Montana Agate

Nittany Mineralogical Society

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Information on agate

**QUARTZ**

- Macrocrystalline
- Cryptocrystalline
- Not opaque
- Opaque

- Jasper
- Chert
- Flint

Quartz point from Jessieville, Arkansas
Formation of agate

Agates form when silica is deposited in a void or as a replacement of existing material.

However, details of agate formation are not well understood.
Agate is a cryptocrystalline rock with a mohs hardness of about ~ 7.
Agate is somewhat porous. Water may migrate into an agate along cracks and/or structures, and then diffuse into the rock.
A person who wears Montana Agate is likely to have balanced emotions and an enhanced ability to discern the truth and to accept circumstances.
Agate is not opaque, and may have visually-discernable internal banding.
Wearing quartz may make you less susceptible to the effects of alcohol.
The intricate scenes in Montana Agate were “captured” from actual landscapes in the prehistoric past by some unknown mechanism.
The intricate scenes in Montana
Agate evolved from the intrusion of minerals such as iron and manganese.
Wearing agate will prevent insomnia and ensure pleasant dreams.
Information on agate

Agate helps to develop and to increase one’s analytical skills, especially for Gemini’s.
Cracks or secondary porosity features in an agate may be “healed” or cemented by silica in groundwater.
Deposition of silica in an agate is controlled by external factors, mainly the circulation of groundwater.
If external factors were the main control on agate formation, then most agates that form in a given area would be similar in appearance. Because this is not the case, it is likely that internal features (such as cracks, tubes, etc.) also control how silica and impurities are deposited in an agate.
Agate forms


Quartz mineral habits: drusy, twinned, sceptered, phantomed, botryoidal, granular, stalactitic, fibrous amorphous, etc.

Botryoidal form – “Having the form of a bunch of grapes” (Ibid.)

Geodes often have banding along botryoidal surfaces and a drusy-lined void in the interior.
## Geologic setting

### Montana’s geologic history

<table>
<thead>
<tr>
<th>Era</th>
<th>Event Description</th>
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<tr>
<td><strong>PreCambrian</strong></td>
<td>~ 1,000 MY Belt Formation - sedimentary rock in NW Montana</td>
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| **Paleozoic** | 800 MY Rifting – Shoreline just west of Montana-Idaho border  
500 MY Island continent in western MT, ocean in center & east MT.  
60 MY Relative quiet.  
50 MY More tectonic activity, Absaroka volcanism in southwest Montana.  
40 MY Quiet again.  
20 MY Tropical climate, formation of lateritic soils.  
20 MY Quiet again.  
10 MY Uplift & magmatic activity – batholith formation, volcanos, uplift in western MT, Sapphire and Pioneer Blocks detach and skid 50 mi. east  
10 MY Dry period w/ gravel deposition.  6-Mi Crk onto laterite soils, Flaxville.  
80 MY Uplift & magmatic activity – batholith formation, volcanos, uplift in western MT, Sapphire and Pioneer Blocks detach and skid 50 mi. east  
800 MY Rifting – Shoreline just west of Montana-Idaho border  |
| **Mesozoic** | 790 MY Rifting – Shoreline just west of Montana-Idaho border  
500 MY Island continent in western MT, ocean in center & east MT.  
60 MY Relative quiet.  
50 MY More tectonic activity, Absaroka volcanism in southwest Montana.  
40 MY Quiet again.  
20 MY Tropical climate, formation of lateritic soils.  
20 MY Quiet again.  
10 MY Uplift & magmatic activity – batholith formation, volcanos, uplift in western MT, Sapphire and Pioneer Blocks detach and skid 50 mi. east  
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800 MY Rifting – Shoreline just west of Montana-Idaho border  |
| **Cenozoic** | 1.8 MY Yellowstone rhyolite (silica rich) volcanism (3 major episodes), some changes to geochemical environments, silicification and modification of inclusions (???)  
2.5 MY Glaciation, w/ gravel deposition.  6-Mi Crk onto laterite soils, Flaxville.  
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### Notes
- Absaroka volcanism, many mudflows and burial of organic objects, abundant petrified wood found at in-situ deposits. Agates start here (???)
- Episodes of energetic river transport & deposition of gravel & agates, different climatic and geochemical environments, some coloration of agates (???)
- The great Yellowstone rhyolite (silica rich) volcanism (3 major episodes), some changes to geochemical environments, silicification and modification of inclusions (???)
String of volcanic centers
Yellowstone “Super-Volcanism”
Physiographic setting

Gravel deposits from the eastern front of the Rocky Mountains onto the Great Plains.

