The Lake George Gem and Mineral Club -

Club Monthly Meeting, April, 2014

Regular Meeting of the Lake George Gem & Mineral Club
Saturday, April 12, at 10:00AM
Lake George Community Center
***(Please Note*: We will change the meeting time to 9AM for the May meeting.)**

"Colorado's Oldest Rocks": Origin and Simplified Classification of Metamorphic Rocks"
by Bob Carnein

Retired geologist and LGGMC Newsletter Editor Bob Carnein will give members all the information they need to recognize the common metamorphic rocks they are likely to encounter on LGGMC field trips. *See article at the end of this newsletter for a summary.*

Dues are due….see membership application at the end of this Newsletter. Please renew now; unpaid members will be removed from the newsletter mailing list in April and cannot attend Club field trips.

Coming Events

"Social Life in Western Mining Camps", by Mark Vendl and Duane Smith, 7PM, WMMI, Colorado Springs. (free, but RSVP required: rsvp@wmmi.org)	… **April 3**
Columbine Gem & Mineral Society, Monthly meeting, 6:30PM, Mt. Shavano Manor, 525 W. 16th (at J St.), Salida	… **April 10**
"The Age of the Grand Canyon: A Century of Debate", by Karl Karlstrom and Rebecca Flowers, National Mining Hall of Fame & Museum, Leadville.	… **April 11**
North Jeffco Gem and Mineral Club Silent Auction, 6:45PM, APEX Community Recreation Center, 6842 Wadsworth Blvd., Arvada; info at sidewindermin@comcast.net.	… **April 11**
Dinosaur Discovery Day: Bike Ride, 10AM-2PM; http://www.donoridge.org for info.	… **April 12**
Pueblo Rockhounds, Monthly meeting, 7:30PM, Westminster Presbyterian Church, 10 University Circle, Pueblo.	… **April 17**
Colorado Springs Mineralogical Society, Monthly meeting, 6:30PM, Colorado Springs Senior Center, 1514 N. Hancock, Colorado Springs.	… **April 17**
Colorado Mineral and Fossil Show, Ramada Plaza Denver Central (old Holiday Inn)	… **April 18-20**
Colorado Mineralogical Society Annual Auction, Holy Shepherd Lutheran Church, 920 Kipling St., Lakewood; info at rsnelson@gmail.com.	… **May 3**
Friends of Mineralogy, Colorado Chapter, Silent Auction, Clements Community Center, 1580 Yarrow St., Lakewood.	… **May 10**
Pikes Peak Gem & Mineral Show, Western Museum of Mining & Industry; 2nd	… **June 6-8**

Annual Victor Gem & Mineral Show; contact Ruth Zalewski at stcfg@victorcolorado.com for information (and see article in newsletter below). ··· **June 21-22**

Lake George Gem & Mineral Club Annual Gem, Mineral & Fossil Show, in the field next to the Lake George Post Office ··· **Aug. 15-17**

Club News

Welcome New Members:
Peter & Gail Leach (Parker)
Glen Musick (Provo, UT)
Bob Simmons (Colorado Springs)

As some of you know, **Rich Fretterd** recently donated a gigantic smoky quartz crystal to the Pikes Peak Historical Society Museum. This specimen has been on display each of the last several years at our August mineral show. It now has a permanent home, in honor of Rich's late brother, Vincent. Here are some photos of the crew wrestling it into place at the PPHS.


(left) The crystal in its transport trailer (no, it isn't a new mummy); (right) Unloading at the museum.



(left) Rich discusses things with the boss; (center) the new stand; (right) Will it fit?



(left) Are you sure?; (center) The true test; (right); "Dang, that looks good!"
(photos by Bob Carnein)

- **Request for Annual Show Chair or Committee head Volunteer.**

This will be the *last* year for our current Show Chair **Dan Alfrey**.
We **need for a Volunteer** to *either* become the new Chair *or* be the Leader of a Show *Committee*. There are excellent printed guidelines w/ logistic contacts & dates already in place! These were established by John Rakowski & Rebecca Blair. Dan & Jennifer Alfrey have updated the Vender/Dealer electronic database.
The club has permission to hold the 2014 Annual Show in the same beautiful location in Lake George. We have many repeat dealers & several new ones with interest in our fun event!
We also have had great participation from the membership is assisting while the Show is 'on' and getting better every year!!
Ideally, the new volunteer should become involved *as soon as possible* in order to smooth the transition on tasks. Keep in mind, by the Show's end, a good portion of the next year's event is set in place. Give back. **Your club needs You.** Contact an Officer today!

- Here's an announcement from **Bruce Geller**, Curator at the CSM Museum**:**

Announcing another fabulous Book Sale (& Garage Sale)

CSM Museum
1310 Maple Street, Golden, CO

April 18+19, 2014
9 A.M. - 4 P.M.
and
April 20, 2014
1-4 P.M.

