1950 minus median age.

Depth range: 0cm to 200cm (201 points)

Year range of age model: 212 CE to 2024 CE

Year range used in piece: 817 CE to 2016 CE (constrained by sediment data depth range of 1cm to 140cm)

1635 Hurricane: 43cm depth, median calendar year 1633 CE, 95% confidence interval 1572 CE to 1704 CE

1909 Dike: 13cm depth, median calendar year 1912 CE

2. DHVC3_3data2.csv - Sediment Analysis Data

A comma-separated values file containing sediment measurements at each sampled depth in Core 3.

Total data points: 140 depth measurements from 1cm to 140cm

Organic percent range: 0.2% to 75.1%

Grain size range (d50): 39.0 to 647.3 micrometers

Sediment types present: Very Fine Sand (5 points), Fine Sand (38 points), Medium Sand (45 points), Coarse Sand (43 points), Very Coarse Silt (9 points). No clay or peat identified in this core

3. Munsell Color Reference

Sediment colors were classified using the Munsell Color Chart 10YR series. Classification for track assignment was performed using text description only - color codes were not used as they proved unreliable as standalone indicators for sediment type in this core.

4. image-cores_copy.jpg - Core Photograph

A photographic image of all five Duck Harbor vibracores arranged side by side with depth scales. Core 3 (DH_VC_3.3) is the third from the left and extends to approximately 140cm. The photograph was used as a sixth data source for the visual core scan track, scanned pixel by pixel from bottom (oldest) to top (most recent).

KEY SCIENTIFIC FINDINGS FROM CORE 3

No Peat or Clay

Core 3 contains no peat or clay layers. The entire 140cm record consists of sand and silt only, indicating this location within Duck Harbor was subject to consistently energetic hydrological conditions throughout the recorded period.

The 1635 Great Colonial Hurricane

Confirmed present in Core 3 at 43cm depth, median calendar year 1633 CE, 95% confidence interval 1572 CE to 1704 CE. Appears in the sediment record as a coarse sand deposit. Dr. Castagno confirmed the hurricane is visible in cores 3 and 4 only.

Surface Organic Bloom

The surface layers record a dramatic increase in organic content to 75.1%. This represents the most recent deposition captured before sampling and does not represent restoration effects, as the restoration was not yet complete at the time of sampling. In the piece this registers as the organic melody blooming to its highest pitch and loudest volume in the final seconds.

HOW THE DATA WAS TRANSFORMED INTO MUSIC

Time Axis

The Bacon age model converted each sediment depth to a calendar year. The oldest data point in the sediment CSV (140cm, 817 CE) was mapped to the beginning of the composition. The most recent data point (1cm, 2016 CE) was mapped to the end. The piece travels from ancient to recent - oldest layer first, most recent last. The MIDI spans approximately 188 seconds to the last note, with natural instrument decay continuing to approximately 3:10.

Sediment Classification by Description

Each of the 140 depth measurements was classified into one of four tracks using text description matching only:

Track 1: Very Fine Sand and Very Coarse Silt (14 data points total)

Track 2: Fine Sand (38 data points)

Track 3: Medium Sand (45 data points)

Track 4: Coarse Sand (43 data points)

Note Clustering by Energy

The physical energy required to transport sediment particles increases with grain size. This was encoded musically through note clustering: Very fine sand and silt generate 1 note per data point. Fine sand generates 1 note per data point. Medium sand generates 2 simultaneous notes per data point. Coarse sand generates 3 simultaneous notes per data point.

Velocity Scaling

Note velocity (loudness) was scaled proportionally to grain size (d50) across the confirmed range of 39.0 to 647.3 micrometers. Larger grain size equals louder note.

The 1635 Hurricane Marker

The hurricane layer at 43cm depth maps to a beat position of 2:07 in the rendered piece. This is calculated from: the age model placing 43cm at 1633 CE, the sediment data confirming coarse sand at 43cm, and the MIDI timing scaling 1633 CE to 127.9 seconds in the actual file. The hurricane is audible as part of the coarse sand track (bongo loop) which enters at 1:18

Organic Percent Melody

A continuous melodic thread runs through the entire piece on Track 5. Each of the 140 data points generates one note. Pitch is determined by organic percentage across the confirmed range of 0.2% to 75.1%. Low organic maps to low Gong pitch, high organic maps to high pitch. The melody is very quiet and low for most of the piece, then blooms loudly in the final seconds as the surface layer's 75.1% organic content registers.

