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Report on samples from the Great Basin Science Sample and Records Library

13 October 2008

I collected samples from the site of the Great Basin Science Sample and Records Library on 12 and 22 May and on 10 June 2008. Below is a brief report on initial observations.

As has been observed in the past on the campuses of the Desert Research Institute and Truckee Meadows Community College, swelling and collapsing ground, due to clay minerals that expand when they get wet and contract when they dry out, occurs at the site. We should therefore be careful not to irrigate or allow rain water to wet the ground below the building site. There probably isn't much that can be done to avoid rain water during construction, but once the building is finished, we should be sure that rain water running off the roof or onto the site from the nearby ground does not get channeled directly below the building. Presumably the over-excavation and fill with non-expansive material (sand-sized decomposed granite) that has been done will help avoid problems, but further avoidance of possible problems is warranted.

The outcrop of andesite (a type of igneous/volcanic rock that is intermediate in chemical composition between basalt and rhyolite/granite) that occurred at the site was essentially removed during excavation for the building pad. Although much of the surrounding material is hydrothermally altered, the outcropping andesite is surprisingly unaltered. It still contains fresh plagioclase feldspar and magnetite. A small amount of unaltered andesite remains near the bottom of the north end of the road cut on the east side of the building, although this is currently buried under loose soil that was put on top of the road cut. This exposure should remain after construction.

The bulk of the rock in the road cut is hydrothermally altered andesite. On the basis of mineralogical analysis by powder x-ray diffraction, the rock contains variable amounts of interlayered illite-smectite (an expansive clay containing oxides of sodium, calcium, potassium, aluminum, and silicon), quartz (silica), smectite (another expansive clay containing oxides of sodium, calcium, aluminum, and silicon), and gypsum (hydrated calcium sulfate). Goethite (iron oxyhydroxide) discolors some rocks to shades of rusty orange, red, and brown. This type of alteration is termed "argillic" and is common in hydrothermally altered volcanic rocks throughout the world.

The clay minerals and quartz formed from acidic hydrothermal fluids that permeated the area around DRI during the Miocene Epoch; the heat for the hydrothermal fluids was probably related to the volcanism that formed the andesite. From radiometric dating of similar rocks in the region, the volcanism and hydrothermal alteration probably occurred between 11 and 18 million years ago. A volcanic belt, perhaps ancestral to the present-day Cascade Range, occurred in western Nevada at that time. Pyrite (iron disulfide) probably precipitated from the hydrothermal fluids as well, but it has been oxidized (by rain water) and removed, with some of its iron remaining as goethite and some of its sulfur remaining as gypsum.

The presence of these clay minerals, which will expand when wet, makes irrigation anywhere near the building unwise. Furthermore, rain water should be diverted away from the building, so that it does not wet the clay minerals in any altered andesite that may underlie the building site. To avoid problems with swelling clays, the site was over-excavated, then filled with at least two feet of decomposed granite (a non-expansive material), followed by six inches of aggregate, below the six-inch reinforced concrete pad. Further precautions against potential problems with swelling clays include keeping irrigated plants away from the building, limiting irrigation to slow, drip irrigation that gets the moisture to the roots of the plants but hopefully not into the swelling clays, and controlling rain-water runoff so that it does not channel back underneath the building.

A major-oxide chemical analysis, by Mario Desilets of the Nevada Bureau of Mines and Geology, of the least altered volcanic rock from the outcrop confirms the field identification of the rock as an andesite. Although this has no direct bearing on the geotechnical aspects of the site, it fits with the general view that the site was once part of an active chain of volcanoes, similar to the Cascade Range today.

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13 October 2008

Samples from the Great Basin Science Sample and Records Library*

GBSSRL-1: Andesite from outcrop, portion of sample given to Mario Desilets for whole-rock/major oxide chemical analysis; large block awaiting slabbing
Collected 12 May 2008
The chemical analysis confirms the identification as an andesite. A basaltic andesite would have a lower silica content (52 to 57%), and a dacite would have a higher silica content (>63%). A trachyandesite would have a higher sodium plus potassium content.