Hundreds of books, maps, journals, U.S.G.S. folios, minerals, fossils, etc.
Prices vary by item or box. Most prices will drop throughout the event.
Information: 303-273-3815

Field-trip coordinator **Todd Mattson** has been working hard to fill up this spring/summer's trip schedule. A ***preliminary*** (NO PROMISES) list includes the following:
Holcim quarry; Ace-In-The-Hole claim (**Rich Fretterd**); Forever mine (**Townsend and Frankie Wolfe**); Wigwam Creek; Spruce Grove Campground; Bad Boys of Cripple Creek; Petra Placer (**Rich Fretterd**); Topaz Mountain (**Joe and Krystal Dorris**); St. Peters Dome; Smoky Hawk mine (**Joe and Krystal Dorris**); Hartsel barite (**Dave Harvey**); Goethite Hill; Devils Hole mine; New Hope amethyst (**Jim Meacham**); Last Chance mine; Molly Kathleen Gold mine.

Steve Veatch sent the following e-mail about a Lake George Pebble Pup:

Greetings, A local third grade students, Jarrod Gallop, wrote an article that was published in Deposits Magazine. He is a member of the Lake George Pebble Pups and attends **Columbine Elementary School in Woodland Park.** I worked with Jerrod by showing him how to structure a story, write a Haiku, and do the photography. He undertook the project and did an excellent job. This article appeared first in the local newspaper and has been published across the United States in various rock and mineral club newsletters. **Today a newspaper reporter met with me, the student author and the school principal, Veronica Wolken.**

It is newsworthy that a third grade student had an article published in an international magazine, but it is even more important that because of his article, the editors of the magazine are going to make his article the first of a regular column. His brother, also in 3rd grade, is going to have his article published in the next edition. I will be using other students who can contribute to this column in both pebble pup units.

Steve

At the October meeting, the following officers and committee chairs were elected for 2014:

President: **Suz Core (**suzc@peakinet.net)
Vice President: **Jo Beckwith (**shawneewolf@hotmail.com)
Treasurer: **Wayne Johnston** (wjohnston719@q.com)
Secretary: **Norma Engelberg** (njengel60@gmail.com)
Newsletter Editor: **Bob Carnein** (ccarnein@gmail.com)
Membership/Badges: **Jerolynn Kawamoto** (Jerrolynn@wildblue.net)
Field-Trip Coordinator: **Todd Mattson** (busman842@q.com)
Webmaster and 2014 Show Chair: **Dan Alfrey** AlfreyDan@aol.com)
Pebble Pups Coordinator: **Steve Veatch** (sgeoveatch@att.net)

Earth-Science Scholars/Pebble Pups Corner

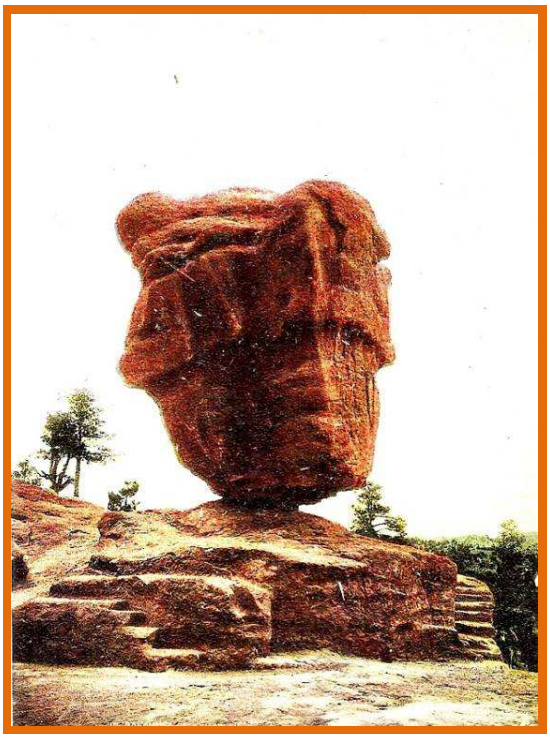
Here's the schedule for this year's remaining Pebble Pups/Earth-Science Scholars classes and activities:

April: Colorado-Wyoming diamond area (**Steve Veatch; Gavin Noller**)
National Poetry Month
May: Orienteering (**Dan Alfrey**)

Earth-Science Scholars and Pebble Pups meet **from September through May** on the **third Tuesday of each month at 6PM in the Lake George Community Center**. Be sure you check regularly at www.LGGMClub.org for details and updates, or contact **Steve Veatch** at steven.veatch@gmail.com.

A Haiku Poem by Reed Noller

There it stands silent
A magnificent red rock
Will it ever move



Balanced Rock in Garden of the Gods. Vintage postcard from the Pebble Pup Collection. Note steps chiseled into the rock. The steps are gone today.

Author's bio: Reed Noller is 11 years old and in 5th grade. His favorite subject in school is Art, and he attends his school art club. Outside of school, Reed loves to play hockey and learn about rocks in the Colorado Springs Pebble Pups.

Remember, new students and their parents are always welcome; Earth-Science Scholars and Pebble Pups are welcome on LGGM Club field trips.

Notes from the Editor

Bob Carnein, Editor

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719-687-2739

Several members have commented that they would like to learn more about basic geology, so they can better understand what they see in the field. In response to that, I will present a program on metamorphic rocks at the April meeting. Here's an article that gives the basics.