Figure 2. — Physical divisions of the United States and maximum extent of the continental ice sheets during the Great Ice Age.
What makes Montana agate desirable?

- Scenic features w/ distinct, prominent blacks & reds
- Well-silicified, takes a good polish
- The really good stuff is VERY, VERY UNCOMMON ! ! On a really productive 5-day rockhunting trip, I may collect as much as 150 – 200 lbs of agate. If I’m lucky, a few rocks will be “Omigosh” quality.
Tom Harmon of Crane, MT has been collecting and working with Montana agates for many years.

Harmon has developed a descriptive system for classifying Montana agates.

His book is highly recommended !!!!!!
You can get a copy at www.Harmons.net
Formation of scenic features

Some observations and speculation:

- Entry and migration of minerals through cracks, botryoidal surfaces, and other internal structures (secondary porosity features).
- Deposition of minerals along secondary porosity features.
- Deposition of flat “snowflake” dendrites along botryoidal surfaces… retreating water leaves behind mineral precipitate in dendritic form.
- Climate – widely variable water level and infiltrating water conditions, highly variable geochemical conditions.
- Transport in flowing water …. re-working, cracking & healing.
- Formation of free-floating, 3-d dendrites, seems to be more characteristic of black inclusions than brown/red inclusions
- “Chromatographic” dispersal, by water movement through primary porosity features
- Red/brown inclusions (ribbon bands) seem more susceptible to “smearing” of ribbon banded inclusions than black inclusions.
A Brief Trip to Montana agate country

From east of the Mississippi River, head for Interstate 90. It’s a very straight shot across North Dakota. The last few miles across North Dakota go through the Theodore Roosevelt Badlands.
A Brief Trip to Montana agate country

THE YELLOWSTONE RIVER

Interstate 90 generally follows the Yellowstone River from Glendive to Livingston, Montana. This river originates south of Yellowstone National Park and terminates when it joins the Missouri River north of here. It is the longest undammed river in the lower 48 states.

When the West was won, most rivers were left to damming and damming. The river is the repository of countless wild and dam-free over its entire length. The Yellowstone flows free for over 500 miles, draining a watershed greater in area than all of the New England states combined.

In the 1970s, Montanans had a great debate over this mighty river's future. When the Buckley State Reserve's substantial amount of water to remain instead so that the Yellowstone might never be depleted and might forever remain free-flowing.

Other users of the river—municipal, agricultural and industrial—also provided for. Today, this waterway is in balance with all its users, including nature's creatures. Few American rivers can still make that claim.

Bridge over the Yellowstone River at Terry, MT.

Gravel bar near Terry.

Gravel bar near Calypso.
A Brief Trip to Montana agate country

Bridge over the Yellowstone River at Calypso, MT.

Campsite on the Yellowstone River.

Low water ! ! ! ! ! !

Sportsman's access near Fallon, MT.
A Brief Trip to Montana agate country

Be sure to visit Makoshika State Park near Glendive.
WHERE ARE THE BEST PLACES TO COLLECT?

- Gravel bars
- Tributaries
- Fields in river valley & uplands.
- County roads

ALWAYS ASK PERMISSION BEFORE ENTERING PRIVATE LAND ! ! ! ! !
Collecting Montana agate

GRAVEL BARS

• Best to access by boat.
• Relatively few access points – look for “sportsman’s access” locations on State road maps.
• Gravel bars in the River are public land…. should be OK to collect.
• In early spring, the River is high….. late summer is probably better on the River.
• The best collectors can distinguish agates by the “skin” texture, even with a mud coating. Some people can even distinguish agates under water.