SiO_2(%)	58.7
TiO_2(%)	0.745
Al_2O_3(%)	18.5
Fe_2O_3-T(%)	6.99
MnO(%)	0.131
MgO(%)	2.85
CaO(%)	5.34
Na_2O(%)	3.44
K_20(%)	1.82
P_2O_5(%)	0.219
LOI(%)	1.94
Total(%)	100.7

GBSSRL-2: White clay from cut next to DRI, sample given to Mario Desilets for XRD clay determination
Collected 22 May 2008
XRD confirms quartz, gypsum, illite-smectite (1:1), and smectite.

GBSSRL-3: Greenish white clay from cut next to DRI, with visible 1-mm gypsum crystals on some samples, sample without visible gypsum given to Mario Desilets for XRD clay determination
Collected 22 May 2008
XRD confirms quartz, gypsum, illite-smectite (1:1), and smectite.

GBSSRL-4: White clay from cut next to DRI, sample given to Mario Desilets for XRD clay determination
Collected 22 May 2008
XRD confirms quartz, gypsum, and illite-smectite (1:1),
but not obviously smectite as in GBSSRL-2 and 3.

GBSSRL-5: Andesite from outcrop, sent by David Davis for polished thin section
Collected 12 May 2008
Polished thin sections (2 made of the same rock): Plagioclase occurs in the matrix and as phenocyrsts aligned with the flow direction of the lava. Plagioclase

crystals are mostly fresh, although some crystals are partially altered to clay or illite. Pyroxene occurs as pale green to pale reddish brown phenocrysts. Pyroxene is mostly fresh, but some is altered to chlorite and occasionally minor calcite. Magnetite is abundant as phenocrysts and in the matrix. Other minerals include biotite (green and rare brownish green pleochroic) and pyrrhotite (rare, occurring inside magnetite grains).

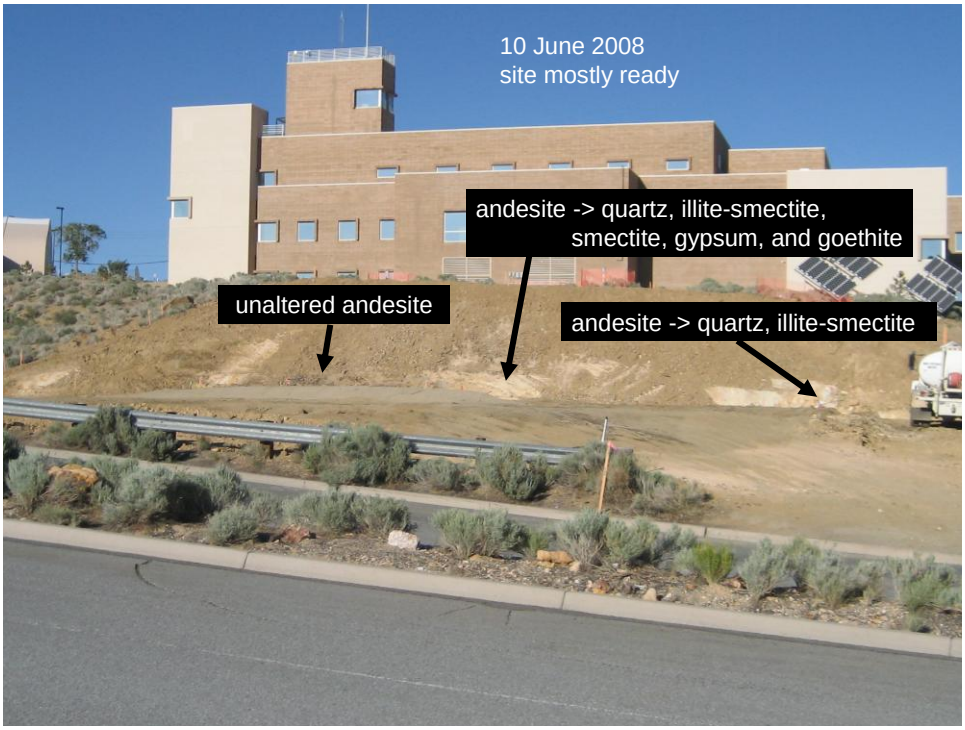
GBSSRL-6: Andesite from rubble after outcrop destroyed by bulldozer, large block awaiting slabbing
Collected 22 May 2008; additional large block collected 10 June 2008

GBSSRL-7: White clay from cut next to DRI, sample given to Mario Desilets for XRD clay determination
Collected 10 June 2008
XRD confirms quartz and poorly crystallized illite-smectite (1:1), but no smectite, illite, or gypsum.

