Vermont Dept. of Environmental Conservation Strategic Plan 2013-2015

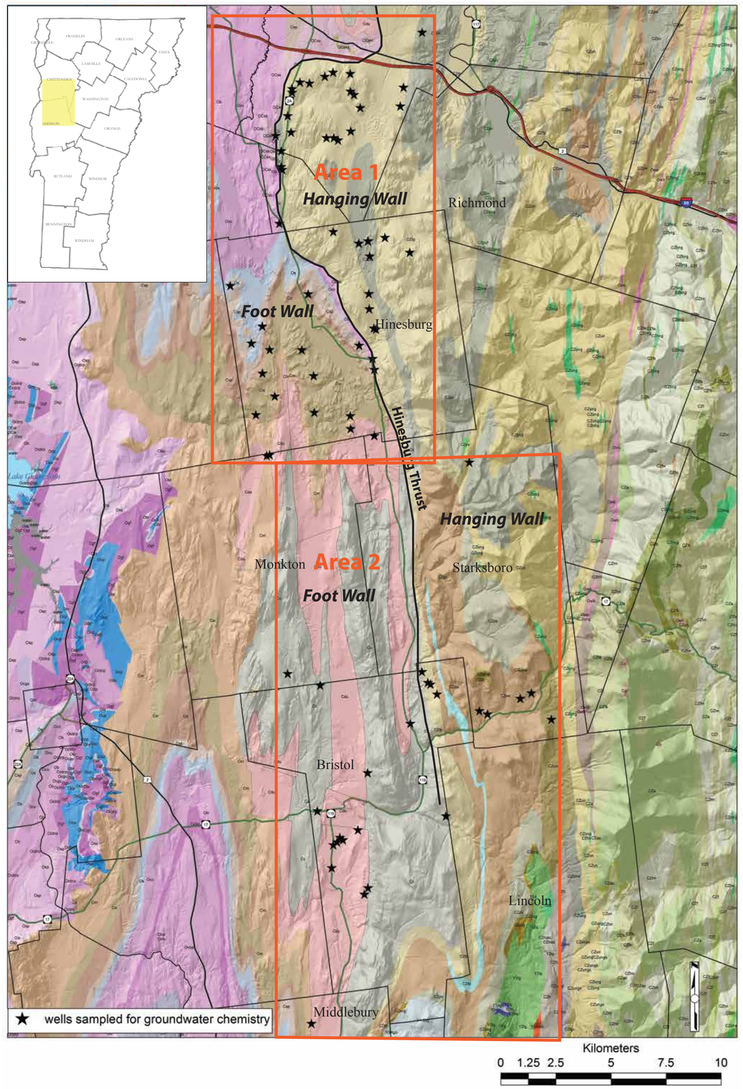
Goal 8: Develop a coordinated statewide effort to address pollution that threatens the public health and the environment

Outcome 2: Updated groundwater protections which fulfill state public trust obligations

