

Susquehanna Shale Hills CZO – Summary of Harrys Valley (HV) Well 1:

Drilled: 08/26/15 - 08/27/15

Location: N40.69775 W77.91899, elevation 1737 feet (WGS84 - Garmin GPSMAP 60CSx Handheld GPS Navigator), across from Garner run camp, 15 feet from the road. Per Brandon Forsythe, water table at Jo Hays Vista (elevation 2082 feet) was 270 feet below the surface in 1970. Water table at the drilling site during drilling was 5 feet below the surface.

Participating Personnel: Brandon Forsythe, Chris Aldrich (Stone Environmental, Inc.), Ryan Kroecker (University of Guelph), Bob Ingleton (Guelph), Donovan Capes (Guelph), Dave Pederson.

Drilling and Well Construction:

Drilling was accomplished with a Hydracore Prospector. The drill rig platform was placed on two 6" x 6"s, each 6' long. Six lag bolts attached the platform to the 6" x 6"s along with four 6" nails bent over to prevent the platform from sliding. Four foot 1" diameter pins were pounded into the ground; two on each side of the platform. Chains were wrapped around the pins and over the top of the platform, and tightened using chain binders in order to counter the upward force when drilling. Fordia NW steel casings were used, with an outside diameter (OD) of 3.5" and an inside diameter (ID) of 3.0", in 5' sections. All steel casing was removed as the 5 port multilevel monitoring system was installed. Fordia NW coring rods with OD 2.625" and ID of 2.25" were placed inside the casing. One partial core of intermittent rock was obtained between the 11'-16' sections.

The well was completed by installing a 5 port multilevel monitoring system. Three 3/4" CANTEX Schedule 40 electrical conduit type PVC pipes were installed, with 1-foot sampling zones at depths of 30, 20, and 7 feet below ground surface. The well was developed by purging each depth for approximately one hour immediately after putting in the multi-level sensors. A 3/8" drill bit was used to drill several holes in the bottom 1 foot of each PVC pipe. There are two 1/4" polyethylene tubing sections with an ID of 0.170" placed at 20 and 7 feet below ground surface. All five ports have Sun Guard 90 vinyl coated fiberglass mesh for filtering. The 1/4" tubing was taped alongside the 3/4" PVC. Each depth of PVC was placed inside casing prior to removing the casing. Material (sand) was used to backfill around the multilevel system. More sand may be needed as it settles. The three PVC pipes are capped. After allowing for settling time, a 4' long, 3" diameter section of PVC and cap will be placed around the system for protection.

Recovered Material:

Overburden of 30' was drilled without hitting anything more than intermittent rocks. Between rocks, sand was always recovered. The sand was mostly orange colored, but it varied from grey to red to black in places. No trend in color was noticed. Three bags of orange sand were collected, labeled HR-1 sand, from an unknown depth. No other sand was recovered. No material containing clay was recovered. A few rocks were recovered before 11' depth. These were put into a bag and labelled Run #0. Rocks that were cored and recovered were put into Ziploc bags and lines were marked on them, red and blue to orient up and down, respectively. They were not contiguous. Sand was found everywhere in between rocks.

Labeled:

Between 11' and 16' depths, the recovered rock samples were labeled "Run 1". Five pieces were recovered:

- 1a – Shallowest depth. Light yellow to white in color with some brown/yellow staining. Well sorted and well cemented.
- 1b – Deeper than 1a. Light yellow to white in color with some brown/yellow staining. Well sorted and well cemented. Some subangular mU (350-500 μ) grains at top of sample. Small 0.3 in zone near bottom of sample with cL-mU quartz grains; majority of sample fU-fL. Minor dissolution pits.
- 1c – Deeper than 1b. Yellow to rose/grey in color. Extensive dissolution pits on outer portion of sample (similar to Run#0 sample) with red staining inside the pits. cemented quartzite (fU-mL 177-350 μ in size).
- 1d – Deeper than 1c. Yellow/ beige to yellow orange in color. Some minor yellow to red/brown staining at top of core. Well-cemented, well-sorted fu-fL grain size. Some 45° joint fractures (see image c) are observed.
- 1e – Deeper than 1d. Grey/white to beige to color; minimal red-brown staining. Sand/clay mixture adhered to outside of sample. fU-mL grain size. Well-sorted and cemented.

