September 2008 Mineral of the Month: Agate

With its beautiful coloration and distinctive banding patterns, this month's mineral is considered by many experts to be the world's most recognizable and popular gemstone. Our specimens were collected, cut, and polished in Soledade--southern Brazil's "City of Precious Stones."

PHYSICAL PROPERTIES

Chemistry: SiO_2 Silicon Dioxide, often containing small amounts of iron and manganese
Class: Silicates
Subclass: Tectosilicates
Group: Quartz
Subgroup: Microcrystalline Quartz (Chalcedony)
Crystal System: Hexagonal
Crystal Habits: Usually as nodules, interior linings of geodes, and rounded, alluvial pebbles.
Color: Red, pink, orange, yellow, green, blue, gray-blue, gray, white, brown, and black; usually as multicolored bands, layers, or inclusions.
Luster: Waxy and vitreous to dull
Transparency: Usually translucent, sometimes opaque or transparent.
Streak: White
Refractive Index: 1.55
Cleavage: None
Fracture: Conchoidal to subconchoidal and irregular, brittle to tough.
Hardness: Mohs 6.5-7.0
Specific Gravity: 2.62-2.65
Luminescence: Sometimes fluoresces yellow or blue-white.
Distinctive Features & Tests: Best field marks for agate, which is difficult to confuse with other minerals, are translucency; multi-colored bands, layers, or inclusions; wide range of colors; hardness; and low specific gravity.
Dana Classification Number: 75.1.3.1

NAME

Pronounced "A-get," (rhymes with "tag it"), the name derives from *Achatēs*, an ancient Greek name for the Dirillo River on Italy's island of Sicily, a former source of the stone. The correct Portuguese pronunciation of the locality name "Soledade" is "so-la-DAH-gee." In European mineralogical literature, agate appears as the Dutch *agaat*, the German *achat*, and the Italian and Spanish *agata*.

COMPOSITION

It was not our intention to feature two quartz varieties in a row, but we're glad it worked out this way, allowing us the opportunity to shine the spotlight on these common but comely minerals/gemstones so well-loved by humankind. We last featured agate nearly ten years ago, in November 1998, sending Club members exceptional polished pieces of "Condor Agate" from Argentina, a brightly colored fortification agate that has become scarcer and more valuable in the decade since we featured it.

As we discussed last month, quartz is divided into two subgroups according to crystal size. Macrocrystalline quartz (simply called "quartz") exhibits large, transparent-to-translucent, individual crystals or groups of crystals and includes such familiar varieties as amethyst, citrine, rock crystal, milky quartz, smoky quartz, and rose quartz. Microcrystalline or cryptocrystalline quartz, which consists of microscopic, interlocked silica grains or fibrous silica crystals, is also called "chalcedony" and includes many beautiful varieties, such as chrysoprase, carnelian, onyx, and of course, agate. For a detailed discussion of how chalcedony differs from quartz, see "Microcrystalline Quartz" in our August 2008 write-up on Mookaite jasper. (We can send you a copy if you weren't a member then, just let us know.)

As indicated by its chemical formula SiO_2, quartz contains two elements, the semimetal silicon (Si) and oxygen (O). The molecular weight of quartz consists of 53.26 percent oxygen and 46.74 percent silicon. The cation (positively charged ion) in the quartz molecule is the silicon ion Si^{4+}, which has a +4 charge. The anion (negatively charged ion) consists of two oxygen ions $2O^{2-}$ with a collective -4 charge. The balance of these +4 and -4 charges provides the quartz molecule with electrical stability.

As a silicate, quartz is a member of the largest of all mineral classes. The silica tetrahedron $(SiO_4)^{4-}$, the fundamental building block of the silicates, consists of a silicon ion surrounded by four equally spaced oxygen ions that are positioned at the four corners of a tetrahedron (a four-faced polyhedron). In the quartz-crystal lattice, all four of the oxygen ions in each silica tetrahedron bond covalently to the silicon ions of adjacent tetrahedra. Each silicon ion is thus surrounded by four oxygen ions, and each oxygen ion by two silicon ions. This arrangement satisfies the -4 charge of each individual tetrahedron and creates the infinite, three-dimensional structure of quartz, in which each balanced molecular unit is represented by the formula SiO_2.

