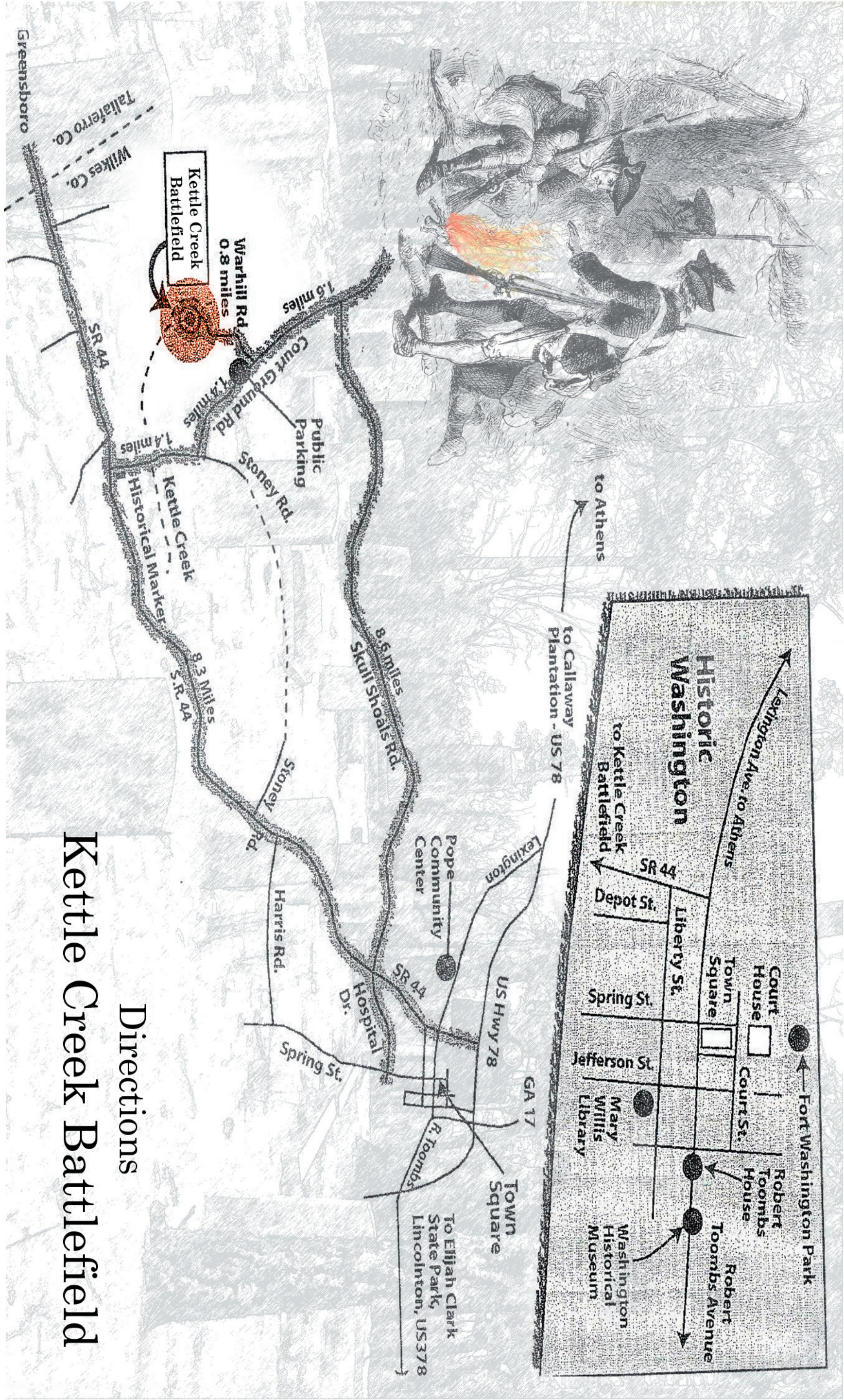

Kettle Creek Battlefield Association, Inc. P.O. Box 729, Washington, GA 30673
September 2015

Kettle Creek ROCKS

A Layman's Guide to the Rocks of Kettle Creek Battlefield.

by

Dan Williams

Notes

KCBA

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give rise to soils that are far less acidic than the norm. Over many thousands of years the big amphibolite outcrop has been eroding and releasing high amounts of calcium and magnesium into Kettle Creek and its head-water streams. Each time Kettle Creek flooded, the calcium and magnesium were washed out of the creek bed and on to the adjacent bottom-land along the creek.

