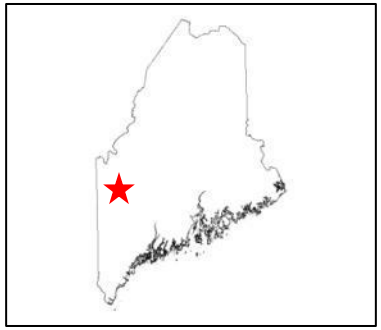
Geologic Site of the Month

July, 2005

# *Some Geological Features at Smalls Falls, Maine*



44 51‘ 30.47“ N, 70 30‘ 58.74“ W

Text by
Robert Marvinney

## Introduction

Smalls Falls is an exceptional series of falls and plunge pools on the Sandy River just upstream from its confluence with Chandler Mill Stream in Township E. The Maine Department of Transportation maintains a rest stop with picnic tables at this location on Route 4 just a few miles north of Madrid. In addition to providing travelers with a scenic respite, Smalls Falls exposes some interesting geology.


Photo by R. Marvinney

## General geology of the Smalls Falls area

With its potential to unravel some of the mysteries of the Northern Appalachians, along with a reasonable potential for mineral deposits, the bedrock geology of the area around Smalls Falls has been the subject of considerable inquiry for several decades. The wealth of mapping has revealed a geological history spanning nearly 500 million years. Most of the bedrock units at Smalls Falls and nearby are either Late Silurian (423-417 million years) or Early Devonian (417-391 million years) in age. The units include a variety of sedimentary rock types that have been metamorphosed to varying degrees by a regionally pervasive metamorphic event that is locally punctuated by metamorphism related to abundant intrusive igneous rocks, predominantly granite. Originally horizontal, the metamorphosed sedimentary layering in the rock is now turned up on edge and runs northeast-southwest across the landscape.

## General geology of the Smalls Falls area

Figure 1 is a portion of a regional geologic map by Moench and others (1995) that shows the general distribution of rock units in the area. Rocks of Silurian age are shown in various shades of green with the older rocks generally toward the northwest. The unit labeled Ssf is the Smalls Falls Formation which will be the focus of this discussion. Sp is the Perry Mountain formation, a mix of thick quartzite and schist. Units beginning with Sr are members of the Rangeley Formation. Various Devonian units, younger than the Smalls Falls Formation, are shown in blue shades and have labels beginning with D. The pink blobs on this map are younger Devonian intrusions of granite and related rocks.

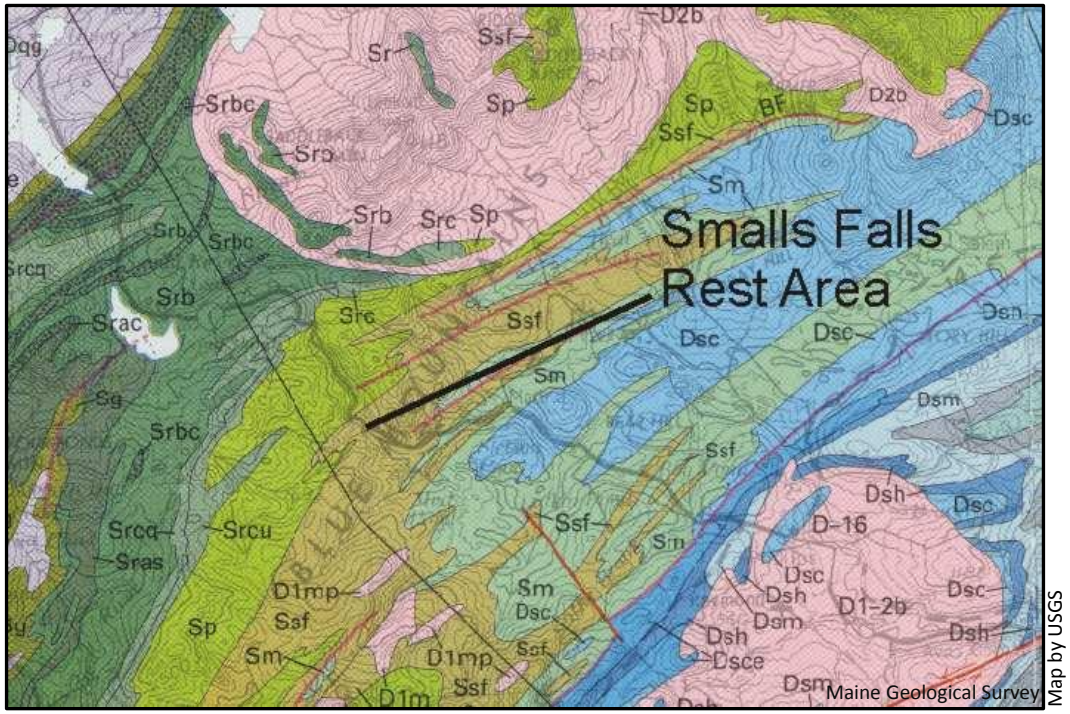



**Figure 1.** Portion of the regional geologic map by Moench and others (1995)

## General geology of the Smalls Falls area

Figure 2 shows the generalized distribution of the Smalls Falls Formation throughout western and central Maine