Between 16' and 21', the recovered rock samples were labeled "Run 2". Four pieces were recovered:

- 2a – Pink/Rose to yellow/white in color. Zone of white discoloration (looks as if rose colored staining was removed). Extensive dissolution pits with red/brown staining. Similar features to previous samples. Well-sorted, cemented quartzite.
- 2b – Yellow/beige in color, yellow/brown staining on top of sample. No dissolution features. Some layers. Grain size ranges from mU/mL to fU-mL; well-sorted. Some fracture along top could contain some clay particulate.
- 2c – Yellow/beige to white in color. Some fractures with yellow/red-brown coloration and potential clays; bottom yellow/brown in color. Some dissolution pits. Grain size ranges fU-mL; well-sorted.
- 2d - Yellow. White in color; some brick-red staining (surficial). Well-sorted and cemented with some dissolution pits. Grain size fU.

Harrys Valley Well (HV Well 1)
Susquehanna Shale Hills CZO

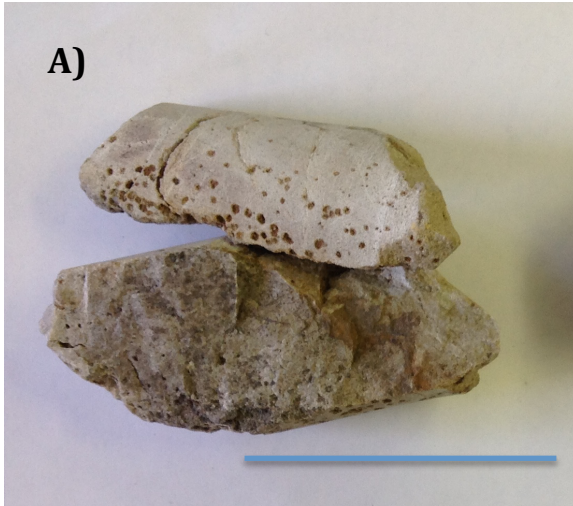
Drilled 8/26/15-8/27/15

Core photo log, Images taken 08/28/15 and 9/2/15



Depth Interval: Less than 11'

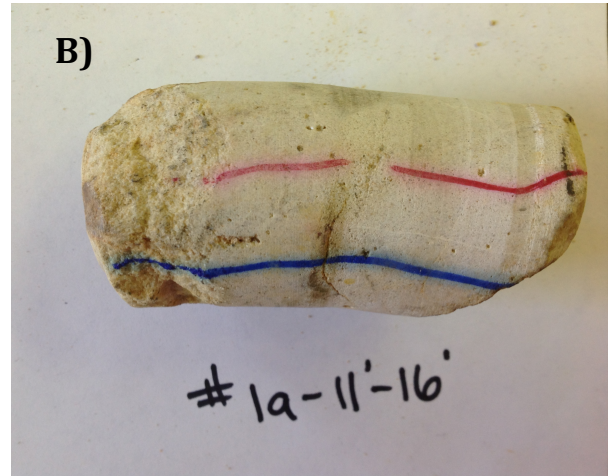
Run # 0



Sample Description: Light rose to grey in color. Sample split down the middle exposing grey interior. Outer portion of core contains dissolution pits with red-brown staining. Consists of mostly well-sorted, cemented quartz (grain size fU -fL; 125-250 μ , rounded grains). Top of core is oriented to the left. Blue line in Figure A is 8in.