ALWAYS ASK PERMISSION BEFORE ENTERING PRIVATE LAND ! ! ! !
In late summer, some of the areas high up on the gravel bars are scoured by wind-blown sand – agates may be more visible than early in year.

To start, use a rock hammer to chip likely-looking rocks. After your eyes are “calibrated” (may take 3 – 5 outings), you’ll be less reliant on chipping rocks.

Some of the gravel bars are huge. Walk them systematically….. set up a grid system and walk a pattern.

The river is treacherous..... fast current, many large rocks...... be careful ! !

ALWAYS ASK PERMISSION BEFORE ENTERING PRIVATE LAND ! ! ! !
Collecting Montana agate

**TRIBUTARIES**

- Use 30’ x 60’ USGS topo maps to identify tributaries that have large drainage areas.
- Look for access where the tributaries flow from the upland area out onto the Valley floor…… seems to be a setting where stream bedload is dropped.
- Some DeLorme maps show the location of BLM land….. BLM land is open for public access.

If you have a GPS unit and a laptop, this is a GREAT application for GPS ! ! ! Otherwise, it can be difficult to navigate to some of the out-of-the-way locations. I really like DeLorme “Streets”….. good coverage of county roads.

**ALWAYS ASK PERMISSION BEFORE ENTERING PRIVATE LAND ! ! ! !**
Collecting Montana agate

COUNTY ROADS

- Some County roads are maintained by patching with gravel and/or by grading to remove ruts. Large gravel is gradually exposed and “kicked” to the sides of the roads by traffic.
- You can cruise the County roads slowly and look for agate chips in the road. If you see agate chips and large gravel, it may be worth getting out and looking along the swales along the shoulder. If all you see is small gravel, it’s probably not worth stopping.
- In the spring, grass may be thick and rocks may be hard to see. The rattlesnakes are harder to see, too. In the fall, grass is usually dried up and rocks are more visible.

ALWAYS ASK PERMISSION BEFORE ENTERING PRIVATE LAND ! ! ! !
Collecting Montana agate

FIELDS

- Look for fields with at least some large gravel at the surface.
- If you see large gravel in a field with some agate present, try to get permission to walk the field and plan to spend some time.
- Walk the field methodically. Identify landmarks for your starting and ending points, then walk a pattern of parallel lines ~ 20 feet between lines.
- Upland agates will often have a distinctive white crust on the surface.

RESPECT LANDOWNERS ! ! ! !
ALWAYS ASK PERMISSION TO WALK INTO FIELDS ! !
NEVER WALK ON GROWING CROPS ! !
ALWAYS ASK PERMISSION BEFORE ENTERING PRIVATE LAND ! ! ! !
Working with Montana agate

CUTTING

- To inspect the rock, wet it and hold under a bright light
- Spend some time and thought to assess features carefully, decide the best orientation to cut
- Does the rock have full-bodied dendrites? Ribbon banding? Cut perpendicular to the banding.
- Is the rock checked? Try to cut parallel to checks so that you get more unchecked slab.
- Does the rock have thin line dendrites? Try to cut parallel to the best, flattest, botryoidal surfaces.
- Does the rock have flat, planar features? Cut parallel to planes, try to “nick” the planes that have some dark features.
- If the rock has a coarse crystalline center, you may get full-bodied dendrite “trees” at the intersections of botryoidal surfaces.
For small or irregularly-shaped pieces, glue to wooden sticks (such as 2” x 2” x 6” pine)

• Use a mixture of Elmer’s glue & sawdust.
• Touch up the glue as needed. Let the glue harden for at least 3 days after the last application of glue.
Working with Montana agate

**CUTTING**

- I use 25% mineral oil, 75% odorless mineral spirits as a lubricant for my rock saw.
- I usually squirt in a small amount of rubbing alcohol to reduce oil mist. However, I have to let the alcohol evaporate from the reservoir before cutting rocks on sticks or else the Elmer’s glue will release and the rocks will fly off.
- Cut slabs at least 4 mm thick. Use heel pieces to make thick, deep-crowned cabs.
Working with Montana agate

**LAYERED DENDRITES**

Cut slabs parallel to planar features

Al Siegel of Terry Montana suggested gluing agates to wood using a mixture of sawdust and Elmer’s glue. This makes it easy to clamp the wood into your rock saw carriage. This won’t work if you’re using water as a coolant/lubricant.
For rocks that appear to have very good features, consider grinding away skin to get a better look at interior.

