

# Massachusetts Geophonic

by Arvid Tomayko

[arvidtomayko.com](http://arvidtomayko.com)

2013-14

Contents:

- **Quick Start**
- **How it Works**
- **Controlling Massachusetts Geophonic**

# Massachusetts Geophonic

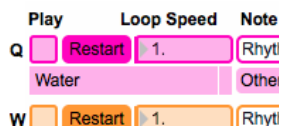
## Quick Start

Massachusetts Geophonic is a performative interactive piece that uses data from the USGS Massachusetts geological map as a palette with which the performer can create music – music from geologic data. Here's how to quickly get going:

- Use the mouse to drag the endpoints of one of the four colored lines in Cape Cod Bay so the line is on the map of Massachusetts.



- Click the **Play** button at the left of the controls corresponding to the color of the line.



- The playhead should begin to move and you should hear notes being played. You're good to go! If not, see “Troubleshooting” below.
  - Experiment with moving the line around and listening to different regions of the map or changing the speed of the loop.
  - When you've got the hang of that, try turning on the **Rock Type > Timbre** mapping in the top right corner.
  - Clicking a geologic term in the controls section will search for it using Google.

## Troubleshooting

### Nothing is Happening...

If the playhead doesn't move and/or you hear no sound, you may need to adjust your audio settings.

- Make sure you're volume is turned up :-)
- Make sure **Audio Processing** is checked in the mixer

- Click the Audio Processing **Settings** button to bring up the audio settings dialog. Select your desired audio driver and input and output device.
  - On Mac the driver should always be “Core Audio” and, unless you have another audio interface you want to use, the output should be “Built-In Output”
  - On Windows things are a bit more difficult to predict since there are so many different hardware configurations. If you have an MME driver try using that. If you have a 3<sup>rd</sup> party audio interface with an ASIO driver, this will give the best results.
  - The input device is not important – Massachusetts Geophonic does not use audio input
- You may have to turn Audio on at the top of the settings dialog if it is off.
- Massachusetts Geophonic should remember your audio settings at the next launch and you shouldn't have to go through this again.

## Audio Glitches

If the audio is cutting in and out or has glitches, you may need to adjust your audio settings. I find these settings need tweaking much more often on Windows than they do on Mac.

- Click the Audio Processing **Settings** button to bring up the audio settings dialog.
- Try increasing the “I/O Vector Size”. This will add latency, but reduce demands on your computer.
- If Sampling Rate is greater than 44100 Hz, try reducing it to 44100.
- If you're on Windows, try a different audio driver from the “Driver” list.
- Try increasing “Signal Vector Size”. This may or may not slightly change the behavior of the sound generation.
- Try enabling/disabling “Parallel Processing”.
- Make sure the Input Device you're using is on the same piece of hardware as your output device.

If none of this works, your computer may just be too slow. Sorry :-)

# Massachusetts Geophonic – How it works

Massachusetts Geophonic is a performative interactive piece that uses data from the USGS Massachusetts geological map as a palette with which the performer can create music – music from geologic data.

## Data

The map of Massachusetts shows various layers of geological data:

- Bedrock Type
- Bedrock Age
- Faults
- Surface Covering
- Surface Covering Depth
- Gravity anomaly (which is a measure of the density of rock beneath the surface)

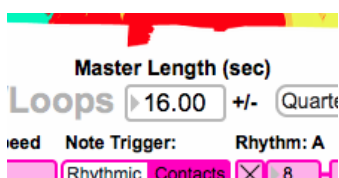
The check boxes in the upper right turn on or off the effect of each of these layers of data on the sound produced.

## Loops



The four colored lines represent transects or paths through the map that you can move – either by dragging the endpoints or the entire line. Musically, they're loops with a playhead that travels along them over and over again. The geologic data under this playhead at any given time determines the sound that's produced. Generally, a playhead will play a note when it crosses a boundary into a new type or age of rock, but a playhead can also be set to sample the data underneath it at specific intervals so that it plays notes in a rhythmic pattern.

The Master Length determines how long the loops are – and hence how quickly the music repeats itself.



Each loop also has its own controls. There are four sets of controls, corresponding to the similarly colored loops. These allow you to

- play or pause the loop
- reset its playhead to the beginning
- change the speed of the loop relative to the Master Length (or even reverse it)
- play notes either at geologic contacts, or in a rhythmic pattern
- setup up to two concurrent rhythmic patterns
- transpose the pitch of the notes
- change the mapping curve of bedrock age to pitch

Play	Loop Speed	Note Trigger:	Rhythm: A	B	Pitch: Transpose	Curve	Sync	
Q	Restart 1.0	Rhythmic Contacts	<input checked="" type="checkbox"/> 8	<input checked="" type="checkbox"/> 6	0	0.25	off	1
Water		Other	Water	N/A	0			
W	Restart 1.0	Rhythmic Contacts	<input checked="" type="checkbox"/> 8	<input checked="" type="checkbox"/> 6	0	0.25	off	2
Water		Other	Water	N/A	0			
E	Restart 1.0	Rhythmic Contacts	<input checked="" type="checkbox"/> 8	<input checked="" type="checkbox"/> 6	0	0.25	off	3
Water		Other	Water	N/A	0			
R	Restart 1.0	Rhythmic Contacts	<input checked="" type="checkbox"/> 8	<input checked="" type="checkbox"/> 6	0	0.25	off	4
Water		Other	Water	N/A	0			

Below each of the control sections is information showing the bedrock type and some of its geologic attributes, as well as its age in “Millions of Years Ago” and what the surface covering is like in that area. You can click these text fields to google the term.

