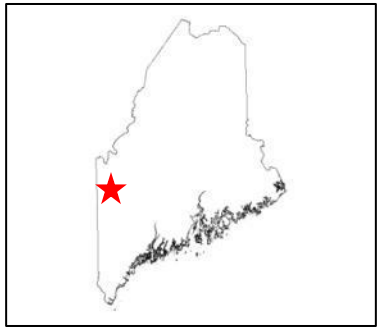
Geologic Site of the Month

December, 2012

The Rangeley Conglomerate



44 55‘ 32.60“ N, 70 36‘ 51.41“ W

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Introduction

A conglomerate is a sedimentary rock that is made up of a collection of rocks that have been cemented together to make one composite rock. Conglomerates are fascinating because of the variety of features that can be seen in an outcrop without need of sampling, magnification, or laboratory analysis. The variety of shapes, sizes, colors, and textures make a conglomerate a great rock for the field naturalist to study.

The two essential parts of a conglomerate are the older rock fragments it contains, called clasts, and the sediment that fills in around the clasts, called the matrix. Careful study of the clasts and their relationship to the matrix gives clues to a three-stage geologic history. The kinds of rocks that make up the various clasts give information about things that happened before the conglomerate formed. The size and shape of the clasts, and the nature of the matrix give information about things that happened while the conglomerate was forming. Features that affect both the clasts and the matrix give information about things that happened after the conglomerate had formed.

Rangeley Conglomerate

We will look at the Rangeley Conglomerate (Figure 1) as an example of how to decipher this three-stage history. Among the clast rock types are sandstone (S), metamorphic vein quartz (Q), and volcanic rhyolite (R). The largest clasts are pebble and cobble sized, embedded in a matrix with a wide range of smaller-sized rock fragments. There is also a variety of grain shapes: the labeled clast of vein quartz is well-rounded; the labeled clast of sandstone is angular, and the labeled clast of rhyolite is sub-rounded.

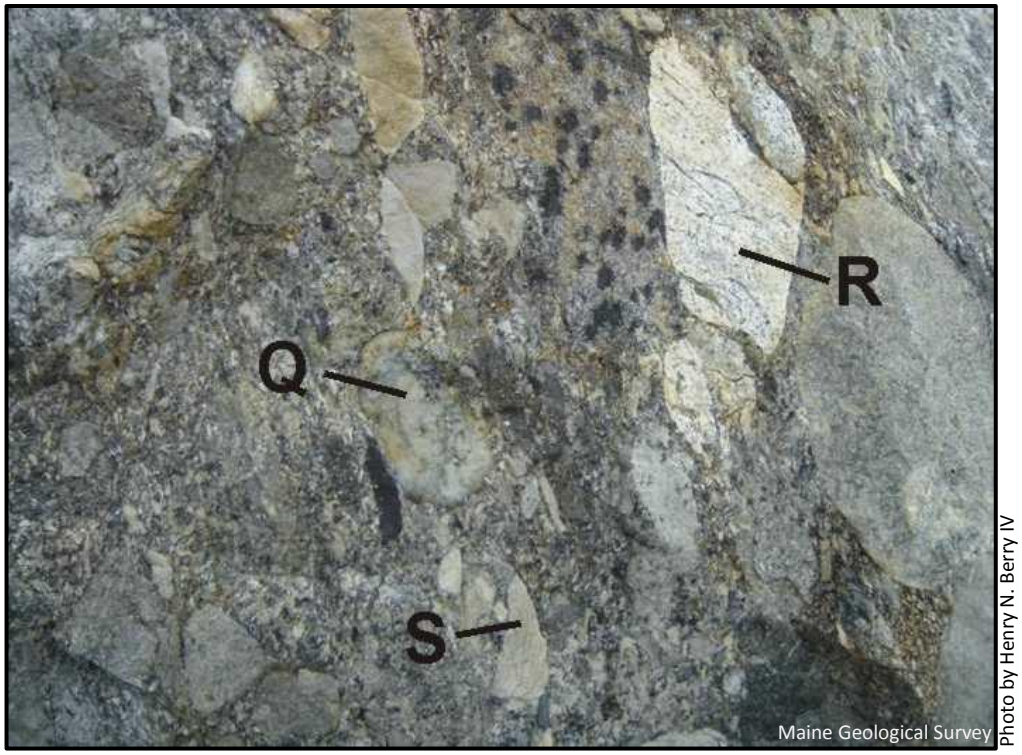

Figure 1. Conglomerate in the lower member (Member A) of the Rangeley Formation.