Silicon and oxygen, the most abundant elements in the Earth's crust, together make up three-quarters of the total crustal weight. Quartz is found in almost all igneous, metamorphic, and sedimentary rocks. Quartz and the hundreds of other silicate minerals account for 92 percent of the Earth's total crustal weight. In silicate minerals, silica anions bond with metallic or semimetallic cations in repeating chains to form seven structural configurations: independent tetrahedral silicates (nesosilicates); double tetrahedral silicates (sorosilicates); single- and double-chain silicates (inosilicates); ring silicates (cyclosilicates); sheet silicates (phyllosilicates); and framework silicates (tectosilicates). Quartz is a framework silicate or tectosilicate.

Because the covalent bonding within the quartz lattice exerts omnidirectional strength, quartz crystals lack centers of symmetry and cleavage planes. This lack of cleavage along with the high bonding strength of close atomic packing explains quartz's substantial hardness of Mohs 7.0 (6.5-7.0 for agate). Despite close atomic packing, the relatively light atomic weights of silicon (28.09) and oxygen (16.00) give quartz a low specific gravity of 2.65 (2.62-2.65 for agate). Because of its microcrystalline nature, chalcedony lacks quartz's structural homogeneity. Homogenous crystal structure and higher purity make quartz transparent to translucent, while less-pure and nonhomogeneous chalcedony is translucent to opaque. Chalcedony is also slightly softer and less dense than quartz.

Unlike macrocrystalline quartz, which grows by adding molecules of silica to new layers on a crystal's surface, chalcedony forms by solidification of silica solutions. Chalcedony consists of silica that has weathered free from silicate minerals and is transported by groundwater as microscopic particles in colloidal suspensions called silica gels. In the low temperatures and pressures of shallow mineralogical environments, these gels eventually crystallize into solid masses of chalcedony composed of interlocking, microscopic crystals. Flint, chert, and jasper can form in sedimentary formations, but agate occurs almost exclusively as nodules within cavities in silica-rich, volcanic rocks (see "The Theory of Agate Genesis").

The Dana mineral classification number 75.1.3.1 first identifies quartz as a tectosilicate silicate (75). The subclassification (1) defines it by both its chemical formula SiO_2 and its four-oxygen coordination, in which each silicon cation is bound to four oxygen anions. Quartz is then assigned to the quartz group (3) as the first (1) and only member. As an allochromatic (other-colored) mineral, the colors of quartz are caused by traces of nonessential, color-producing elements called chromophores, rather than essential elemental components or the nature of its crystal structure. Pure quartz is colorless, but various impurities create a wide range of colors.

THE THEORY OF AGATE GENESIS

Unlike other forms of chalcedony, agate exhibits translucency, a wide range of colors, and distinct patterns of bands, layers, and inclusions. In the mid-1800s, scientists attempting to explain the formation of these bands proposed two general theories. One postulated that silica-rich solutions filled cavities in rocks where they then precipitated as solid, microcrystalline silica in repetitive, superposed bands and layers. Others suggested that thickening lava contained masses of nearly pure silica that eventually formed a gel. As the lava cooled, the impurities within these gelatinous masses separated into bands that later crystallized into agate. The cavity theory generally prevailed, but by 1900, the inability to explain such details as the original source of the silica, the exact method and duration of band formation, and the causes of banding distortions had made agate genesis the subject of a vigorous scientific debate that continues today.

Most researchers now agree that agate genesis begins with hollow cavities within a suitable host rock, usually a high-silica, extrusive (volcanic) igneous rocks such as rhyolite, andesite, and certain types of basalt. These cavities are created when frothy lavas flood onto the surface to quickly form solid crusts that trap gas bubbles within the still-molten lava beneath. The current theory of agate genesis is based largely on the latest understanding of how mineral solutions act in restricted or closed systems.

Agate formation begins when impure, aqueous silica solutions seep through the host rock into cavities and coagulate into thick gels. Within these cavities, the silica solutions react with the cavity walls, forming thin coatings of green-brown celadonite [basic potassium iron magnesium silicate, $KFe^{3+}(Mg,Fe^{2+})Si_4O_{10}(OH)_2$]. This celadonite coating, which often contains aragonite [calcium carbonate, $CaCO_3$] and the zeolite mineral stilbite (a member of a group of hydrous complex aluminum silicates), is found on the exterior of all agate nodules and, during weathering or mining, helps to separate the nodules from the host rock. Next, the silica solutions precipitate a thin layer of grayish-white chalcedony on the celadonite. Together, these two thin layers seal the cavity to create a closed or partially closed system. Although pressure within the host rock sometimes continues to force new solutions into the cavities, the trapped silica gels, which have a plastic consistency, cannot exit the cavities. Under low but increasing pressures, the trapped silica gel separates into bands according to differences in chemical composition, density, and temperature. Band formation progresses from the outside toward the center. The precise factors that determine the time of separation and the specific properties of these bands remains uncertain. Band formation continues until no silica gel is left. Eventually, with decreasing temperatures, the masses of trapped, banded silica gel form solid microcrystalline quartz. If cavities have been completely filled with silica gel, the resulting agate nodules are solid with no hollow center. Partially filled cavities produce agate nodules with hollow centers, in which the center walls consist of macrocrystalline quartz as drusy coatings of large crystals of rock crystal or amethyst.