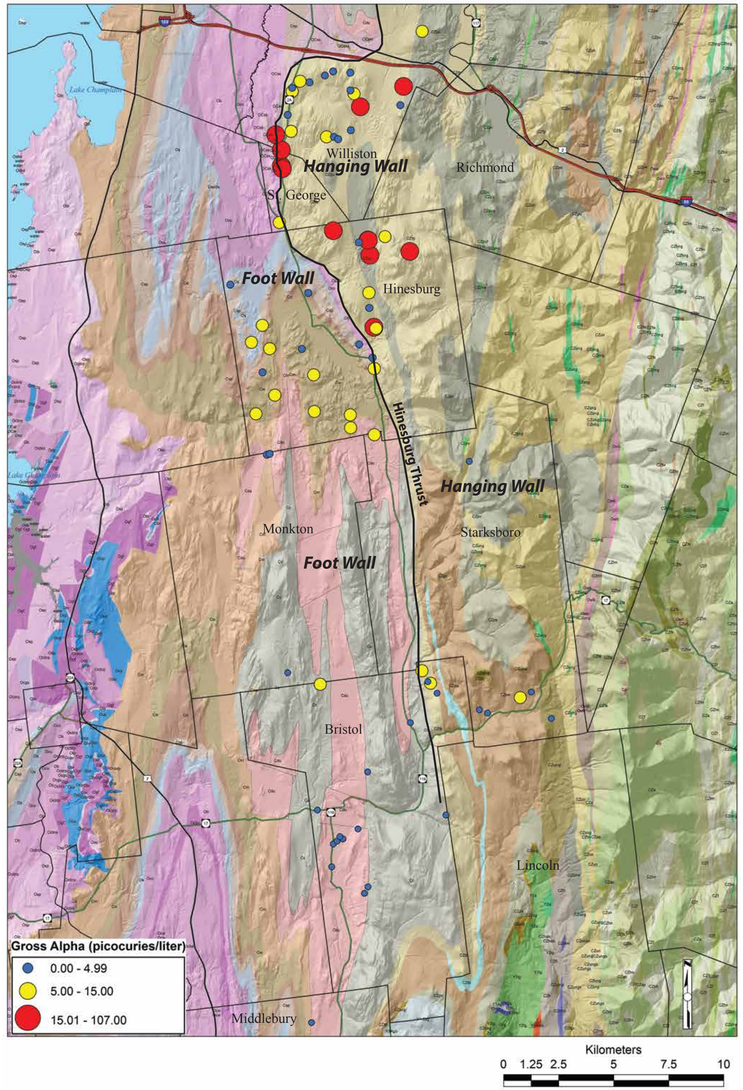
Strategy 3: Produce maps of known sources of groundwater contamination (arsenic, radionuclides) and do public outreach to affected communities (Vermont Geological Survey and Middlebury College Geology Dept.)

SFY14 Milestone: Complete Regional Compilation for west-central Vermont including Williston, Hinesburg, and Bristol.

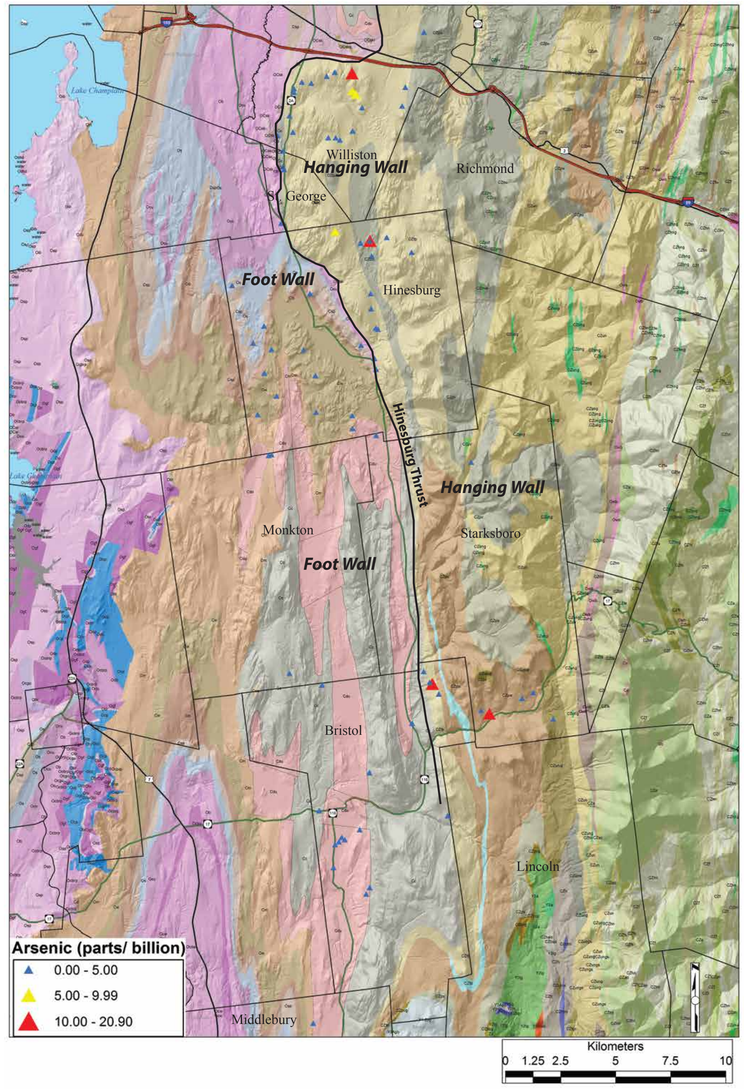
A) Wells Sampled for Groundwater Geochemistry