## Timeline

Additionally, the piece displays bedrock age in the timeline at the bottom, with a colored bar corresponding to each loop on the map. Note that the time scale is not linear... some of these rocks are very, very old.

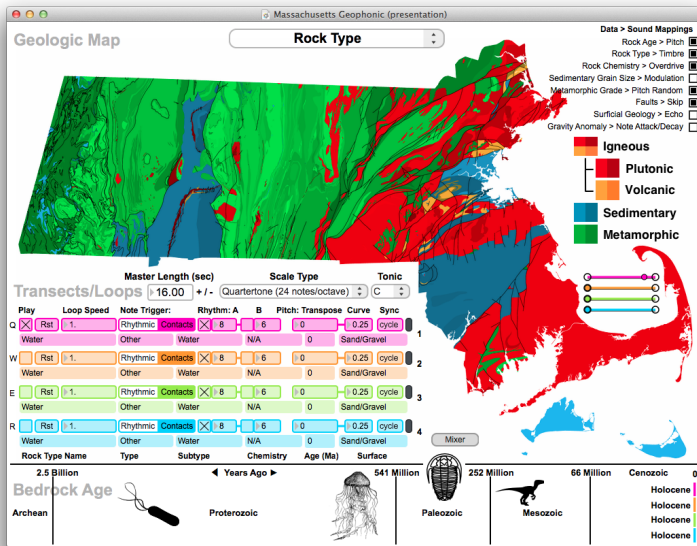
## Data to Sound Mappings

The basic data mappings are as follows:

- Rock Age determines pitch, and also when to play notes in “contacts” mode. You can choose a musical scale and tonic to map the rock age to.
- Rock Type (sedimentary, metamorphic or igneous) determines timbre, or instrument type, for each note:
  - Sedimentary rocks are noisy, percussive sounds
  - Metamorphic rocks are a saw wave
  - Igneous rocks are represented by a resonant filtered oscillator.

- Rock chemistry (mafic to felsic) determines note overdrive
- Grain size determines tremolo or modulation for sedimentary rocks. You can see this represented as different shades of blue on the Rock Type map.
- The metamorphic grade of a rock determines granular pitch randomness. You can see this represented as different shades of green on the Rock Type map.
- Faults produce record skip-like sounds whenever a playhead crosses one.
- Surficial Geology (the surface “stuff” that covers the bedrock) determines the length and feedback of a delay or echo.
- Lastly, isostatic gravity anomaly determines the attack and decay characteristics of the notes.
- The playhead's location East-to-West on the map determines the Left-Right panning of the sound produced.
- Areas outside the state or in the ocean will not produce sound.

# Controlling Massachusetts Geophonic

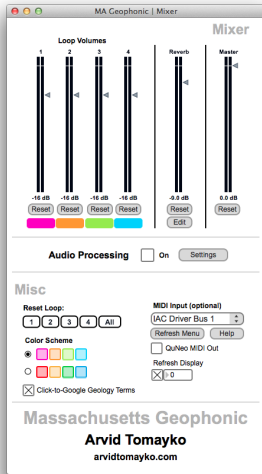


## Controls

- **Click and Drag Up or Down** to increase or decrease value of number boxes.
  - Note: Dragging in the left side of the box changes the value by larger increments, dragging in the right side changes the value by smaller increments.
- Map
  - **Drag the Endpoint** of a loop with the mouse to position it on the map
  - **Shift-Drag** a loop to move both endpoints at once
  - **Click and Drag** on a loop's middle section to move its playhead
  - **Data > Sound Mappings**: choose which data layers are mapped to sound. Turning on a mapping or clicking it's name displays the most relevant data view.
- Global controls – affect all Loops/Transects
  - **Master Length**: The length in seconds of a loop with a speed of 1.0
  - **Scale Type**: Type of musical scale pitch is quantized to. Default is Quartertone.
  - **Tonic**: set root note of musical scale

(does not transpose)

- **Transpose**: transpose all pitches by this many semitones
- Loop/Transect Controls (four individual sets of controls)
  - **Play**: turn on or off a loop/transect
  - **Rst**: Reset the playhead to the loop's beginning
  - **Loop Speed**: speed multiplier for this transect/loop
  - **Note Trigger**: set whether notes are generated by crossing of contacts or by rhythmic patterns
  - **Rhythm A and B**: Two rhythmic divisions of the loop that can be turned on or off. Can be used together to create polyrhythms. Only active in rhythmic trigger mode.
  - **Pitch**:
    - **Transpose**: offset the pitch of notes by this many semitones
    - **Curve**: the exponent of the Rock Age > Pitch mapping curve. 1 is linear mapping.
  - **Sync**: how the loop syncs to the master time.
- The Mixer window allows you to:
  - Adjust the volume of the four loops, reverb, the overall volume
  - Edit reverb settings. The included reverb is TAL-Reverb II from Togu Audio Line.
  - Reset loops/transects to default state
  - Change color scheme
  - Toggle click-to-google of geology terms in interface
  - Use a MIDI interface to control mixer and Master Length
  - Toggle audio processing (must be on or you'll hear nothing). Turn off to save CPU cycles when MA Geophonic is open but not in use.



## Keyboard Shortcuts

- **Q, W, E, R:** start/stop loops (transects) 1-4 (Q = 1, W = 2, E = 3, R = 4)
- **+ / - :** double or halve the Master Length
- **A, S, D, F:** end any notes currently being held by the corresponding loop (A = 1, S = 2, D = 3, F = 4)
- **Number Keys:** after clicking in a number box, you can type a value for speed, rhythm, etc
- **Cmd-F (mac) / Ctrl-F (win):** fullscreen
- **Cmd-I (mac) / Ctrl-I (win):** Show Mixer