Over time, trees, shrubs and herbaceous plants that love the less acidic soils derived from high calcium and magnesium have found their way to the banks of Kettle Creek where they form a forest community quite different from the forest community usually found along Georgia streams. Plant seeds move up and down water channels just like people and animals, so a plant growing hundreds of miles away can release seeds that eventually turn up and thrive in an ideal habitat like the high calcium and magnesium soils of Kettle Creek.

A list of calcium and magnesium-loving trees found at the Kettle Creek battle site includes shagbark hickory, southern sugar maple, pawpaw, winged elm, sugarberry, Eastern redbud and Eastern red cedar. Walk the trail that circles the base of War Hill and you will find them. Shagbark hickory has very flaky bark, and the leaves of southern sugar maple look like the flag of Canada.

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Kettle Creek Rocks

And Their Origin

Dan Williams*

Introduction

Site History

The Kettle Creek battle site, located in Wilkes County, Georgia eight miles west of present-day Washington, commemorates one of the most important Revolutionary War battles fought in Georgia. On February 14, 1779, around 400 American Patriot troops commanded by Colonel Andrew Pickens surprised and defeated around 600 British Loyalists commanded by Colonel John Boyd. Casualties from the battle included 40-70 British dead and 9 Patriot dead. Colonel Boyd was mortally wounded early in the battle and died that evening.

Much of the battle centered on and around War Hill, a distinctive knob-shaped prominence now owned by Wilkes County and operated as a battlefield park. Today, War Hill has a State of Georgia Historical marker describing the battle, an enclosed area with headstones of Revolutionary War veterans and a commemorative stone monument.

While no battle participants are buried in the enclosed area with the headstones (erected in the twenty-first century), the battle account of Colonel Pickens indicates a mass burial of those killed in the battle. This mass burial has not yet been located.

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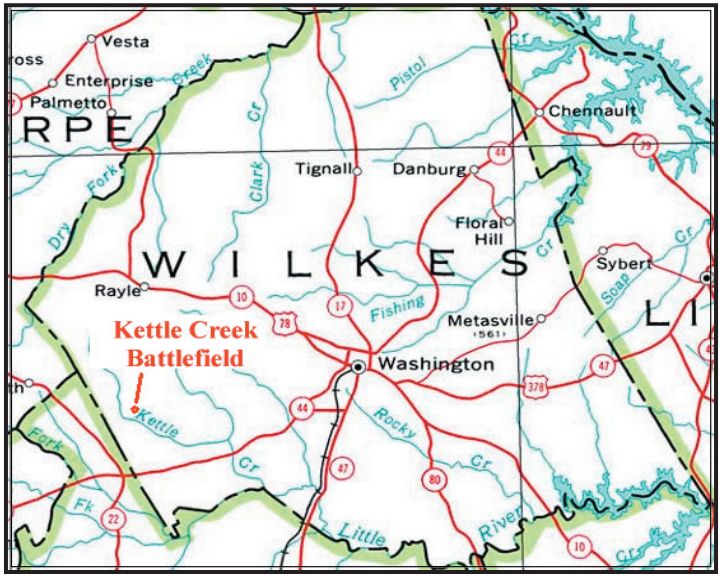


Map 1. Kettle Creek Battle Site

Local Area

This report is an overview of the geology and soils of War Hill and its immediate vicinity. The major rock types found here are described, including a discussion of their probable origin in terms of plate tectonics, the theory that the outer shell of the earth is composed of several plates which glide over each other. The report also summarizes the interesting relationship between the area's geology and its plant communities.

