From Bedrock to Buildings
Do you know where your infrastructure comes from?

INTRO

This project provided me with the opportunity to apply my academic training in a field based setting to collect, interpret and compare existing data on the bedrock of Maine. Additionally I wanted to provide important information and awareness regarding the inner workings of our states infrastructure. Stop for a second and think, did you drive here? Or did you walk? Perhaps you flew? Concrete, asphalt, crushed stone, gravel, brick, whatever materials your mode of transportation took you over, were not always there to ease our travels. Those materials that make up our roads, sidewalks and runways all have to be extracted from the earth, and those methods of extraction have become a time honored tradition. A tradition suturing the relationships between the quarries, the State of Maine and drilling and blasting contractors to maintain the states infrastructure and provide a supply of good paying jobs. Few understand or know the journey "from bedrock to buildings", this poster provides and introduction that leaves you walking away with a little more knowledge in your pocket and appreciation for the surface under your feet.

What I Did

- Marked GPS location of every sample site
- Gathered and took photographs for sites
- Collected 3 samples from each site for analysis
- Cut all samples into slabs for viewing grain structures and composition
- Consulted with previously publish data and maps to match samples to their formation
- Consulted with my Professors for help with research
- Gathered all samples post-blast so they were fresh and not yet weathered
- Calculated estimated densities for each sample

How it's Done

Once a site has been identified for quarry blasting, surveys are conducted to calculate the estimated yield (in cubic yards) for the client. The surveyors take grade measurements across the terrain to create a 3D map and calculate the volume of the bedrock on site. Next, a blaster will paint a pattern of dots across the area accompanied with drill depths that were provided by the surveyor. The dots and depths serve as markers for the drillers who will bore the holes for the explosives and stick PVC pipe in them to secure the overburden from caving in. Occasionally the drillers are required to drill "kicker holes" (see image key), which are drilled at an angle into a space of the bedrock that would otherwise be untouched by the pattern laid out for vertical drilling. Once all the drilling is complete, the blaster will return with a crew of laborers and an explosive truck. All the holes get loaded with explosive product (but not completely full), tied together with detonation cord, and topped off with crushed stone to "stem" the hole full. The crushed stone serves as a plug to help distribute the explosion laterally rather than vertically to achieve good breakage evenly throughout. Once everything is ready to go a site security plan is implemented, clearing everyone out of the quarry and signaling for the blast with a series of air horn blasts. 3 air horn blasts is the 10-minute warning, followed by a 2 blasts of the horn when the blast is set to go off or "HOT". The explosives dentonate crushing the rock from a massive solid wall to a mosaic pile of different colored and size stones. Following the completion of the blast the final wail of the horn is followed by one last radio check to give the all clear.. Every good blaster is aiming for breakage that results in less crushing for the quarry. Once blasting is done the quarry will crush the rock into all sorts of sizes, those different aggregates will then be shuffled around the state in every which direction for a myriad of projects ranging from small construction sites to statewide infrastructure maintenance, to the foundation of the building in which you are standing in.