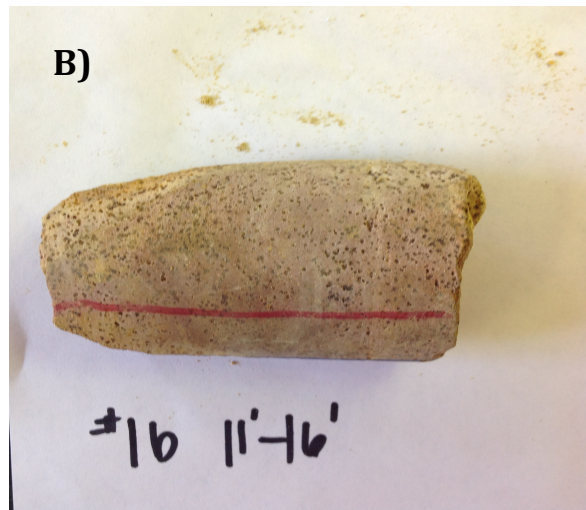
Depth Interval: 11'- 16'

Run #1a



Sample Description: Light yellow to white in color with some brown/yellow staining. Well sorted and well cemented. Some subangular mU (350-500 μ) grains at top of sample. Small 0.3 in zone near bottom of sample with cL-mU quartz grains; majority of sample fU-fL. Minor dissolution pits. Blue line in figure A is 8 in. In figure B, red line is top, blue line is bottom. Figure C, is the core after 1 week of drying; ruler is in inches. All images are captured so top of core is to the left.

Run #1b



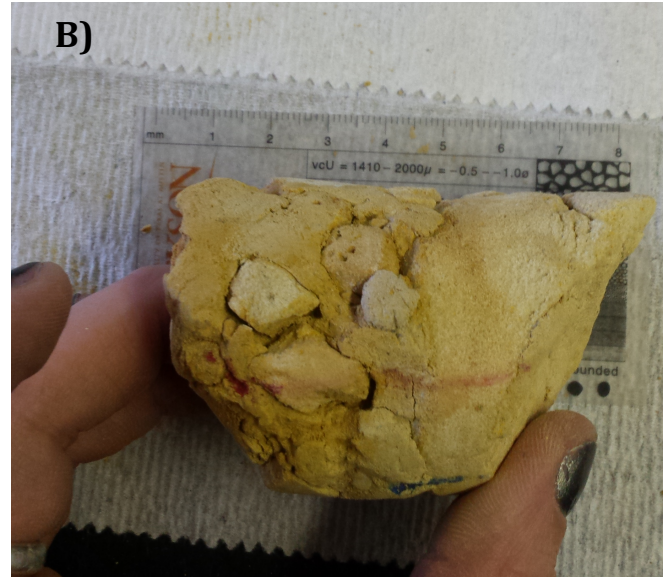
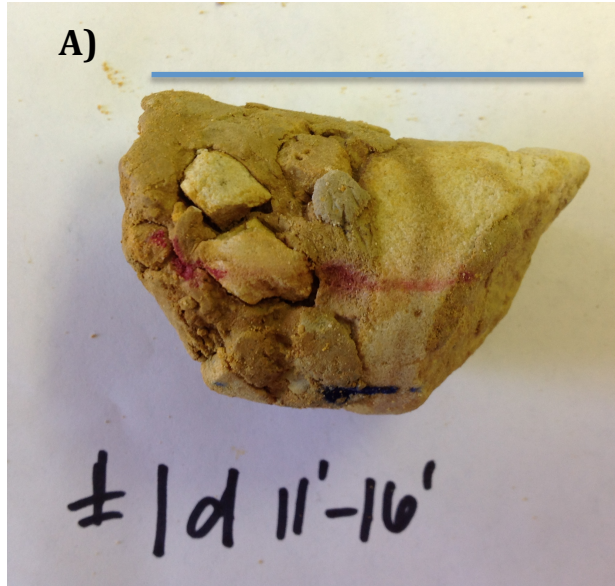
Sample Description: Yellow to rose/grey in color. Extensive dissolution pits on outer portion of sample (similar to Run#0 sample) with red staining inside the pits. cemented quartzite (fU-mL 177-350 μ in size). Blue line in Figure A is 8 in. Top of core is to the left. Figures C and D are after one week of drying; ruler is in inches