B) Scaled Naturally-Occurring Radioactivity (Gross Alpha) Results



C) Scaled Naturally-Occurring Arsenic Results



From 2005 - 2014, the Vermont Geological Survey and Middlebury College Geology Dept. (Dr. Peter Ryan and students) sampled groundwater from 79 wells in west-central Vermont for geochemical analysis. The focus of this project was to understand the distribution of naturally-occurring radioactivity in groundwater, after it was reported in some public water supply wells in Chittenden County in 2000. Sampling and analysis of groundwater from wells in Area 1 occurred from 2005- 2009, whereas that for Area 2 took place in 2013-2014. The well locations are overlain on the bedrock geologic map of Vermont (Ratcliffe et al., 2011). The Hinesburg Thrust Fault separates metamorphic rocks of the Green Mountains (hanging wall =east) from weakly-metamorphosed sedimentary rocks of the Champlain Valley (foot wall =west).

Bedrock Geology Modified From:
Ratcliffe, N.M., Stanley, R.S, Gale, M.H., Thompson, P.J., and Walsh, G.J., 2011, Bedrock Geologic Map of Vermont: U.S. Geological Survey Scientific Investigations Map 3184, 3 sheets, scale 1:100,000.

The first part of this study focused on the towns of Williston, Hinesburg, and St. George (Area 1), where the elevated radioactivity was first reported. The gross alpha levels analyzed in the groundwater samples were divided into three groupings as recommended by the Vermont Dept. of Health (http://healthvermont.gov/enviro/rad/alpha.aspx): 1) Gross alpha is <5 pci/liter and no further testing is recommended, 2) 5 pci/ liter </= Gross alpha </= 15 pci/liter and testing for 226 and 228 radium are recommended, 3) Gross alpha >15 pci/liter and testing for 226 and 228 radium and uranium are recommended. Average gross alpha levels for groundwater from hanging wall and foot wall wells in Area 1 are 18.4 and 7 picocuries/ liter, respectively. Whereas 38.7% of wells sampled in the hanging wall have gross alpha levels >15 picocuries/liter, 0% of foot wall wells do. Detailed work by Kim et al. (2014) showed that the hanging wall rocks were the source of the elevated radioactivity in groundwater in Area 1.

The second part of this study focused on the same geologic context, the hanging and foot walls of the Hineburg Thrust, farther to the south in the towns of Monkton, Starksboro, Bristol, and Middlebury. Average gross alpha levels for groundwater from hanging wall and foot wall wells in Area 2 are 3.8 and 2.3 picocuries, respectively. No wells had gross alpha levels that exceeded 15 picocuries /liter. These results are markedly different than those to the north, where groundwater from wells completed in the the hanging wall had significantly higher gross alpha levels. Detailed work by Favorito (2014) describes the groundwater geochemistry of Area 2 in detail. The owners of all wells in areas 1 and 2 were notified of their radionuclide results and whether any further action was necessary.

Elevated levels of arsenic in groundwater from bedrock wells in west-central Vermont are much less common than radionuclides. The Maximum Contaminant Level (MCL) for arsenic in groundwater is 10 parts/ billion. Using the same geologic context as before, 4/38 (10.5%) of hanging wall wells have elevated arsenic levels whereas 0/36 (0%) of foot wall wells do. The owners of all wells in areas 1 and 2 were notified of their arsenic results and whether any further action was necessary.

References:

Favorito, J.E., 2014, Lithologic and Structural Controls on Radionuclides in Groundwater in the Bristol Quadrangle, Vermont: Middlebury College Senior Thesis, 100 p.

Kim, J.J,, Ryan, P., Klepeis, K., Gleeson, T., North, K., Bean, J., Davis, L., and Filoon, J., 2014, Tectonic Evolution of a Paleozoic Thrust Fault Influences the Hydrogeology of a Fractured Rock Aquifer, Northeastern Appalachian Foreland: Geofluids, doi: 10.1111/gfl. 12076, 25 p.