Location

The field site is an outcrop on the east side of Maine Route 4 that was blasted for the construction of Route 4. It is immediately south of Overlook Road, and about 0.8 miles north of South Shore Drive, which goes to the State Park (Figure 2). This site is described as the last part of Stop 4, field trip A-1, p. 17, by Boone and others (1970), and also as Stop 7 of the field guide by Moench and Boudette (1987).

Figure 2. Google map of the area around the Rangeley Conglomerate outcrop.

Source Area

The outcrop is in Sandy River Plantation, south of the town of Rangeley (Figure 2). The conglomerate here is in the oldest part of the Rangeley Formation, named Member A (Moench and Boudette, 1987). Conglomerates also occur in other parts of the Rangeley Formation, notably in Member C. Not all these conglomerates are the same.

The clasts in the conglomerate consist of many different kinds of rock. They must have been eroded from older bedrock, and then transported to a place where they were deposited together. Looking at the kinds of rock in a conglomerate, therefore, gives a picture of the source area that was being eroded.

Source Area

The Rangeley Conglomerate includes a wide variety of rock types, including sedimentary, volcanic, and plutonic rocks (Figures 3-4). These rocks can be found intact to the northwest of Rangeley, in the present-day Boundary Mountains region.

Figure 3. Conglomerate in the lower member (Member A) of the Rangeley Formation. Among the many rock types is a conspicuous cobble-sized clast of metamorphic rock (M) in the middle of the photo. The clasts are resting against each other here, suggesting this sediment was deposited by moving water, such as currents or waves.

Source Area

This means not only that the rocks to the northwest are older than the Rangeley Formation, but furthermore, that they had been uplifted and were being eroded at the time the conglomerate was being deposited. The rock to the right of the line in Figure 4 is pebble conglomerate, while the rock to the left is cobble conglomerate. These were different layers that formed in sequence, one on top of another, even though the layers are now nearly vertical.

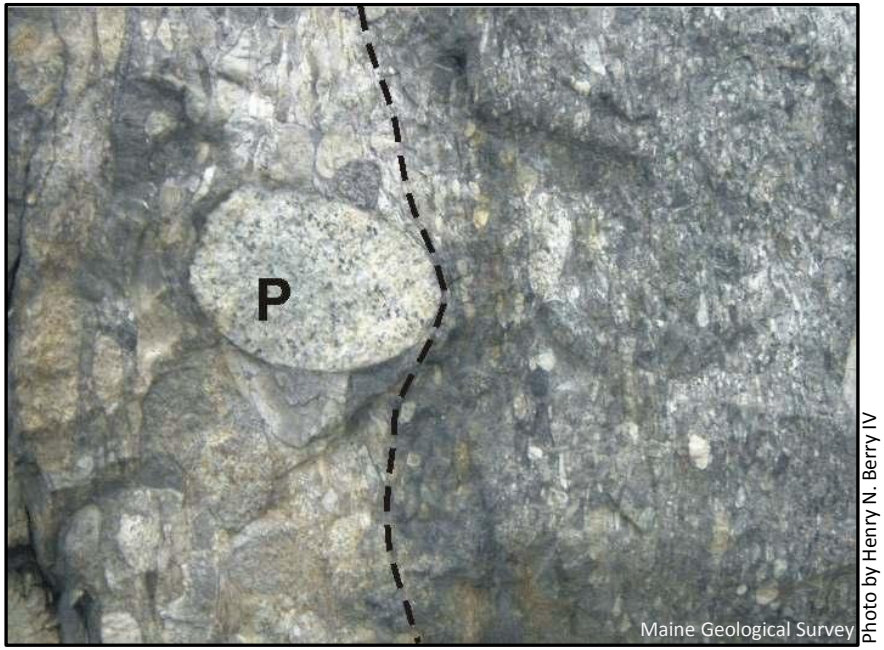

Figure 4. Conglomerate in the lower member, A, of the Rangeley Formation. The cobble-sized clast of plutonic rock (P) is well-rounded. Plutonic rocks are a class of igneous rocks that form underground, and have large, interlocking mineral grains. This clast is probably granodiorite or tonalite rather than granite. It is common for certain rock types to form sedimentary clasts of a particular shape, as this round clast represents.