Run # 1c



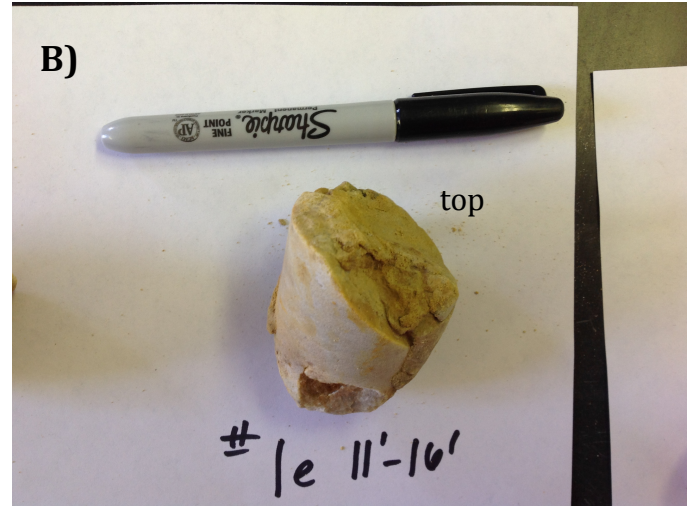
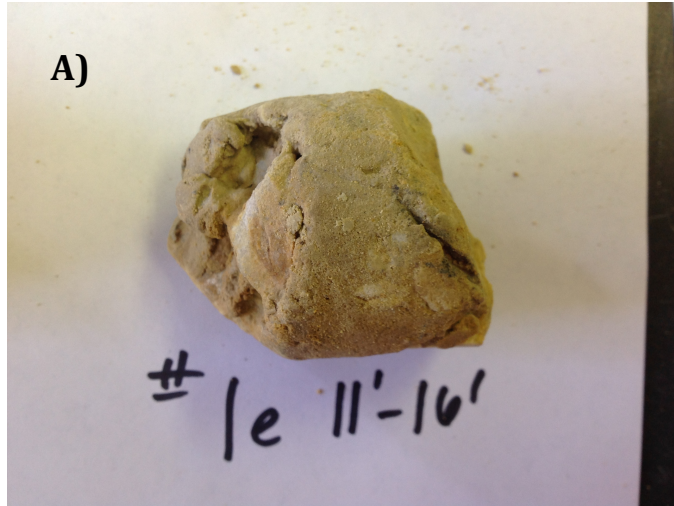
Sample Description: Yellow/ beige to yellow orange in color. Some minor yellow to red/brown staining at top of core. Well cemented, well-sorted fu-FL grain size. Some 45° joint fractures (see image C) are observed. Blue line in Figure A is 8in. Top of core is to the left. Figure C, is the core after one week of drying

Run #1d



Sample Description: Sample different than previous. Not same well-cemented, well-sorted pure quartzite. Top of sample (imaged to the left) contains clasts 0.5-1 inches in diameter amongst sandy/clay mixture (mU grain size; 350-500 μ). Yellow/beige to light yellow/tan in color. Bottom of the core (right side of images) is more similar to other samples, cemented, well-sorted quartzite, but more friable. Noted some (~10 dissolution pits near top of the sample). Blue line in Figure A represents 7in. Figure B is after one week of drying; ruler is in inches.