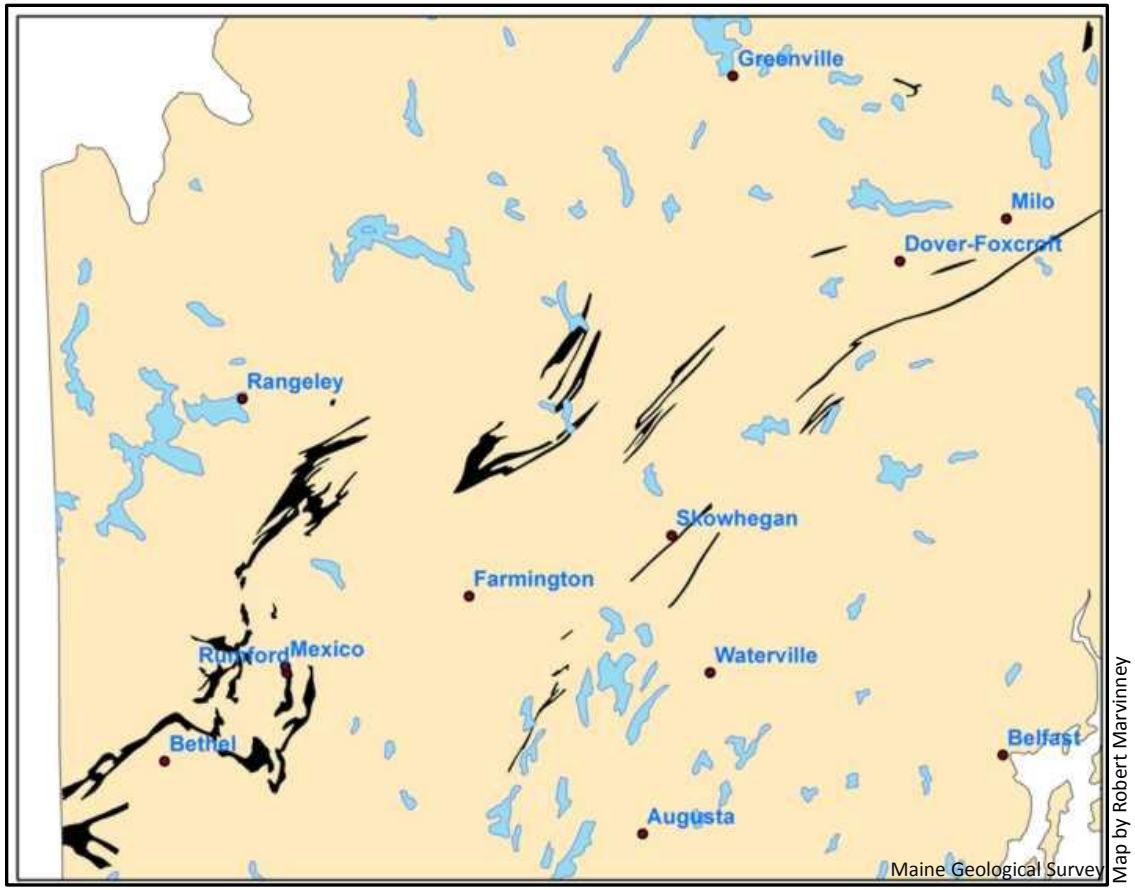



**Figure 2.** Map showing the generalized distribution of the Smalls Falls Formation throughout western and central, ME.

## Smalls Falls Formation

The falls at this rest area are quite picturesque and are underlain entirely with the Smalls Falls Formation. This is primarily a black schist with thin layers of light brown quartzite. The schist contains abundant pyrrhotite (an iron sulfide mineral), along with lesser amounts of other sulfide minerals, that result in the distinctive rusty weathering of the schist. Graphite (just good old carbon) is abundant in this rock as well and gives it the dark black color on fresh surfaces.

Guidotti and Van Baalen (2001) chemically analyzed some samples of the Smalls Falls Formation and found concentrations of metals such as lead, zinc, chromium, vanadium, nickel, arsenic, and others. An environmental consequence of the abundance of metallic sulfide minerals is that ground water in this formation can be highly acidic and contain toxic metals.

## Small Falls


**Figure 3.** An overview of Smalls Falls from the footbridge across the Sandy River. This is a popular spot for swimming on a hot day. Ledges are held up by slightly more resistant rock and the large plunge pools are developed in thick sequences of schist.