If, after first cut, it looks like a better orientation is possible, re-set the stone on stick.

For planar features, take your time..... if first cut is a bust, advance the rock only to the next plane w/ dark features.

Use a very slow advance rate on rock saw carriage.
Soak slabs in soapy water to remove cutting oil. Can remove excess oil first using kitty litter.

Identify checks in slab. May want to trace checks w/ sharpie. Don’t try to include unhealed checks in cabs.

For small slabs that don’t immediately suggest good cab features …… tumble them and re-inspect. Will make features easier to see, pick cab outline better, slab may fall apart along weak cracks.

Whack the slabs on bench surface….. slab may break along weak cracks.
Working with Montana agate

CABS

• For free-forms, use a pencil to outline cabs. Once you’re satisfied with the result, re-trace w/ fine-point Sharpie. Trim the form on trim-saw.
• Glue pre-forms to dowels using glue gun & high-temperature glue. Heat the rock first (under lamp) – will drive out water & make glue bond better.
• I do a preliminary grind on #80 diamond disk w/ lots of water…. saves wear on the #80 grinding wheel.
CABS

- Always finish bottom. Put flat crown on bottom, small bevel on bottom edge.
- It’s very difficult to put a good finish on flat surfaces using a cab machine…. make sure that you have at least a slight curvature.
- Can tumble to finish after #80 grind ……. I do this sometimes if I’m making a lot of cabs of one particular type of stone such as Cripple Creek jasper, but who’d really want to do this for a top-grade Montana agate ???

Working with Montana agate
For hand specimens, either use the “heel” from the first cut, or else don’t cut the rock all the way through.

Grind and polish a flat crown on the cut surface of the hand specimen.

If you don’t cut the specimen, you may want to wet it w/ baby oil or Vaseline periodically to enhance appearance.
Working with Montana agate

JEWELRY

- Lots of sources of information on silver working, but you really learn from experience.
- Don’t be afraid to ruin some silver – better to start over than to try to salvage a burned, puckered, or poorly-fit piece.

Yellowstone Jewelry

I like to use a minimal amount of silver so that the setting doesn’t detract from the stone…….. the stone is the main attraction.
Yellowstone Jewelry

Large, free-floating, 3-D dendrites and dendrite specks.

Small 3-D dendrites, larger dendrite in white-banded central region.

Free-floating, 3-D dendrites and some brown ribbon banding.
Small dendrite specks and red ribbon banding. Some of the crust was left on the right side of this cab. Linda found this rock on a county road near Terry, MT.

Small, subtle dendrites and a pretty, amorphous, red central region. This was a “heel” piece (i.e., first piece cut from the rock), so it’s fairly thick.
Brown ribbon banding and black “tubes” (almost like sagenite ????).

Notice how the matrix is clear surrounding the black “tubes” on the left side of the stone. Did the “tubes” present an avenue for preferential water circulation and alteration of the matrix?

Nice red central area, one well-formed, 3-D black dendrite at top.
Yellowstone Jewelry

A nice example of thin line crust dendrite.

This cab came from near the exterior of the stone, so you can see some healed cracks and crust-associated features along the top of the stone. Nice red ribbon banding.
The area near the bottom that looks like giraffe skin is uniform mineral (iron?) coating on botryoidal surface. The intersections between “lumps” are clear, which gives nice definition to the shapes.

Everyone has a few “That looks like…..” stones. This one looks like a Blue jay sitting on a nest.
Places to go in Montana

TERRY
Prairie Unique (Store w/ some agates & local info)
Terry Badlands (North of Yellowstone River)

GLENDIVE
Mart’s Agates
Makoshika State Park

CRANE
Harmon’s Rock Shop