Band formation in agate is a very complex process. Such physical properties of bands as thickness and color are determined by temperature, pressure, chemistry, the presence of impurities, pH, and saturation level of the silica solutions. Because these factors are often interrelated, the resulting limitless variety of agate patterns and colors makes every agate unique. While the silica gel is still in a plastic state, other factors can deform the developing bands. Solid impurities within the gel can act as "seeds" that facilitate the growth of surrounding, independent banding-pattern systems. This creates "eye agate," which exhibits

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individual circular banding patterns. Certain conditions during banding development can form thin bands that alternate in micro- and macrocrystalline characteristics that diffract light to create the iridescent effect in "iris agate."

Pressure can also distort banding patterns. When internal cavity pressure exceeds that of the surrounding host rock, the silica gel attempts to equalize the pressure by moving toward the weakest point(s) of the cavity wall, distorting the existing bands by "dragging" them toward the wall. The tiny, hollow channels in these outward-pointing band distortions are called "escape tubes." At the wall, the silica gel sometimes bulges as it reacts with the celadonite layer and its associated minerals to form "eye" patterns. Pressure distortions explain the origin of "fortification agate"—agate in which banding takes the distinctive shape of the outline of medieval fortresses.

Most agate coloration is some shade of red or blue, with "reds" including everything from pale pinks to oranges and brick-reds, and "blues" ranging from the palest grays to a spectrum of blues and nearly black. All these colors, which appear as both the softest pastels and intense hues, are caused by ferrous (Fe^{2+}) and ferric (Fe^{3+}) iron chromophores (coloring agents). Traces of manganese and nickel oxides produce rarer agate colors such as yellow and green. Agate's common white bands consist of nearly pure silica that is largely devoid of chromophores.

The current theory of agate genesis remains in a state of flux as mineralogists continue to attempt to determine the origin of the silica in the original solutions, the physical and chemical factors that govern banding formation, the nature of the triggering mechanisms that convert banded silica gel into agate, the precise nature and purpose of "escape tubes," and whether agate formation occurs contemporaneously with host-rock formation or, as most researchers believe, over much longer periods of time.

A basic knowledge of agate-genesis theory will make your agate specimen all the more fascinating. Study it closely and see if you can identify "escape tubes," associated fortification patterns, and other banding distortions; subtle variations in band thickness and color; "eye patterns"; the greenish-brown celadonite rim coating (which may appear whitish from oxidation); and center cavities with drusy coatings of macrocrystalline quartz.

COLLECTING LOCALITIES

Agate occurs in in situ deposits and as scattered nodules and alluvial fragments. After weathering free of its host rock, agate's hardness and durability enable it to survive extended alluvial transport. Because of its relatively low density, alluvial agate is often found atop the gravels of plains and rivers. Although less abundant than chert, flint, or jasper, agate is widely distributed and has many collecting localities. The following localities include only those known for particularly attractive or commercially valuable specimens. Our agate specimens were collected near Soledade in Rio Grande do Sul, Brazil. Other regional sources include the volcanic formations and river gravels near Iguaçu Falls at Foz do Iguaçu in Paraná, Brazil, and the Quarai River gravels at Artigas in Artigas Department, Uruguay.

Japanese agate is collected at Chinkobe in Hiyama Province on the island of Hokkaido; Chinese agate is found in the Yangtze River gravels at Nanjing in Jaingzu Province. Australian agate comes from Agate Creek near Georgetown in northern Queensland, and from Boggabri in Pottinger County in New South Wales. African agate is found at M'banza Congo in the Zaire Province of Angola, the Llorin area of

Nigeria, the Nile River gravels and the Red Sea beaches in Egypt, and the Mtwara region in southeastern Tanzania. In India, fine agate also comes from Rajpipla near Gujarat in the Deccan Traps region.

European sources include Scurdle Ness, Lunan Bay, Blue Hole, and Todd's Hole near Montrose, Angus, Scotland; the Regulice area near Kraków, Malopolskie, Poland; and the Ruchlitz and Kohren–Salls areas of Saxony, Germany. Also, small quantities of fine agate are still found at the historic Nahe River quarries at Idar-Oberstein in Rheinland-Phalz, Germany.