Geographic Location

Map 1 shows the general location of the Kettle Creek battle site situated in the lower Piedmont physiographic province which is characterized by low rolling hills and soils made of clay and occasionally sand. This province is one of five different landforms which include mountains, valleys, ridges, and plains.

toward the northwest, so all the rock layers were squeezed into narrow bands oriented perpendicular to this pressure. Take a look at a map of the Appalachian Mountains and you will see they too are oriented along a line from northeast to southwest, reflecting the results of this tremendous pressure.

This amphibolite outcrop in Kettle Creek is the same rock type that you see on Map 2 as the long narrow dark purple band just north of the battle site. Amphibolite is very dark in color with scattered white patches. The dark mineral is mostly hornblende, but there may be some of the mineral pyroxene here too. Both of these dark minerals are very high in iron, magnesium and calcium. The scattered white patches are the mineral feldspar, but this feldspar has no potassium, very little sodium and lots of calcium.

Amphibolite is quite hard with a crystalline texture. The Indians laboriously made hand axes called celts from amphibolite and similar hard crystalline rocks. When archaeologists surveyed the Kettle Creek area recently, they found one of these amphibolite celts.

The amphibolite most likely began as deep ocean crust pushed up in the Middleton Lowndesville fault when the Carolina Terrane volcanic island chain crashed into ancient North America. It was originally the igneous rock called basalt just like the dark basalt lava of Hawaii. Heat and pressure turned the basalt into the metamorphic rock amphibolite.

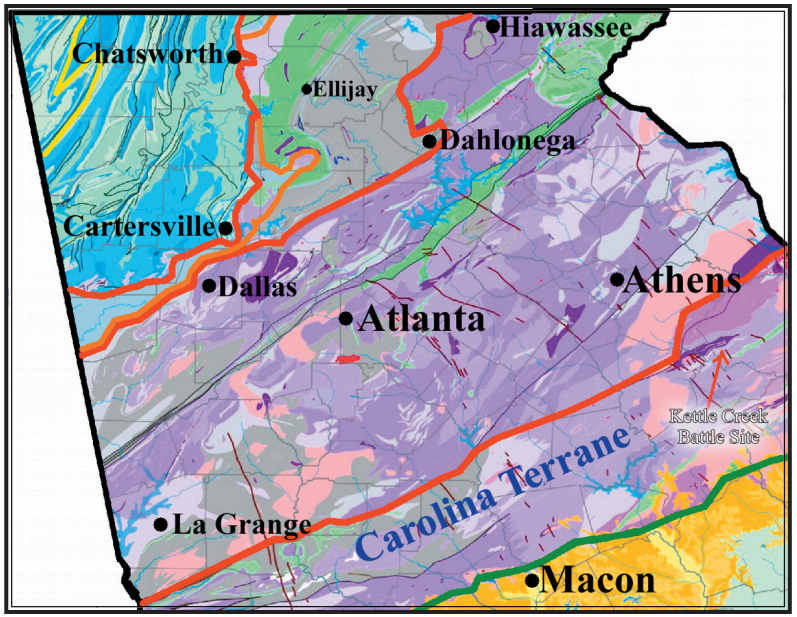
The amphibolite is important because it has resulted in a unique combination of plants all along Kettle Creek including the battle site. Here is how. Most of Georgia's soils are acidic and contain very little calcium and magnesium, important nutrients all plants need. Plant communities adapted to acidic soils are common in Georgia. Amphibolite has lots of calcium and magnesium which

Amphibolite

that formed deep underground at the base of the volcanic island. It eventually cooled, hardening into an igneous rock called diorite, the main rock forming the roots of the Andes Mountains in South America. Much later, the diorite was squeezed by heat and pressure into the metamorphic rock biotite hornblende gneiss. The rock and soil above it eventually weathered away leaving it exposed.

The least abundant rock found in outcrop at the Kettle Creek battle site is also the most important rock in terms of soil and vegetation. It is called amphibolite and is marked on Map 3 by the red letter A. This sedimentary rock forms several narrow lines that stretch across the bed of Kettle Creek. If you find this outcrop and you have a compass, you will see the lines are oriented longways from northeast to southwest. This is probably more than just coincidence.