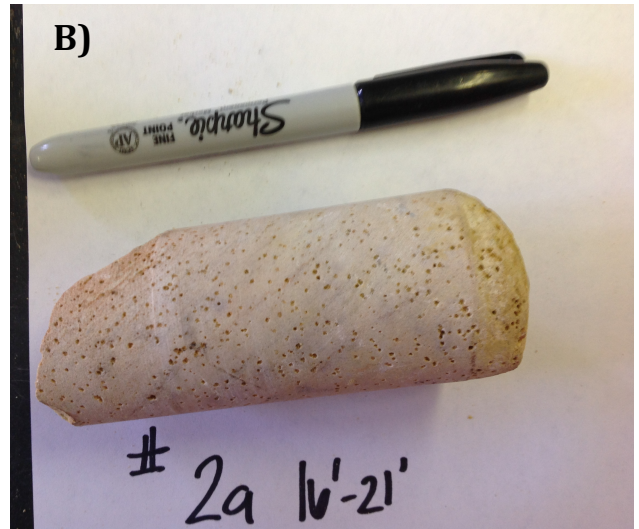
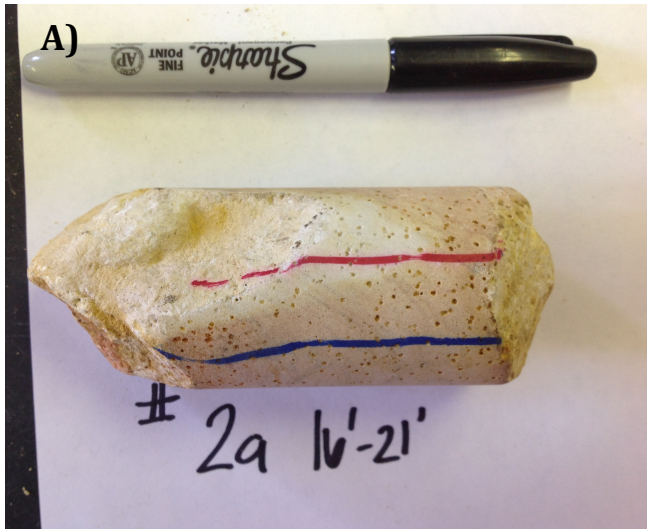
Run #1e



Sample Description: Grey/white to beige to color; minimal red-brown staining. Sand/clay mixture adhered to outside of sample. fU-mL grain size. Well-sorted and cemented.

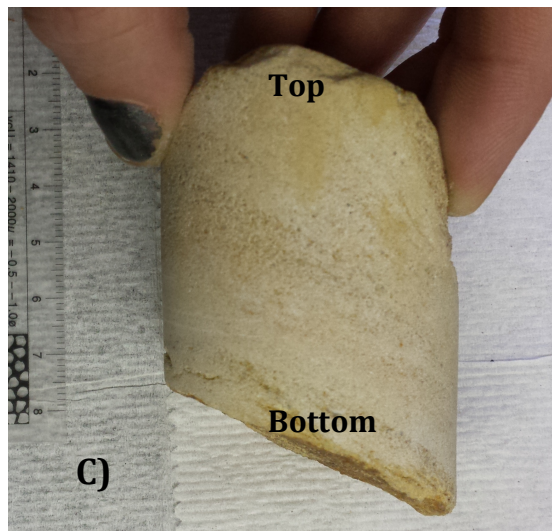
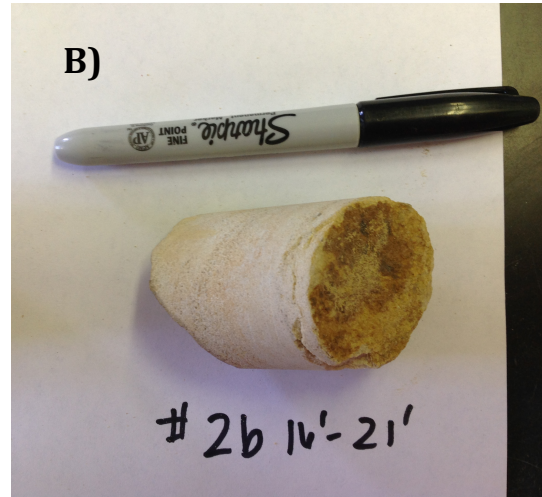
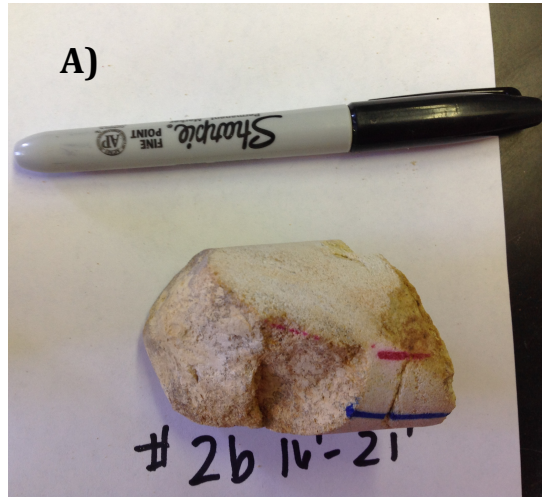
Depth Interval: 16'-21'