GBSSRL-8: Clay-rich breccia from rubble in cut next to DRI
Collected 10 June 2008

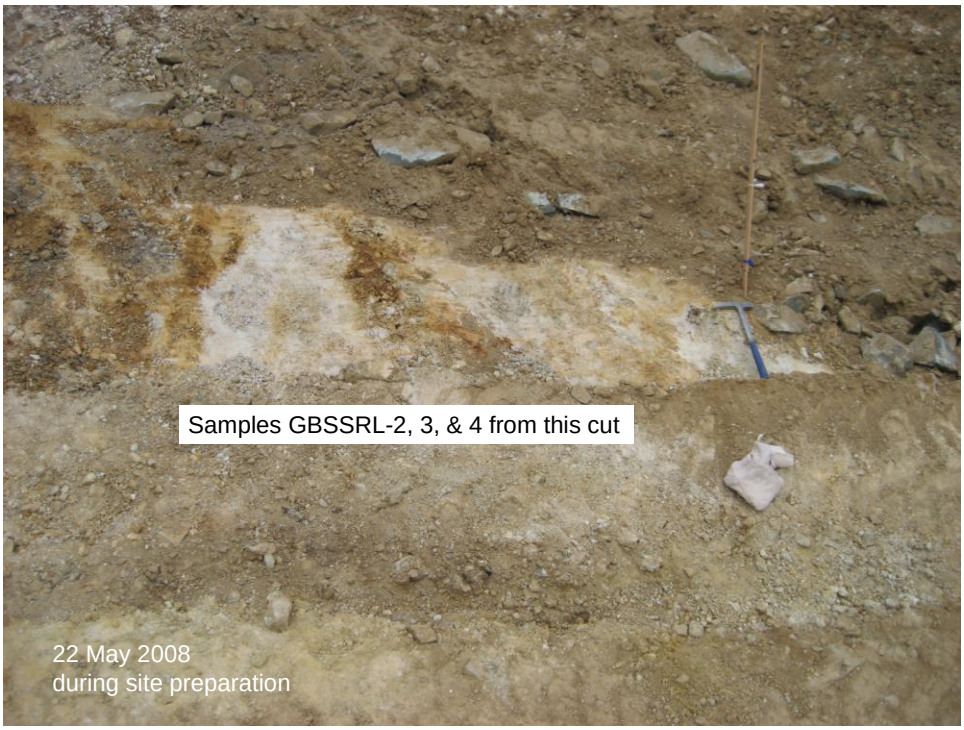
Below are photographs of the site and sample locations.