The plate tectonic events that pushed the Carolina Terrane on to ancient North America caused tremendous pressure directed



Map 2. Kettle Creek in the Carolina Terrane

Geologic Location and Its Origin

Map 2 shows the battle site's location in terms of its geologic province.

The Kettle Creek battle site is located in the Carolina Terrane geologic province (a specific land area based on its origin). On map 2 the Carolina Terrane is the area in the lower portion of the map between the green line just above Macon in the lower right hand corner and the red line just above the words "Carolina Terrane".

Though the Carolina Terrane looks small, it actually extends many miles under the sandy land of the Georgia Coastal Plain which was created because of erosion. Geologists have excellent evidence indicating the Carolina Terrane was a volcanic island chain extending along the coast of ancient North America around 400 million years ago. The islands of Japan are a modern-day example of a volcanic

island chain. The Carolina Terrane island chain formed when pressure from an expanding mid-ocean ridge caused a section of deep ocean crust to break, and one piece was shoved under the adjacent piece, a process called plate subduction. The Mariana Trench of the Western Pacific marks the greatest ocean depth on earth and is a modern-day ocean plate subduction zone where an eastern plate was shoved downward making the trench.

In the western north Atlantic, the shoved-down (subducted) piece of ocean crust was pushed down into earth's mantle where it melted and then rose up and erupted on the ocean floor above, forming the volcanic island chain. More pressure from the expanding mid-ocean ridge caused the volcanic island chain to crash into ancient North America where it was permanently attached at a fault zone (the lowest red line on Map 2). Geologists call this particular fault zone the Middleton-Lowndesville fault. You can see it runs across the state from just below Athens to just below LaGrange.

When the Carolina Terrane volcanic island chain was shoved up against and on top of ancient North America, a lot of deep ocean crust came up with it and was deposited along the fault line. A big patch of this deep ocean crust is shown on Map 2 as a long narrow irregular band of dark purple located just north of the Kettle Creek battle site. The headwaters of Kettle Creek emerge from this outcrop of deep ocean crust, and this has much to do with the soils and plants of the Kettle Creek battle site as we shall soon see.

The rocks found at the Kettle Creek battle site began as igneous (volcanic) and sedimentary rocks (from sediments) associated with volcanic eruptions. Later, all these rocks were deformed by the heat and pressure of subsequent plate tectonic events. This turned

Biotite hornblende gneiss

means a metamorphic rock containing the minerals quartz, feldspar, biotite and sometimes hornblende. Gneiss rock often has light and dark-colored stripes telling you it has experienced much heat and pressure that made it a metamorphic rock.

Take a hammer and crack a piece of this rock. Look closely at the fresh surface. You will first notice many black specks. These are made mostly of the mineral biotite which is a kind of mica containing medium amounts of iron. Some of the black specks may be the mineral hornblende (even more iron), but it is very difficult to tell these two black minerals apart. A mixture of these black specks is common in the ditches along roadsides and are easily seen against the white sandy surface soil.

The white spots are the mineral feldspar. The feldspar in quartz muscovite sericite schist has lots of potassium in it, but the feldspar in this biotite hornblende gneiss has lots of sodium instead of potassium. You will also see lots of quartz grains in this rock. Quartz always looks clear or gray in a rock.

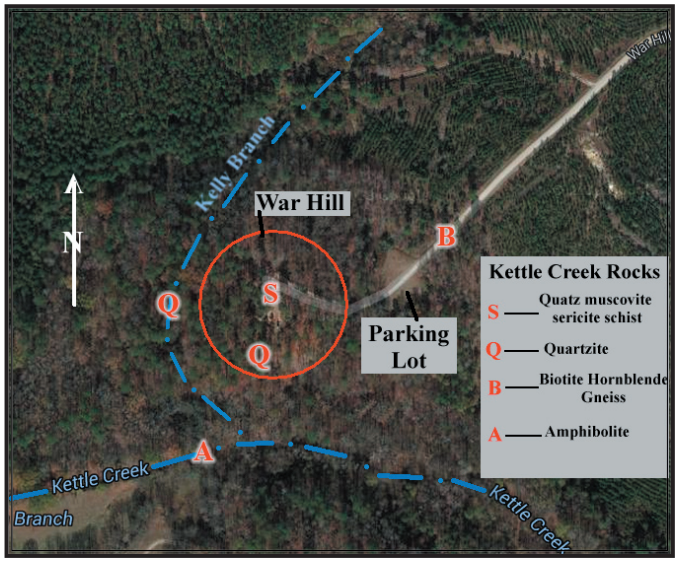
Biotite hornblende gneiss began as magma (molten rock)