"Metamorphic Rocks: Colorado's Oldest Rocks"

by Bob Carnein

We normally think of Colorado's various granite intrusives as the oldest rocks in the state. The Pikes Peak Granite varies in age but averages about a billion years old. The Cripple Creek Granite/Silver Plume Granite averages over 1.4 billion years old. However, these granite plutons had to *intrude* something—they had to penetrate some older "host rocks" that at one time surrounded and overlaid them. These truly ancient rocks are exposed in many places in the Colorado Front Range and constitute the so-called "Idaho Springs Formation".

The rocks of the Idaho Springs Formation started out as ancient sediments and volcanic rocks that were heated and squeezed during a primeval mountain-building episode about 1.75 billion years ago. In places, they got so hot that they began to melt, forming new igneous rocks. But, in most places, they were simply changed (recrystallized) by the heat, pressure, and chemically active fluids (water with dissolved chemicals) generated during the mountain-building episode. Later, bodies of magma that became the Silver Plume and Pikes Peak granites penetrated and locally re-heated them. Subsequent uplift and erosion produced exposures of these rocks at various locations in central Colorado. Remnants of the Idaho Springs commonly are surrounded by masses of granite, forming "islands" in the sea of granite. On Figure 1, the blue and pinkish brown colors show exposures (brighter colors) and hypothesized subsurface distribution (paler colors), as mapped by scientists of the U.S. Geological Survey.

Rocks of the Idaho Springs Formation belong to a big category of Earth materials called ***metamorphic rocks***. The name comes from the English and Greek *meta* (change) and the Greek *morphē* (form). The process by which the rocks form is *metamorphism* (not metamorphosis, a term usually used in zoology). In metamorphism, previously existing rocks (igneous, sedimentary, or older metamorphic rocks) are changed through the action of heat, pressure (squeezing), and/or chemically active fluids (water with dissolved chemicals), acting in varying proportions. The process is said to be *isochemical,* meaning that the chemistry of the original rock is pretty much preserved, though the texture and mineralogy change. (If the chemistry changes significantly, due to addition or removal of material, the process is called *metasomatism.*) *Any* rock can undergo metamorphism, and, as a result, metamorphic rocks are the most varied of all Earth's rock types.

The ***rock cycle*** (Figure 2) is used by geologists to show the relationships between the three major rock types and the processes that convert one to another. If we consider igneous rocks to be the starting point, all three rock types grade into each other. Although it's possible to follow the outer arrows on the cycle, notice that arrows on the inside of the diagram represent short circuits—e.g. igneous rocks can convert directly to metamorphic rocks without first converting to sediments; metamorphic rocks can convert to sediments without melting to form magma; etc.

One can reach any point on the diagram via several different routes. Geologists think that many (maybe most) granites form by ultrametamorphism (called *anatexis* by geologists) of rocks that were originally mudstones and shales, which have a chemical composition very much like that of granite. For years, geologists puzzled over an odd

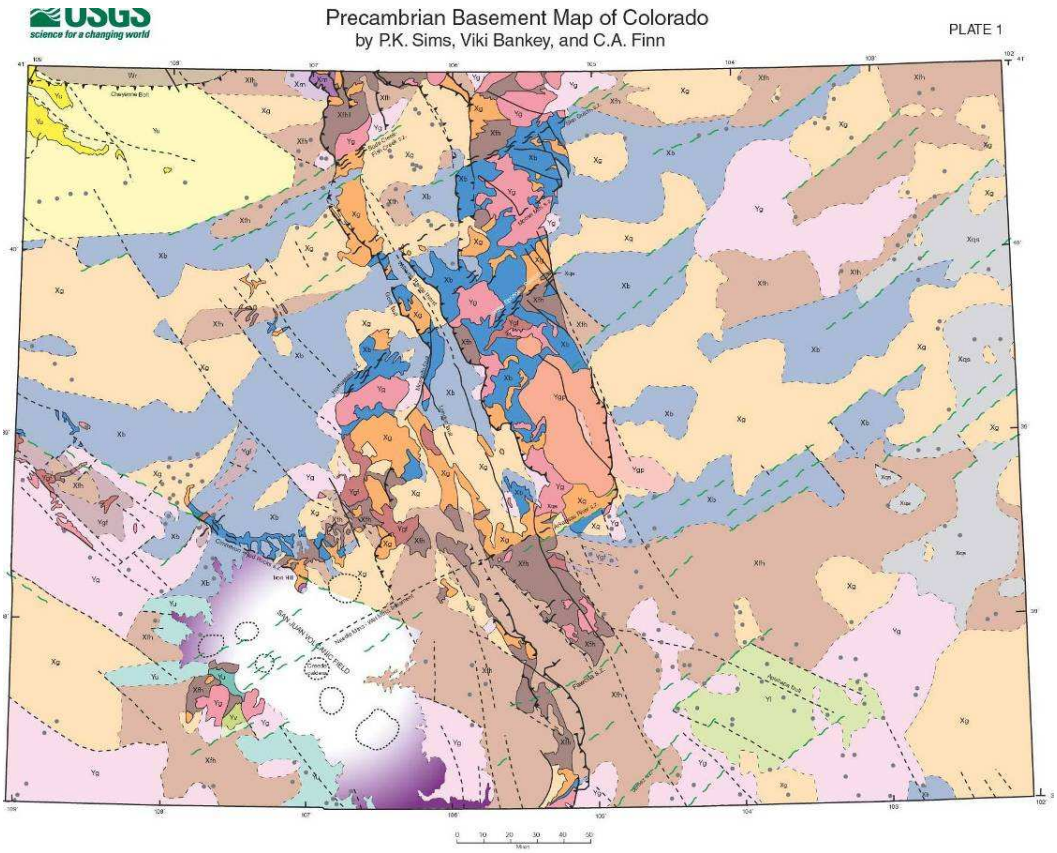

Figure 1. Geologic map of Colorado, showing distribution of Precambrian rocks at the surface (bright colors) and inferred in the subsurface (paler colors). (pubs.usgs.gov)