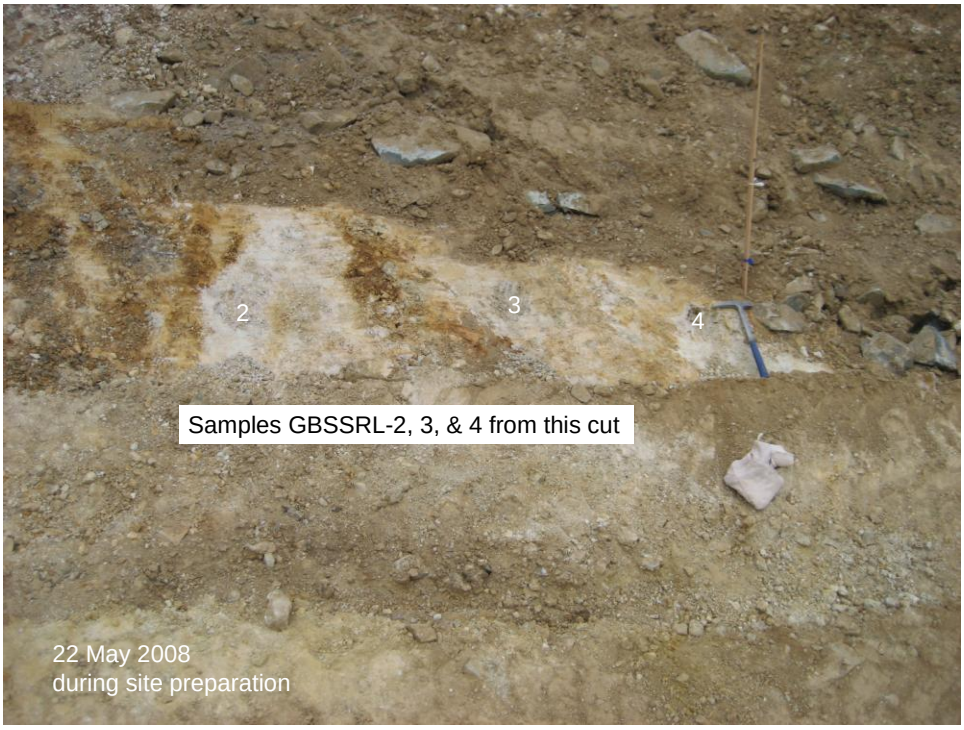

10 June 2008
site mostly ready


10 June 2008
site mostly ready
andesite -> quartz, illite-smectite,
smectite, gypsum, and goethite
unaltered andesite
andesite -> quartz, illite-smectite


Road cut into unaltered andesite
10 June 2008
site mostly ready


22 May 2008
Samples GBSSRL-2, 3, & 4 collected from the cut east of the new building


Samples GBSSRL-2, 3, & 4 from this cut
22 May 2008
during site preparation

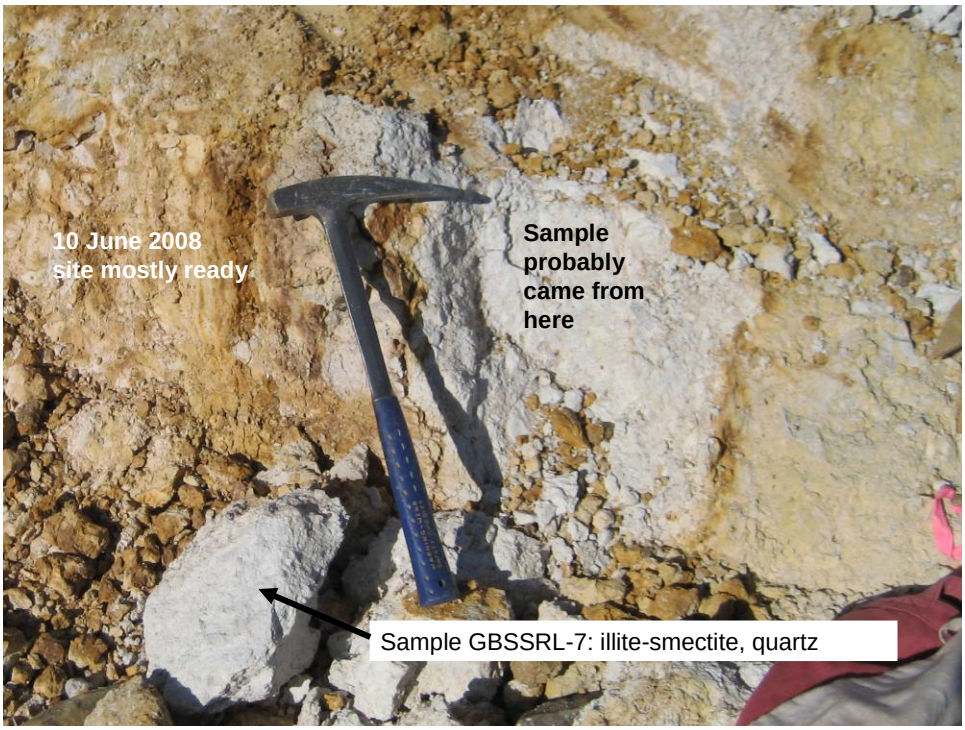

2
3
4
Samples GBSSRL-2, 3, & 4 from this cut
22 May 2008
during site preparation


Samples GBSSRL-2: illite-smectite, smectite, quartz, gypsum
22 May 2008
during site preparation


Samples GBSSRL-3: illite-smectite, smectite, quartz, gypsum
22 May 2008
during site preparation


Samples GBSSRL-4: illite-smectite, quartz, gypsum
22 May 2008
during site preparation


10 June 2008
site mostly ready
Sample GBSSRL-7


10 June 2008
site mostly ready
Sample
probably
came from
here
Sample GBSSRL-7: illite-smectite, quartz