In Mexico, agate is collected commercially at Isla de Santa Catalina in the state of Baja California Sur and at a dozen sites in the state of Chihuahua. Canadian agate occurs at Troitsa Peak and Eagle Creek in the Whitesall Range in the Omenica Mining Division of British Columbia. Other Canadian sources are the shores of Vancouver Island in British Columbia; the north shore of Lake Superior in Ontario; and numerous sites along the basalt cliffs on the eastern shore of the Bay of Fundy in Nova Scotia. The finest Cuban agate comes from Bayate in Guantánamo Province.

In the western United States, agate is collected in Oregon near Grants Pass, Lake Owyhee, Biggs Junction, and the Rogue River, and most notably at the Madras thunder-egg beds in Jefferson County; in California at East Park Reservoir near Stonyford in Colusa County, the Black River Quarry at Renton in King County, the Hauser geode beds at Wiley Well near Blythe in Riverside County, and the Pisgah crater volcanic field near Ludlow in the Mojave Desert in San Bernadino County; in South Dakota at the Fairburn agate beds near Fairburn in Pennington County; in Nebraska near Ashland in Saunders County and at Bayard in Morrill County; in Colorado at the Twin Mountains geode field in Rio Grande County; and in south-central Montana in the Bighorn River and Pryor Mountains in Big Horn County. Beautiful moss agate is also found in the Yellowstone River gravels in eastern Montana in Treasure, Rosebud, Custer, and Prairie counties.

In the eastern United States, agate is collected in Florida at Ballast Point in Tampa Bay in Hillsborough County; in Rhode Island at Diamond Hill near Cumberland in Providence County; in Tennessee at the Silvertooth agate fields at Horse Mountain in Bedford County; and in New Jersey at the Francisco Brothers' Quarry near Little Falls Township in Passaic County, the Chimney Rock quarries at Bridgewater Township in Somerset County, and McDowell's Quarry in Upper Montclair in Essex County.

JEWELRY & DECORATIVE USES

Today, agate is the world's most distinctive and most popular gemstone. Agate's many attributes begin with its eye-catching bands and colors. With its excellent hardness of Mohs 6.5-7.0 and great durability, agate gems can endure daily wear. Easily workable, agate can be carved in fine detail, and its microscopic grain takes a superb polish. Its relative abundance assures affordability. Each agate gem and display piece is unique, for no two pieces ever share the same colors and banding patterns, even if cut from the same rough. Finally, agate colors are easily enhanced.

Over the centuries, agate has been fashioned into an array of gem and decorative items. Agate is usually cut with a specific orientation, most often to form flat or slightly convex surfaces (cabochons) that transect its banding and layering patterns to display them in cross section. This type of cutting is used for display nodules and slabs and for cabochons mounted in belt buckles, bolo ties, and pendants. Agate is cut parallel to its banding patterns only when fashioning cameos, when further grinding will reveal two or more adjacent, superposed bands of different colors. Agate is also tumbled and fashioned into beads and spheres, most notably as the agate marbles that were popular in the early 1900s and are still remembered as "aggies."

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Agate jewelry is usually mounted in silver and has a broad range. Cabochon pendants of lower-grade agate can cost less than $10, while cabochons of similar size in brightly colored and distinctly banded agate can cost more than $100. In recent decades, agate has acquired a "western" image and is increasingly combined with turquoise, red coral, and shell in "western" and "Indian" jewelry. Countless agate nodules are sectioned and polished to serve as display pieces, bookends, and paperweights. Most agate, however, is cut into thin, translucent slabs ranging in size from a few inches to two feet and polished to display backlit colors and banding patterns. Agate slabs serve as distinctive panels for Tiffany-style lamp shades and stained-glass-like creations. Modestly priced display slabs are huge sellers in rock and souvenir shops, while large, polished slabs with spectacular colors and banding patterns command thousands of dollars as objets d'art in upscale galleries.

Agate has been color-enhanced since before Roman times to transform drab, gray banding into brighter, more colorful patterns. More than half the agate sold today, especially the low- and medium-priced display pieces and slabs, has been treated by immersion in chromophoric solutions, usually of organic dyes or the chemical salts of iron, nickel, manganese, chromium, cobalt, and copper. Because of its natural porosity, which varies among individual bands, dyed agate can exhibit a rainbow of intense band colors. Natural agate tends to have earthy, somewhat subdued color tones. Specimens exhibiting vivid "electric" hues of reds, pinks, yellows, blues, or greens have been color-enhanced.