Discussion

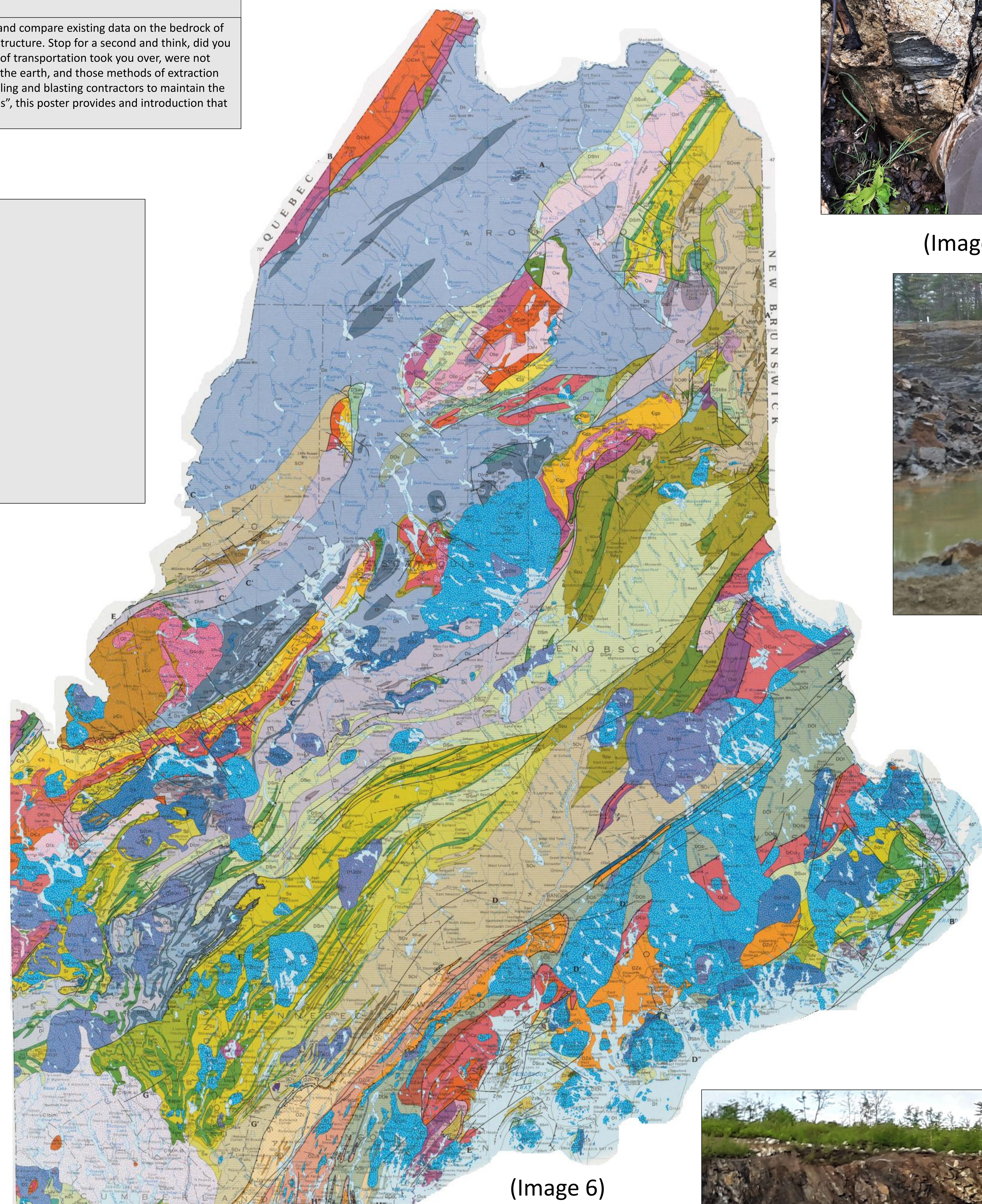
I found that most of the samples I collected did indeed correlate with published data. One outlier is highlighted RED in the table to the bottom right of the map, and the BLUE units represent quarries with two distinctively formations present. The relationship between the sedimentary formations in Maine and plutonic rocks is a classic one. Layers and layers of folded and faulted country rock are cross cut and intruded by younger plutonic bodies and dikes resulting large amounts of metamorphosed rock adjacent to the intrusions. These metamorphic contacts contain high amounts of distortion and recrystallization, resulting in stunning and sometimes confusing outcrops built of thin to thick layers of rock folded and extensively reworked.

In southern Maine where deformation was the strongest, abundant pegmatic dikes have yielded a variety of gems and minerals. Some quarries have set up shop on these pockets of large grained granitoid rocks and have had successful extraction businesses.

A more well-known and traditional use of the bedrock we've seen, is the use of granites and slates throughout New England architecture. Not only does granite and slate display in some places jointed structures (or in some cases cleavage) that help with dimensional cuts for large scale aggregation, both are often used as a road base or even mixed into asphalt for finishing road projects. One could say every layer of the road could be derived from a single rock formation, as long as the material in question is up the states standard for hardness and weathering. That quality standard is different as you move from project to project.

But the back-story remains the same. A tale of multiple events, rifting, subduction, collisions, intrusions and deposition to get us where we are today. And capping it off, the Laurentide ice sheet has left us with a scattered hummocky landscape strewn with till, polished bedrock and glacial outwash materials. Indeed, some of those materials left behind by the glacier are available to be exploited for projects but are in finite supply here on the surface. Many of these deposits are in the water and part of the ecosystem, so we don't have a environmentally friendly way to extract without inflicting some sort ecosystem damage or affecting a rivers natural flow behavior no matter how minute. Even with the glacially deposited gravels and sorted sands it just is not enough to keep up with the growth of our society and the way of life that surrounds it.