Metachert

Quartzite is the next most common rock here, and you can also find it in the bed of Kettle Creek at the foot of War Hill. After feldspar, quartz is the most common mineral on earth.

When the Carolina Terrane volcanic island chain erupted, millions of tons of very fine grained volcanic ash came out along with the tuff. The ash drifted far away from the island and settled deep in the ocean. Eventually many feet of this fine quartz dust accumulated on the deep ocean bottom, forming a rock called bedded chert. Like quartzite, chert is made of quartz grains, but the grains are microscopic in size instead of sand-size. The heat and pressure of metamorphism changed the chert only slightly, but enough that it is now called metachert. Metachert is found here at Kettle Creek, but it is rare. It is common in northwest Georgia.

Now go to the parking lot and then walk along the road leading away from War Hill. Very soon you will come to a high spot where some grayish black rock is lying around along the road. This rock is called biotite hornblende gneiss. Gneiss is a geology word that



Map 3. Rocks of Kettle Creek Battle Site

all of them into metamorphic rocks, which usually have a layered appearance and includes marble and slate.

The Rocks

Map 3 shows the rocks of the Kettle Creek battle site. If you go to the top of War Hill (marked S on Map 3), you will see it is rocky. Look closely at one of these rocks and you can see several colors. Each color is a mineral and may be a crystal or smaller. The clear or gray color is quartz which is very hard. It resists being washed away by rain better than any other mineral, and that is why War Hill is a high hill top.

Look again and you will also see a whitish sometimes shiny mineral. This is a form of the mineral muscovite mica. This form is called sericite. It is softer than quartz and contains potassium, aluminum, and silicate. Muscovite is a common Georgia mineral like quartz. Its sericite form is less common, but is abundant where

Quartz muscovite sericite schist

volcanic activity took place long ago. The red color you might see is iron staining.

This rock containing quartz and muscovite (as sericite) is called quartz muscovite sericite schist. Schist is just a geology word meaning a metamorphic rock with soft minerals like muscovite that looks flattened, smeared and shiny.

It began long ago as pieces of the minerals quartz and feldspar blown from volcanoes of the Carolina Terrane volcanic island chain. Feldspar is a very common Georgia mineral that looks white in rocks and contains potassium, sodium, calcium, aluminum, and silicate. This quartz and feldspar material was originally called volcanic tuff and modern-day examples include the material blown from Mt. St. Helens in Washington State (1980) and the rock composing the Grand Canyon of the Yellowstone River in Yellowstone National Park in Wyoming.

This volcanic tuff settled down on the underwater sides of the volcano where hot water from deep volcanic vents (black smokers) flushed through this porous material, pumping reddish iron into it and

Quartzite

turning the feldspar into muscovite and then sericite. This process is called hydrothermal alteration, and nearby Graves Mountain in Lincoln County is an outstanding example of this process. At Graves Mountain not only iron, but also the metal titanium was pumped into the tuff, creating some of the world's finest specimens of the mineral rutile (titanium oxide). Titanium oxide makes a strong heat-resistant metal used in the aerospace industry and also in more than 70% of paints as a substitute for lead. Quartz muscovite silica schist is the most common rock type on War Hill.

If you walk toward the south side of War Hill from the top, you will come across a big outcrop of rocks running down the entire south face of the hill. Find it by walking from the historic marker toward the big stone monument and look toward the right. This rock is called quartzite. Quartzite began as sand-size pieces of quartz (silicate and oxygen) with less feldspar mixed in that came from the volcano and was mashed by overlying layers into sandstone. Much later, heat and pressure partially melted the sand grains, welding them together to form quartzite, the metamorphic equivalent of sandstone.