Sedimentology

Sedimentology is the study of sedimentary rocks, including their description and origin. For conglomerates, the size, shape, and arrangement of clasts is a reflection of the way they were transported and deposited by water. Large pebbles and cobbles can be moved only in high-energy environments, such as in fast-moving streams or by storm waves. The Rangeley conglomerates at this site have a variety of clast sizes from layer to layer with some that are dominantly pebbles (Figure 5).

Figure 5. Pebble conglomerate in the lower member (Member A) of the Rangeley Formation. Most of the clasts in this photo are various types of sedimentary rock. The strong alignment of the pebbles (parallel to the pencil) is due to later compression of the rock during metamorphism.

Sedimentology

And, some that are dominantly sand (Figure 6). Still others are poorly sorted by size, and contain large and small clasts mixed together (Figure 1 and 3). All of these factors together imply a dynamic environment with changing conditions. As in Figure 4, adjacent layers of pebble conglomerate are visible at the left and right edges of Figure 6, showing that once-horizontal layers are now nearly vertical.

Figure 6. Gray sand layer with a solitary white pebble. This pebble was supported by the sand matrix at the time it was deposited, probably in a slurry emplaced as a submarine debris flow or slide. Darker spots are merely wet places where a little light snow was brushed away, one November afternoon.

Sedimentology

The arrangement of clasts in the matrix is worth noting. For sediment in which flowing water is the dominant transport mechanism, larger clasts generally rest directly on each other, tightly packed, with finer-grained matrix filling the spaces (Figure 1 and 3). In debris flows or slides, all particles flow together regardless of size, and the clasts are commonly supported by the matrix (Figure 6-7).

Figure 7. Pebble to cobble conglomerate in the lower member (Member A) of the Rangeley Formation. This rock shows a clear distinction between the clasts and the matrix. Streaks in the matrix are aligned with the clasts, defining a vertical structure in the rock that formed during metamorphism at high pressure and temperature.

Sedimentology and Later Metamorphism

Finally, clast shape, and particularly the presence of sharp edges or corners, is a reflection of how long the clasts have been transported. During transport, clasts hit each other, progressively breaking off sharp corners and making the fragments more rounded. The conglomerates at this site include many angular to sub-angular grains, suggesting they have not traveled far (Figure 1 and 3). As with size, though, the degree of roundness is not uniform, and there are many rounded clasts as well.

Taken together, all these features indicate that this part of the Rangeley Formation accumulated in a dynamic environment in which a variety of older rocks to the northwest were being eroded, transported a short distance by fast-moving streams, and deposited near the edge of a marine basin by submarine currents and debris flows. The ages of rocks in the region indicate that this occurred in the Silurian Period of geologic time (approximately 435 million years ago).

Tens of millions of years later, in the Devonian Period of geologic time, all the rocks of central New England, including the Rangeley Formation, were involved in a significant mountain-building event. During this process, the rocks of the Rangeley Formation were altered by heat and pressure, a process of change called metamorphism.

The most obvious features of metamorphism at this site are *(1)* the fact that the layers are tilted steeply (Figure 4 and 6), and *(2)* that in many places the clasts and matrix have been stretched, flattened, or bent due to the heat and pressure (Figure 3, 5, and 7). These factors make it all the more remarkable that so many original features of the conglomerate have been preserved.

References and Additional Information

Boone, Gary M., Boudette, Eugene L., and Moench, Robert H., 1970, Bedrock geology of the Rangeley lakes-Dead River basin region, western Maine. In Boone, Gary M. (editor), Guidebook for field trips in the Rangeley lakes Dead River basin region, western Maine: New England Intercollegiate Geological Conference, Trip A-1, p. 1-24. (Note: the entire guidebook is available for download from the UNH library)

Moench, Robert H., and Boudette, Eugene L., 1987, Stratigraphy of the Rangeley area, western Maine. In Roy, David C. (editor), Geological Society of America, Centennial Field Guide, v. 5 (Northeastern Section), p. 273-278.

Osberg, P. H., Moench, R. H., and Warner, Jeffrey, 1968, Stratigraphy of the Merrimack synclinorium in west-central Maine. In Zen, E-an, White, Walter S., Hadley, Jarvis B., and Thompson, James B., Jr. (editors), Studies of Appalachian geology, northern and maritime: Interscience Publishers, New York and London, p. 241-253.

Smith, Edward S. C., 1923, The Rangeley conglomerate: American Journal of Science, 5th series, v. 5. p. 147-154.

Nice introduction to sedimentary rock textures and what they mean: Textures of Sedimentary Rocks (179Kb pdf format)