Visual Core Scan

A sixth track was generated by scanning the actual photograph of Core 3 pixel by pixel from the bottom (oldest) to the top (most recent). At each of 120 evenly spaced sample points, the average brightness of a horizontal strip across the core column was measured. Dark pixels mapped to lower Gong pitches, light pixels to higher pitches. This track sits in the C2 register and acts as a quiet continuous foundation.

The Gong Pentatonic Scale

All six tracks use the Gong pentatonic scale: C, D, E, G, A - semitone offsets 0, 2, 4, 7, 9 from root. The scale contains no semitones and no tritone, producing no dissonance regardless of which combination of notes sound simultaneously. Track registers: Track 1 C3, Track 2 C4, Track 3 C5, Track 4 C6, Track 5 C4, Track 6 C2.

INSTRUMENT ASSIGNMENTS

All instruments from the G-Town Church Sampling Project by Tobias Marberger. Creative Commons license.

Track 1 - Very Fine Sand / Very Coarse Silt: Toy Glockenspiel C#4

Track 2 - Fine Sand: Egg

Track 3 - Medium Sand: Mandolin C#4

Track 4 - Coarse Sand: Bongo Loop

Track 5 - Organic Percent Melody: Wood Sticks

Track 6 - Visual Core Scan: Water Bowl B

CONFIRMED TRACK TIMESTAMPS

All timestamps below are confirmed by direct analysis of deposits_core3_fixed__6_.mid:

Track 1 - Very Fine Sand / Very Coarse Silt: first note 0:58, last note 1:14

Track 2 - Fine Sand: first note 0:00, last note 2:18

Track 3 - Medium Sand: first note 0:16, last note 2:02

Track 4 - Coarse Sand: first note 1:18, last note 2:55

Track 5 - Organic Percent Melody: first note 0:00, last note 3:08

Track 6 - Visual Core Scan: first note 0:00, last note 2:57

Total MIDI notes: 515

Tempo: 60 BPM

Last MIDI note: 3:08

Presented duration: approximately 3 minutes 10 seconds including natural instrument decay

CONFIRMED HISTORICAL TIMELINE

Event timestamps calculated from age model and sediment data, verified against actual MIDI file timing. Hurricane timestamp confirmed from direct mapping of 43cm depth through age model to MIDI beat position.

0:00 | 817 CE | Piece begins

1:45 | 1492 CE | Colonization of the Americas begins

2:05 | 1620 CE | Pilgrims arrive

2:07 | 1635 CE | Hurricane (confirmed at 43cm depth, median 1633 CE)

2:30 | 1776 CE | American Revolution

2:51 | 1909 CE | Chequessett Neck Dike construction

2:59 | 1962 CE | Rachel Carson publishes Silent Spring

3:08 | 2016 CE | Sampling / last MIDI note

TECHNICAL SPECIFICATIONS

MIDI format: Format 1, 6 tracks, 480 ticks per beat

Tempo: 60 BPM

Total notes: 515 (confirmed by direct file analysis)

Note duration: 0.5 beats per note. Sustain handled by instrument release in Reaper.

Source MIDI file: deposits_core3_fixed__6_.mid

DAW: Reaper

Code: Custom Python script generating binary MIDI directly from scientific data files.

CITATIONS AND REFERENCES

Primary data: Castagno, K. (2025). Duck Harbor Vibracore Dataset DH_VC_3.3. Center for Coastal Studies, Provincetown, Massachusetts. Unpublished raw data.

Age modeling: Blaauw, M. and Christen, J.A. (2011). Flexible paleoclimate age-depth models using an autoregressive gamma process. Bayesian Analysis 6(3): 457-474.

Color classification: Munsell Color Chart, 10YR series. Munsell Color, Grand Rapids, Michigan.

Instrument samples: Marberger, Tobias. G-Town Church Sampling Project. Creative Commons license. Grebbestad, Sweden.

Site context: Herring River Restoration Project. herringriver.org.

Historical event: Hurricane of 1635. Confirmed in sediment record by Dr. K. Castagno, 2025. Present in cores 3 and 4 only.

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