Run #2a



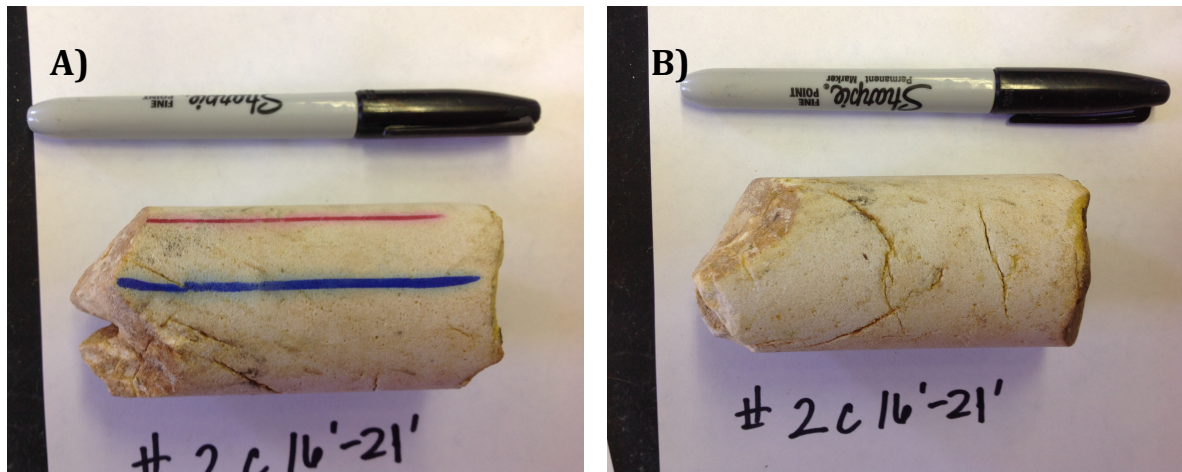
Sample Description: Pink/Rose to yellow/white in color. Zone of white discoloration (looks as if rose colored staining was removed). Extensive dissolution pits with red/brown staining. Similar features to previous samples. Well-sorted, cemented quartzite fU-mL grain size. Top of sample imaged to the left. Figure C is imaged after one week of drying, ruler in inches.

Run #2b



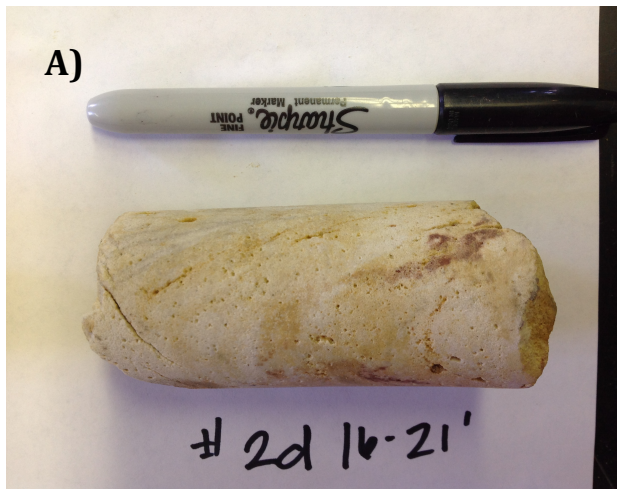
Sample Description: Yellow/beige in color, yellow/brown staining on bottom of sample (Figure D). No dissolution features. Some layers. Grain size ranges from mU/mL to fU-mL; well-sorted. Some fracture along top could contain some clay particulate. Figures C and D are after one week of drying; ruler is in inches.

Run # 2c



Sample Description: Yellow/beige to white in color. Some fractures with yellow/red-brown coloration and potential clays; bottom yellow/brown in color. Some dissolution pits. Grain size ranges fU-mL; well-sorted. Top is orientated to the left, sharpie for scale.

Run #2d



Sample Description: Yellow. White in color; some brick-red staining (surficial). Well-sorted and cemented with some dissolution pits. Grain size fU. Top is oriented to the left; ruler is in inches. Figures C and D are after drying for one week.