group of rocks known as *migmatites*, which often appear to be a swirly mixture of metamorphic-looking and igneous-looking rocks that grade into each other (Figure 3). Migmatites probably represent this anatexis, where the metamorphic rocks started to melt to form new granite magma. Because shale and mudstone are the commonest sedimentary rocks, granite is a common product of anatexis and makes up a major part of the crust of the continents.

Geologists recognize two kinds of metamorphism, depending on which conditions (heat, pressure, chemically active fluids) dominate. In reality, chemically active fluids are essential to both types, and so the distinction depends mostly on whether heat or pressure dominates. (Here, we're talking about *directed* pressure, resulting from plate-tectonic movements, not the pressure exerted by the overlying rocks, which is called *lithostatic* pressure.) In ***contact metamorphism***, heat is the dominant agent of metamorphism. In ***regional metamorphism***, directed pressure, combined with heating, is especially important. Which kind of metamorphism occurs depends on the geologic setting.

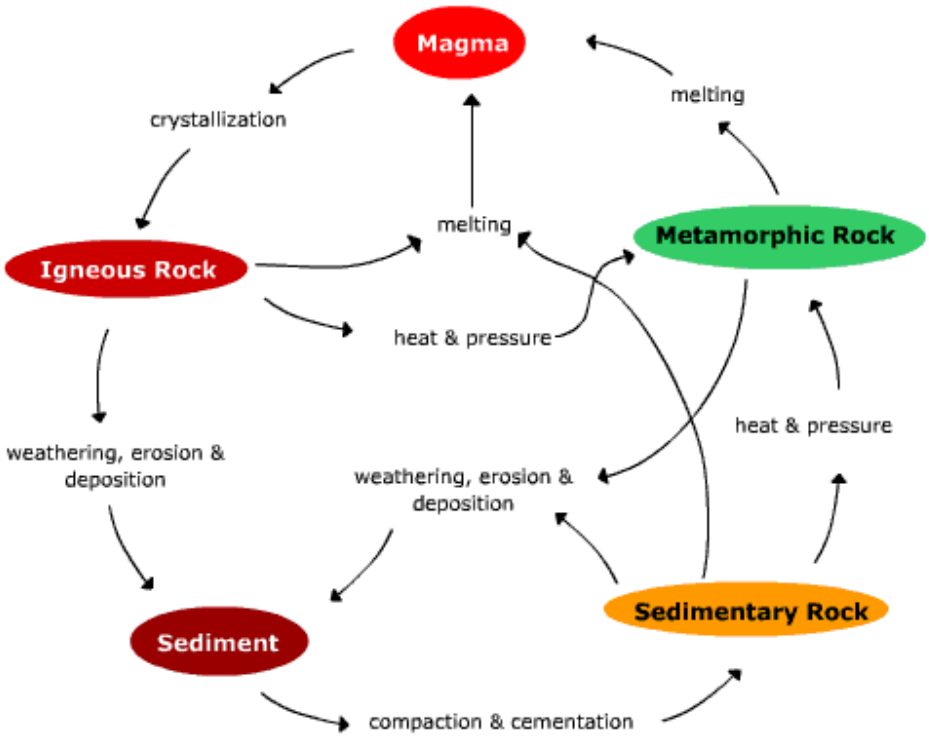

Figure 2. The rock cycle (e-education.psu.edu)

Figure 3. Typical appearance of rocks (migmatite) formed by anatexis. (users.monash.edu.au)

Contact Metamorphism. Contact metamorphism occurs when older rocks are "cooked" because they are in contact with younger hot magma or lava. When magmas come in contact with older rocks and crystallize (e.g. at the bottom of a lava flow or at the edges of an intrusive body), they heat the surrounding rocks and the fluids contained in them. A common misconception is that the older surrounding rocks at an igneous contact might melt. This would be very rare, because most magmas aren't much hotter than their crystallization temperature. The older rocks are usually cool enough to make the magma crystallize at the contact, rather than melting anything. Because rocks are really good insulators, the effects of contact metamorphism don't penetrate very far from the contact. In fact, even where very large bodies of magma intrude wet rocks, the contact metamorphic aureole is unlikely to be more than a few hundred yards wide.

Contact metamorphism occurs wherever geologic conditions favor intrusion of magma into older rocks. Two geologic settings are likely candidates. The first of these occurs where uplift and stretching of the crust produces a ***rift zone*** (Figure 5). Because crustal rocks are brittle, uplift and stretching cause fractures (faults) to form near the surface, as well as thinning of the crust underneath. Gravity pulls material sideways off the uplift, reducing the pressure underneath. As the pressure on the underlying material decreases, it tends to melt, forming magma that rises into the rift and along the fractures. Volcanic activity may occur at the surface. In any of the places where magma is intruded or extruded, contact metamorphism is likely to occur.

