

Geologic Site of the Month  
February, 2005

***Geology of Augusta's Third Bridge Access Ways***



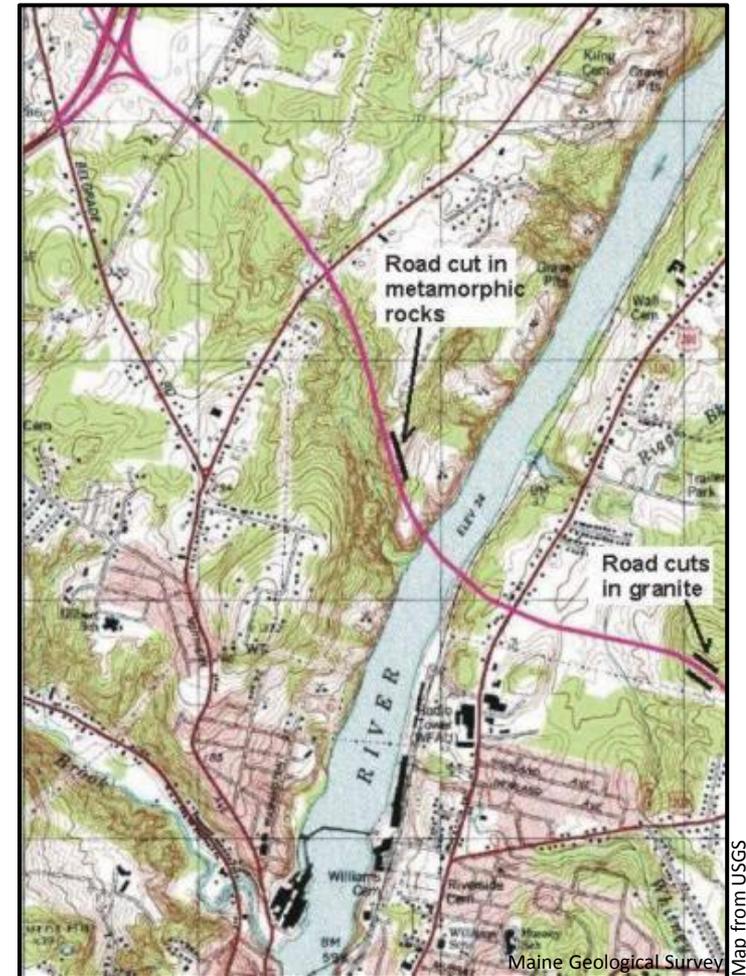
44 20' 7.35" N, 69 45' 53.12" W

Text by  
Robert Marvinney



## Introduction

After years of planning followed by years of construction, Augusta's Third Bridge was opened in November 2004 to whisk traffic across the Kennebec River to Belfast and points beyond. Although the highlighted benefit of the third bridge is the improvement of traffic on congested downtown streets, an added benefit for geologists has been the creation of several large road cuts that display the contrasting geology of the Capitol area. As testament to Maine Department of Transportation traffic forecasting capabilities, please note that in spite of having been open only a few months at the time of this writing, the new bridge already experiences heavy traffic. If you build it, they will come! Viewing the exposures here should be done only with a careful emphasis on safety.



**Figure 1.** Topographic map showing locations of study site.



### Road Cut Geology

The bedrock geology of the Augusta area is the subject of an on-going mapping project supported in part by the [National Cooperative Geologic Mapping Program](#). Although a detailed bedrock geologic map of Augusta and vicinity is still a few years off, early reconnaissance mapping provides a general framework for the current study. From this earlier work, geologists have established that the greater Augusta area is underlain with a variety of metamorphic rocks and granites that intruded them.

The strongly layered metamorphic rocks were originally layers of sand and mud that were deposited in an ocean basin around 430 million years ago. A continental collision that produced the Appalachian Mountains around 400 million years ago destroyed the basin between what was then the eastern margin of North America and a small continental landmass in the ancestral Atlantic Ocean. Heat and pressure associated with this event metamorphosed the original sedimentary material. Sand layers became granofels, a variety of metamorphic rock similar to gneiss with more or less equally sized crystals of quartz, feldspar, and mica, but lacking the prominent banding. Mud layers became schist, a metamorphic rock characterized by strongly aligned mica crystals. The forces of continental collision also folded the rocks so that the layering, presumed originally to have been nearly horizontal, is now tilted on edge.

Into the metamorphosed and tilted layered rock rose a magma produced during the continental collision by melting some of the lower crust. This magma forced its way into the metamorphic rocks and eventually cooled to form small granite bodies.



### Metamorphic Rocks

Our geological tour begins on the west side of the river where a very large road cut exposes about 1,000 feet of layered metamorphic rocks. The best exposures are those closest to the western end of the bridge.



Photo by Robert Marviny

**Figure 2.** This is an overview of the prominent outcrop of layered metamorphic rocks at the western end of the bridge. The layering that was originally horizontal is now nearly vertical (and closely parallel to the holes drilled for blasting the roadway). This is an almost edge-on view of the layering. Most layers are about 10 centimeters thick but some beds are up to a meter thick and others are thinner. Also notice a few prominent fractures near the bottom of the road cut.