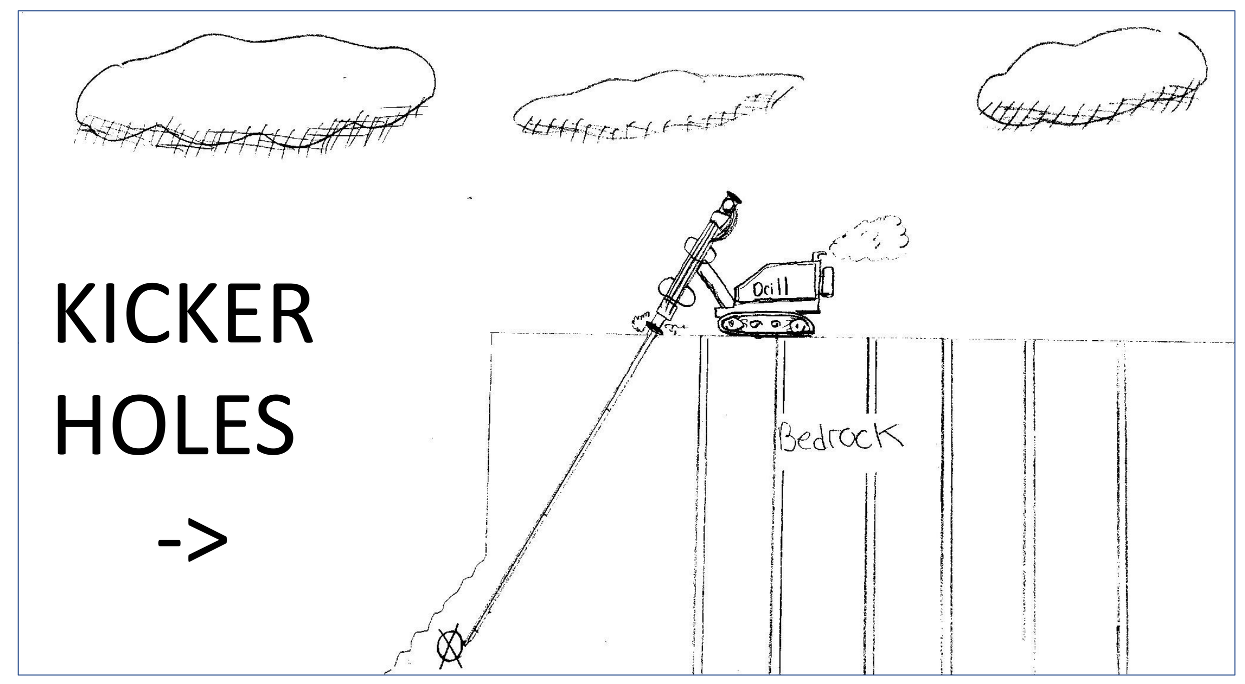
So what do we do for materials in an increasingly sand scarce lanscape? We go down into the earth, we drill, blast and crush our way down. Unlike a normal surface mining operation, blasting down into the bedrock provides us with the materials we need to grow and sustain, while also providing us with the opportunity to study the earth as we go down into it (a massive free cross section if you will). It is definitely not a pretty business but an absolutely necessary one that continues to become more efficient (with respect to fuel and energy consumption) as the years go by. So I ask you, the next time you stand in a brick or concrete building or walk down that new city sidewalk pause, and think "how did it all get here?"



(Image 2)

(Image 3)

(Image 4)



(Image 1)

(Image 5)

(Image 6)

Image Key

Image 1. Illustration of a "kicker hole"

Image 2. (Windham #2 Sample Site) Country rock xenolith in granite pluton

Image 3. (Windham #2 Sample Site) Granitic dike intruding the country rock

Image 4. (Windsor Sample Site) Exposed oxidizing rock face in the Hutchins Corner Fm.

Image 5. (Casco Sample Site) Stunning Layers in P&K Sand and Gravel

Image 6. A beautiful fold on Noyes Mountain near Greenwood ME

Location	GPS (Lat/Long)	Current Fm. Interpretation	Dom. Lith.	AGE	Reference / Mapper (s)	Density (g/cm3)
Windsor	44.29007534 -69.5915205	Hutchins Corner Fm.	Sulphidic gneiss/Metasedimentary Rocks and fine to large granofels	Silurian-Ordovician	(Grover and Fernandes 2003)	2.74
Caribou	46.89161,-68.02515	Cary Mills Fm.	Thinly bedded Limestone	Silurian - Ordovician	(Roy 1987)	4.66
Dyer Brook	46.06965,-68.22444	Smyrna Mills Fm.	Pelite interbedded limestone	Silurian	(Osberg and Boone 1985)	3.40
Gorham	43.68242,-70.46848	Hutchins Corner Fm.	Calc-Silicate interbedded granofels	Silurian-Ordovician	(Henry and Hussey)	2.27
Eliot	43.18057033 -70.7943518	Webhannet Pluton	Granite	Devonian	(Bothner, Hussey and Thompson 2016)	2.41
Augusta	44.35931,-69.74979	May flower Hill Fm.	Fine to medium grain QFB granofels and minor schists	Silurian	(Marvinney and Barker 2012)	4.82
Windham #2	43.79049,-70.39275	Hutchins Corner Fm. / Unnamed Pluton	Granite / Metasedimentary Rocks and fine to large granofels	Silurian-Ordovician / Carboniferous	(Berry and Hussey1998)	3.97
Cushing	44.034,-69.28711	Waldoboro Pluton Complex	Felspathic Meta-granite	Devonian	(Sidle 1991)	2.17
Casco	44.00251432 -70.4771085	Sebago Pluton	Muscovite Granite	Carboniferous(?)	(Osberg and Bonne 1985)	3.75
Windham	43.69311736-70.39656512	Hutchins Corner Fm./ Unnamed Pluton	Metasedimentary Rocks / Dark green and grey diorite /gabbro	Silurian - Ordovician / Carboniferous	(Berry and Hussey 1998)(Carlson 2019)	3.40
N. Windham	43.86797819 -70.4502036	Sebago Pluton	Granite	Carboniferous	(Berry and hussey 1998)	3.19
Hollis	43.69064534 -70.6186815	Unnamed Granite Pluton / Basalt Dike	Granite/ Basalt	Carboniferous / ?	(Hussey and Marvinney)	2 .64 / 4.25