Because no directed pressure is involved in contact metamorphism, the main effect is recrystallization of the older rock—the mineral grains that are already present simply grow larger. If, for example, the parent rock is limestone (a sedimentary rock made of calcite or dolomite), recrystallization produces larger grains of calcite or dolomite. The resulting metamorphic rock is called ***marble*** (calcite or dolomite marble, depending on its composition). Shale and mudstone are likely to form a rock called ***hornfels***; quartz sandstone yields ***metaquartzite***; conglomerate forms ***metaconglomerate***, and bituminous coal forms ***anthracite*** (sometimes called "hard coal") (Figure 6). Textures and structures from the parent rock may be preserved. Even fossils sometimes survive contact metamorphism. For a classification of common contact metamorphic rocks, see the bottom of Figure 7 (under "nonfoliated" texture).

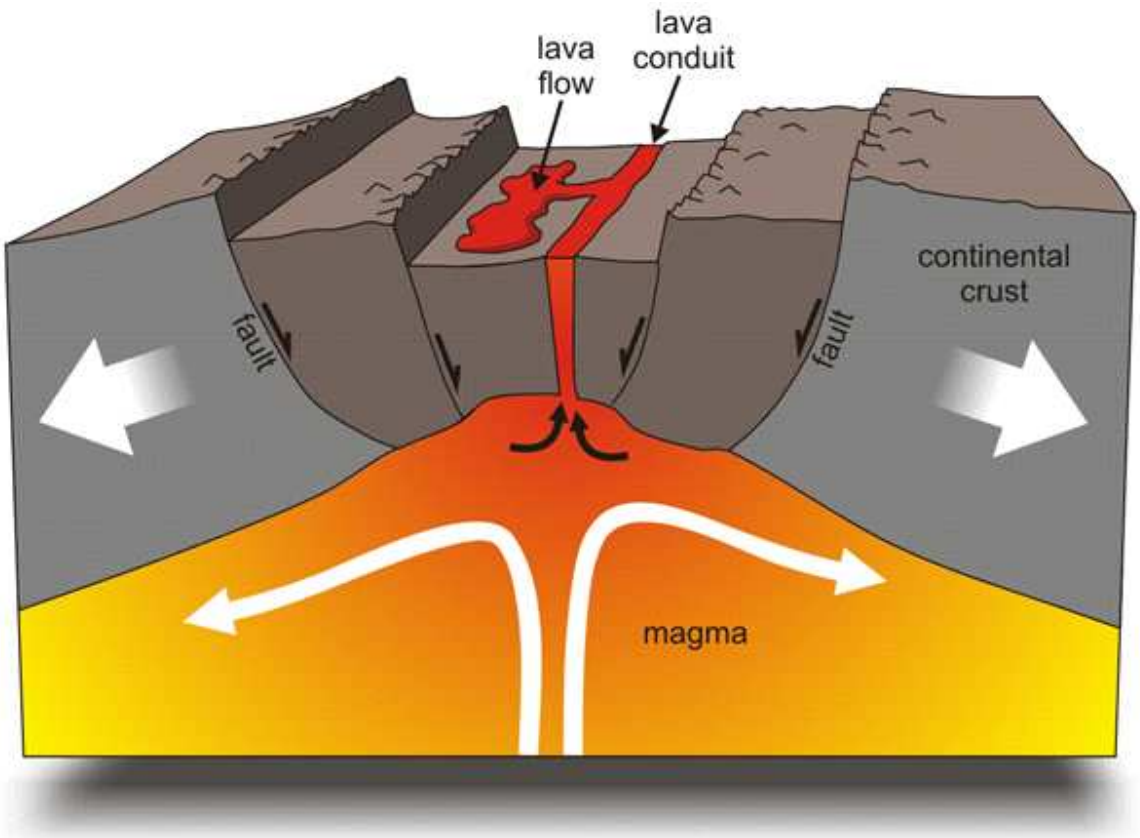

Figure 5. Schematic cross section of a rift zone. (elprofedenaturales.wordpress.com)

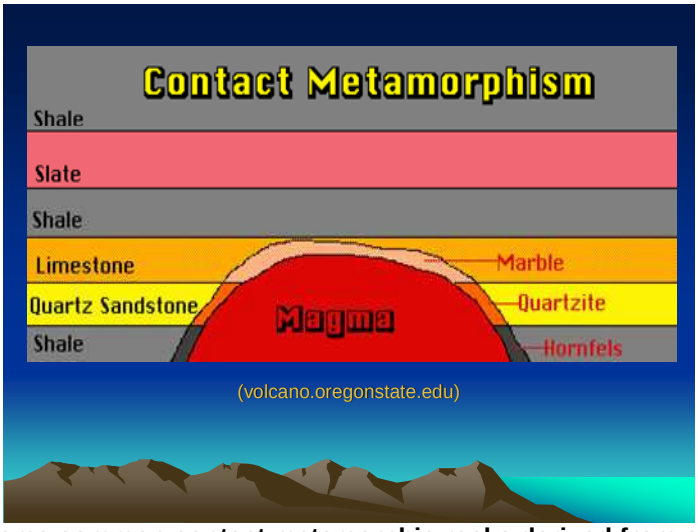

Figure 6. Some common contact metamorphic rocks derived from sediments.