Metamorphic Rocks

Photo by Robert Marvinnay

Maine Geological Survey

**Figure 3.** This close-up shows thin nearly vertical layering. Directly beneath the eraser is a thin layer of schist. Just to the right of this is a thin layer of granofels, then another thin schist, followed by another thicker granofels layer. The overall purple color of the rock is a result of the large amount of biotite (a dark-colored mica mineral) in the rocks. Clay in the original sedimentary material was metamorphosed to biotite by heat and pressure.



Metamorphic Rocks

Photo by Robert Marvinney

**Figure 4.** This shows a lens of minerals that contains more calcium than the rest of the rock. Light colored lenses and layers like this probably were limy concretions (concentrations formed by water moving within the rock) and layers in the rock before metamorphism. The carbon dioxide in the original lime was driven off by the heat of metamorphism and the remaining calcium combined with aluminum and silica to form minerals like epidote (green speckles in this photo) and an orange garnet (grossular), not shown here but evident in other layers. Geologists often refer to layers abundant with these minerals as calc-silicate layers.



### Folds

Although the overall impression of the road cut is that layering is consistently nearly vertical, in some sections layers are folded into other orientations.

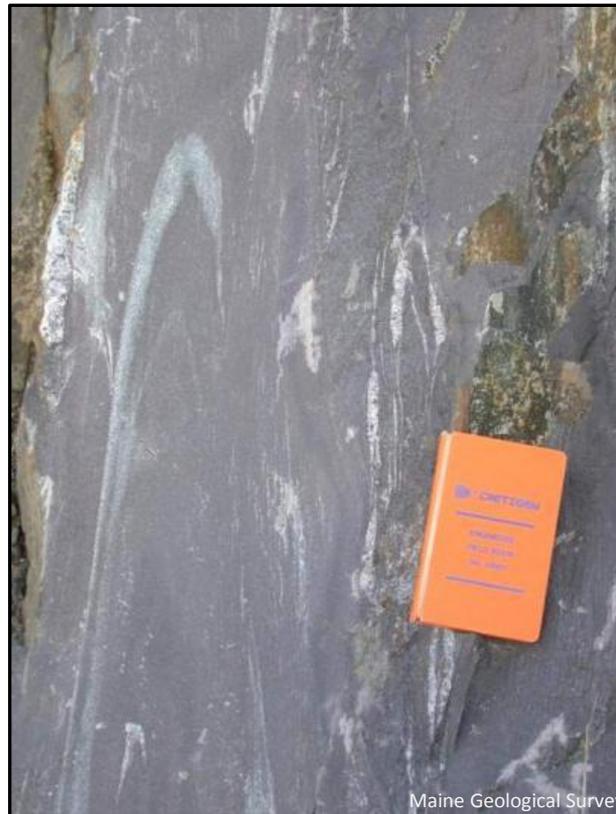


Photo by Robert Marviny

**Figure 5.** This photo shows a small tight fold highlighted by the lighter colored calc-silicate layer in the upper left portion of the photo. There are also some folded quartz veins above the notebook.

## Granite

The roadcuts on the eastern side of the access road, east of Route 201, are in granite. Unfortunately the contact between the granite and the metamorphic rocks is not exposed in this area. The granite is a small body, underlying only the small hill through which the road cuts.



**Figure 6.** This photo is an overview of the road cut. Note the numerous nearly horizontal fractures and the nearly vertical drill holes. In this central section of the road cut, the granite is consistently fine-grained and gray in color.



**Figure 7.** This is a close up of the granite in Figure 6. It contains fine grains of feldspar (white), quartz (gray), and biotite mica (black).

Blocks within the Granite



**Figure 8.** Near the eastern end of the road cut, the granite contains some interesting blocks of other kinds of rocks. This is a chunk of metamorphic rock that got mixed in with the granitic magma as it forced its way upward through the crust.

Blocks within the Granite



**Figure 9.** This is a block of pegmatite, a very coarse cousin of granite containing pink feldspar, gray quartz, and black biotite mica.

Granite Fractures

Photos by Robert Marvinnay



**Figure 10.** This overview provides a perspective on fracturing in the granite. Most of the fractures are nearly horizontal but there are a few that are nearly vertical. These are the major conduits for groundwater flow. A driller drills a well until a fracture is intersected that provides water to the well.

**Figure 11.** This close-up shows how most of the water in this road cut moves through a nearly horizontal fracture. The fracture is wide and loaded with broken rock fragments and clays from the weathering of granite.



Staining in Granite Fractures

**Figure 12.** An interesting feature of water-bearing fractures is the staining of rock around the fracture. Water moving through the fractures often carries naturally occurring metals that can be deposited in the rock, forming prominent stains, in this case of iron.

**Figure 13.** Another example of iron staining. Staining like this is a clear indication of groundwater movement.

Granite Fractures



Photos by Robert Marviny

**Figure 14.** This is a photo of a fracture that dips steeply to the left. It is a wide zone of multiple fractures filled with broken rock fragments and clays. The extensive iron staining in these fractures demonstrates groundwater movement.