## Small Falls Formation

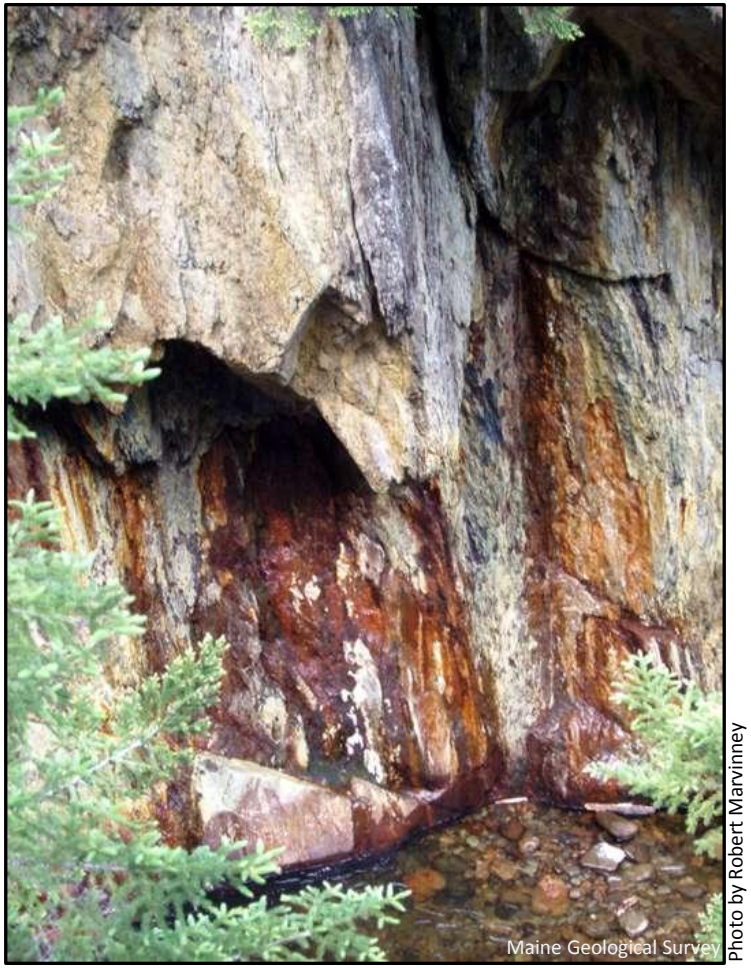



**Figure 4.** An example of rusty weathering. Orange and yellow staining result from weathering of abundant sulfide minerals in the schist.

## Small Falls Formation


**Figure 5.** This image shows bedding as exposed along the well-trodden footpath upstream along the falls. The field of view is about 3 feet and shows alternating layers of resistant quartzite and less resistant schist.

## Small Falls Formation

In Figure 6 thin brown quartzite alternates with thicker gray schist. Graded beds are well preserved, recognized by beds with sharp bases (near the tip of the pencil) which gradually include more and more schist until the top of the layer is all schist. The quartzite was deposited as a quartz sand while the schist was deposited as a fine-grained mud. The top of these beds is toward the top of the image.


**Figure 6.** In places where water frequently polishes the ledge, bedding is well exposed.

## Small Falls Formation


Photo by Robert Marvinney

**Figure 7.** The large, light-colored minerals are andalusite. These grew in the originally muddy layers as heat and pressure increased during regional metamorphism. Some of the crystals show a cross pattern and dark center typical of the chiastolite variety.

## Small Falls Formation


**Figure 8.** Minor offset of a thin quartzite bed. This is not a true "hard rock" fault but a minor offset that occurred while the sediment was soft. The bounding dark schist layers are folded rather than faulted, indicating that the original mud was soft and flowed around the break.

## Small Falls Formation


Photo by Robert Marvinney

**Figure 9.** This is a minor fold in the layering of the Smalls Falls Formation. Note that several layers of quartzite are tightly folded. This fold is an example of the type of folding that affected a large region and resulted in layers being turned up on edge.

## Small Falls Formation


**Figure 10.** In contrast with the image in Figure 9, this image shows folding that affected one layer only. This is an example of a slump where the freshly deposited layer slid down a slope and became contorted before the succeeding layer was deposited. The layering below and above the folded layer is planar and parallel to the bottom and top of the image, respectively.

## References and Additional Information

Guidotti, C.V. and Van Baalen, M.R., 2001, Geological, geochemical, and environmental aspects of metamorphosed black shales in central Maine, in West, D.P. Jr., and Bailey, R.H. (editors), Guidebook for fieldtrips in New England: Geological Society of America, 2001 Annual Meeting, p. F.1-F.26.

Moench, R.H., Boone, G.M., Bothner, W.A., Boudette, E.L., Hatch, N.L., Jr., Hussey, A.M., II, and Marvinney, R.G., 1995, Geologic map of the Sherbrooke-Lewiston area, Maine, New Hampshire, and Vermont, United States, and Quebec, Canada: U.S. Geological Survey, Map I-1898-D, 1:250,000.