In Colorado, a major rift zone occupies the upper Arkansas and San Luis valleys.
A part of the larger Rio Grande rift, this is a zone of faulting and igneous activity—a place where the crust of Colorado has been stretched by huge tectonic forces (see Figure 8). Even Teller and Park counties have been affected by faulting and volcanism related to this activity.

Another place where igneous activity (and thus contact metamorphism) is likely to occur is in a ***subduction zone***. The Earth's crust is broken up into a number of pieces called *tectonic* plates. These plates grow at the "mid-ocean" ridges, and the extra material is balanced at subduction zones. Subduction zones occur where one of the plates of rock making up the Earth's crust sinks beneath the edge of another plate, returning to the Earth's mantle (Figure 9). Such plate boundaries are marked by deep trenches and intense seismic and volcanic activity—the "ring of fire" surrounding most of the Pacific is caused by subduction of the Pacific plate under the edges of the surrounding tectonic plates.

Subduction only involves the sinking of oceanic plates, which are relatively dense. Continental plates are made up of lighter materials and are therefore buoyant and unsinkable. The oldest parts of oceanic plates (farthest from the "mid-ocean ridges" are the coldest and densest, and are most prone to sinking. (Please note that the plates are not "pushed" down into subduction zones—they sink under their own weight, pulling the rest of the plate with them.) The volcanic activity at a subduction zone results from heating of the oceanic plate as it plunges back into the mantle. At a depth of about 150 km., the water saturated sediments carried downward with the plate begin to melt, forming low density magma that rises toward the surface (Figure 9). Where it reaches the surface, the magma makes a volcanic island arc (such as the Aleutian Islands and the Cascades of the Pacific northwest). Clearly, wherever this rising magma contacts older rocks, contact metamorphism will occur.

Classification of Metamorphic Rocks

Name of Rock	Parent Rock	Texture	Grain Size	Notes
Slate	Shale, mudstone, siltstone	Foliated	very fine	smooth dull surfaces
Phyllite	Slate		fine	glossy sheen
Schist	Phyllite		medium to coarse	micaceous minerals
Gneiss	Schist, granite, volcanic rocks		medium to coarse	mineral banding
Marble	limestone	Nonfoliated	medium to coarse	Interlocking calcite or dolomite grains
Metaquartzite	quartz sandstone		medium to coarse	fused quartz grains
Anthracite	bituminous coal		fine	black, shiny, organic rock

(rocksandminerals4u.com)

Figure 7. Classification of metamorphic rocks.

Figure 8. Major components of the Rio Grande rift. (cires.colorado.edu)

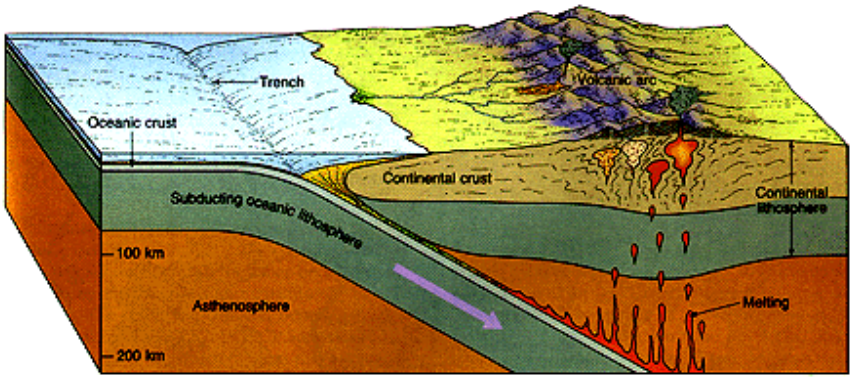

Figure 9. Diagrammatic sketch of a typical subduction zone. (web.ics.purdue.edu)

Regional Metamorphism. Regional metamorphism occurs where rocks are intensely deformed ("squeezed") by stresses directed inward on them from the sides. Such stresses occur mainly where two continental plates collide as a result of complete consumption of an ocean plate in a subduction zone. Once again, because continental crust is buoyant and can't be subducted, when two continents, with their marginal sediments, collide, the material between is squeezed and deformed (Figure 10). This is the mechanism for the formation of many of Earth's great mountain belts, including the modern Himalayas and Alps and the much older Appalachians. Squeezing and deformation are accompanied by heating, due to friction, and may be felt over an area several hundred kilometers wide (hence the name *regional* metamorphism).

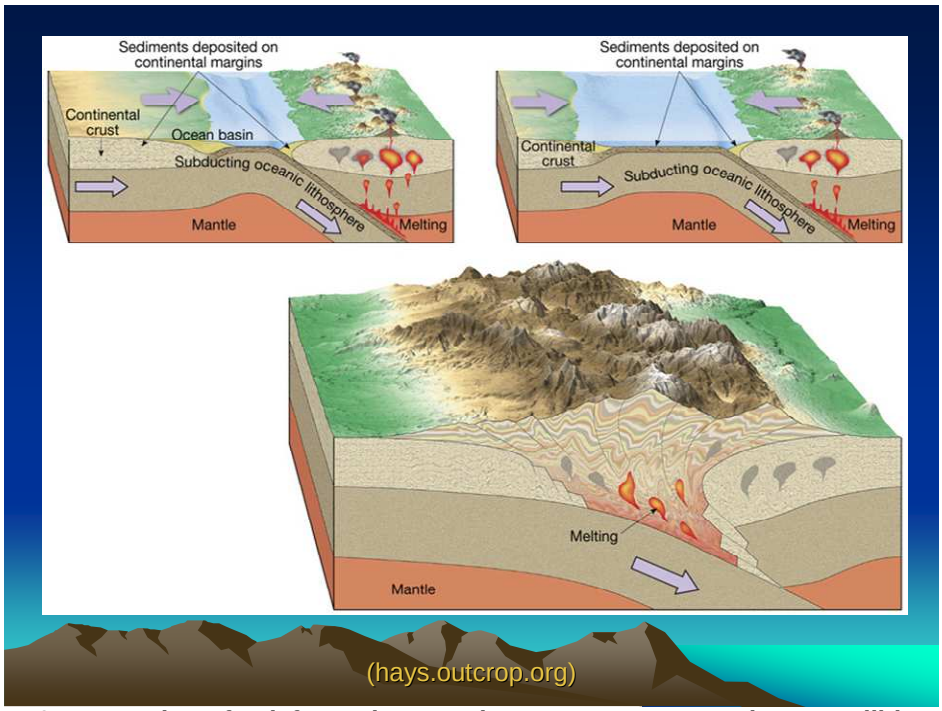

Figure 10. Formation of a deformed mountain system as two continents collide.

In the core of such a mountain system, heating and pressure reach their maximum values, and bodies of granitic magma and migmatites may form here. As one moves outward, the degree of heating and squeezing decreases, and the metamorphic rocks decrease in *grade*. Thus, zones of high grade metamorphism are usually symmetrically bounded by bands of rock of decreasing grade, with unmetamorphosed sediments at the outer boundary of the deformed zone.

Because of the squeezing involved in regional metamorphism, combined with recrystallization that is common in all metamorphism, elongate and platy mineral grains (e.g. micas, hornblende) tend to become aligned as the recrystallization progresses. For example, clay minerals in shale or mudstone are converted into chlorite, biotite, and muscovite mica flakes that align themselves at right angles to the pressure (Figure 11). The resulting *foliated texture* is a characteristic of regional metamorphism that won't be seen in contact metamorphic rocks.

As the temperature and stress increase, the mineral grains grow, and so the texture becomes coarser. If we start with shale or mudstone, which are very fine grained sedimentary rocks, the first foliated metamorphic rock to form is **slate** (Figure 12) (still so fine grained that individual minerals are too small to identify). As temperature and pressure increase, slate turns into **phyllite**, in which tiny mica flakes are barely visible with a 10X lens. Phyllite tends to have a satiny luster because of recrystallization and growth of micas. At the next stage, the micas become clearly visible, in mica **schist**. Feldspars and quartz are likely to be present and are evenly distributed among the mica grains. As a schist becomes hotter and is squeezed more, it may eventually turn into **gneiss**, in which the micas separate into bands separated from feldspar/quartz rich layers. Gneiss typically has distinct color bands or streaks (Figure 12).

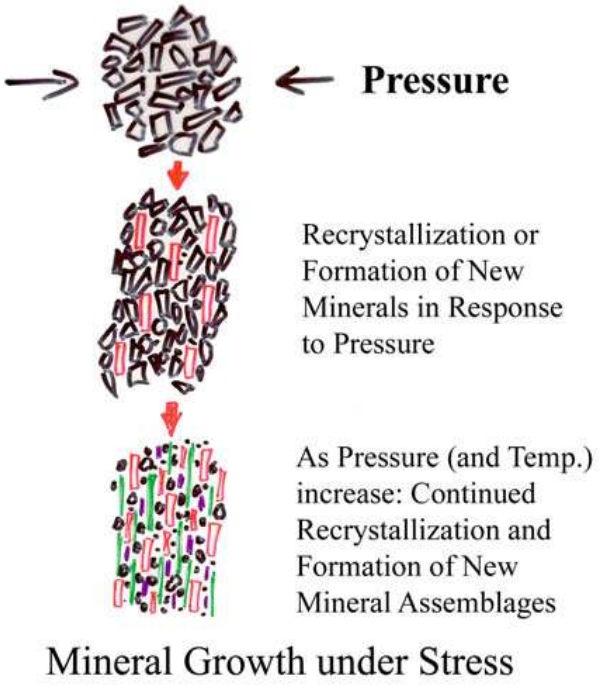

Figure 11. Formation of foliated texture as a result of mineral growth under stress.

Figure 12. (left to right): slate, phyllite, and mica schist.

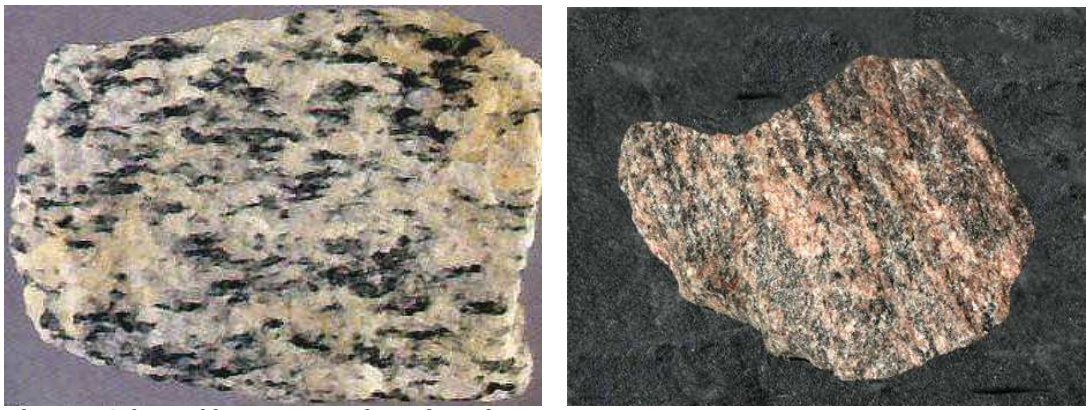

Figure 12 (contd.) Two samples of gneiss.

Another characteristic of increasing temperature and pressure is the re-arrangement of the common chemical components of shale or mudstone to form new minerals. So, in low-grade regional metamorphism, the mica that forms is typically **chlorite**, which gives the rock a greenish tint. As grade increases, chlorite converts to the black mica **biotite**, followed by

almandine garnet, **staurolite** or **kyanite**, and finally **sillimanite** and muscovite (Figure 13). Identification of these *index minerals* allows the geologist to work out the temperature and pressure under which the rock recrystallized. Of course, if the parent rock was something other than shale or mudstone, then a whole different group of minerals may form or recrystallize. Hence the complexity of the study of metamorphic petrology.

Figure 13 (left to right): chlorite; biotite; almandine garnet.

Figure 13 (contd): staurolite (brown); kyanite (blue); sillimanite (silky white).

In Colorado, regional metamorphism is far more widespread than contact metamorphism. In fact, if you find rocks from the Idaho Springs Formation, they represent materials that underwent a major mountain-building episode (orogeny) by continent-continent collision 1.75 billion years ago. So, when somebody talks about 3 mountain-building episodes in Colorado (usually the Laramide, Ancestral Rockies, and formation of the Pikes Peak batholith), they forgot what was probably the most widespread and impressive. Mountain building probably also occurred when the Silver Plume Granite formed, and so we have evidence for at least 5 orogenies, not three. Many of the rocks (mainly schist and gneiss) of the Idaho Springs Formation of central Colorado contain sillimanite—indicating that they formed in the core of what was probably once a very impressive mountain system.

Lake George Gem and Mineral Club
Box 171
Lake George, Colorado 80827
LGGMClub.org

2014 MEMBERSHIP APPLICATION

Name(s) _____

Address _____City _____State __ Zip _____

Telephone ( ) _____ - _____ E-mail _____

Names of family members: _____
_____

Annual membership - dues Jan. 1 through Dec. 31 are as follows:

- ___Individual (18 and over) …….. $15.00
- ___Family…… $25.00

Annual dues are due *on or before* March 31. Members with unpaid dues will be dropped from the roster after this date. Any new member joining on/after August 30 shall pay one half the annual dues.

I hereby agree to abide by the constitution and by-laws of this club.

Signed _____ Date: ____/____/____

I have previously been a member of Lake George Gem & Mineral Club. Yes __ No ___

My interest areas include:
Minerals __ Fossils__ Lapidary __ Crystals __ Micromounts __
Other _____

I would be willing to give a talk to the Club or Pebble Pups. ____ If yes, what topic?:

_____

Please indicate which of the following activities you might be willing to help with:

Writing _____ Editor _____ Mailing _____ Local shows _____

Club Officer _____ Programs _____ Field trips _____ Refreshments _____

Questions about the club or club activities? Contact Suz Core (719) 689-2092.
Rev. December, 2013

Lake George Gem and Mineral Club
P.O. Box 171
Lake George, CO 80827

The Lake George Gem and Mineral Club is a group of people interested in rocks and minerals, fossils, geography and history of the Pikes Peak/South Park area, Indian artifacts and the great outdoors. The club's informational programs and field trips provide an opportunity to learn about earth sciences, rocks and minerals, lapidary work and jewelry making, and to share information and experiences with other members. Guests are welcome to attend, to see what we are about!

The club is geared primarily to amateur collectors and artisans, with programs of interest both to beginners and serious amateurs. The club meets the second Saturday of each month at the Lake George Community Center, located on the north side of US Highway 24 on the east edge of town, sharing a building with the county highway shops. **In the winter we meet at 10:00 AM. From April through October, we meet at 9:00 AM, to allow more time for our field trips.**

Our organization is incorporated under Colorado law as a nonprofit educational organization, and is a member of the Colorado, Rocky Mountain and American Federations of Mineralogical Societies. We also sponsor an annual Gem and Mineral show at Lake George, where collectors and others may purchase or sell rocks, minerals, fossils, gems or jewelry. Annual membership dues (Jan. 1 through Dec. 31) are $15.00 for an individual (18 and over), and $25.00 for a family.

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