HISTORY & LORE

Archaeologists have dated flaked agate projectile points and crudely polished agate amulets to the beginning of human history. By the time of recorded history, various cultures, attracted to agate's colorful and intricate patterns, believed that the stone had the power to do everything from ensuring good crops and curing insomnia to calming electrical storms and bringing general good fortune. Early Egyptians fashioned agate into engraved amulets, cylinder seals, and intaglios. Hindus believed that agate protected children from fear. Medieval physicians prescribed the wearing of agate amulets or the ingesting of finely powdered agate to treat skin diseases, stimulate fertility, protect bone marrow from diseases, alleviate the effects of allergies, and keep the blood healthy. According to modern metaphysical practitioners, agate enhances the ability to discern truth, accept circumstances, recall the past, and focus mental energies.

Agate was named by the Greek philosopher and naturalist Theophrastus (circa 372-287 B.C.) who, after finding the stone in the Achatçs River (now the Dirillo River) on the island of Sicily, wrote of it as *Achatēs*. About 1450 A.D., the Greek word passed into German as *achat* and a century later was anglicized to "agate." Initially, agate was only cut and polished locally. But by 1500 A.D., the superbly cut, colorful agate produced by the stone-cutters of Idar-Oberstein, in what is now Rheinland-Phalz, Germany, had become a trading commodity throughout Europe. Working a plentiful supply of deeply colored, brownish-red agate from river gravels and nearby quarries of the Nahe River Valley, German stonecutters developed advanced cutting-and-polishing methods using large sandstone grinding and polishing wheels powered by the water of the Nahe River. When global trade expanded dramatically in the late 1500s, Idar-Oberstein became the world's leading stonecutting center. By 1700, more than 30 Idar-Oberstein stonecutting operations were providing a steady supply of agate beads, cameos, pendants, vases, goblets, and bowls for worldwide export.

But by 1800, the Nahe River agate deposits were largely depleted and the importance of Idar-Oberstein declined. The city rebounded in the 1830s, however, thanks to the immigration of many Germans to Brazil and Uruguay. German settlers discovered large deposits of agate in what is now the Brazilian state of Rio Grande do Sul and the Artigas area of northern Uruguay. Aware of Idar-Oberstein's need for rough gemstones, they shipped this agate to Europe as ballast on returning empty ships. Because the Brazilian agate lacked the deep coloration of the Nahe River material, German stonecutters turned to mass chemical dying, developing new methods to impart colors of unprecedented variety and brilliance. By 1860, Idar-Oberstein had 150 agate operations that dyed, cut, and polished Brazilian agate. After 1900, Idar-Oberstein again lost its importance when the introduction of electric power decentralized the stonecutting industry. Today, Idar-Oberstein has again regained its importance as a stonecutting center, cutting and polishing agate and a variety of gemstones from around the world.

Agate has been featured on such postage stamps as Algeria's 1.20-dinar stamp of 1983, Armenia's 250-dram stamp of 1998, Australia's 7-cent stamp of 1973, Bulgaria's 1-lev stamp of 1995, Czechoslovakia's 80-halura stamp of 1968, the French Southern and Antarctic Territories' 0.15-franc stamp of 2005, the German Democratic Republic's (former East Germany) 70-pfennige stamp of 1974 and 25-pfennige stamp of 1978, Kenya's 1.50-shilling stamp of 1977, Malawi's 5-tambala stamp of 1980, New Zealand's 2-cent stamp of 1982, Switzerland's 10-centime stamp of 1959, Uruguay's 5-peso stamp of 1972, and the United States' 10-cent stamp of 1974.

Agate is an alternative birthstone for September, and the gemstone for the 12^{th} wedding anniversary. In testimony to its popularity, agate has official gemstone, mineral, or rock status in nine states: Arizona, fire agate; Kentucky, the yellow-and-blue fortification agate called Kentucky agate; Louisiana and Tennessee, agate; Minnesota, Lake Superior agate; Montana, moss agate; Nebraska, blue agate; Oregon, the agate-filled thunder egg; and South Dakota, Fairburn agate.

TECHNOLOGICAL USES

Despite considerable effort, agate has not yet been synthesized in laboratories. Researchers are now employing electron microscopes and mass spectroscopes to study agate microbands in the hope of learning exactly how these bands are formed, knowledge that may have use in the mass-manufacture of advanced composite materials.

ABOUT OUR SPECIMENS

As noted in "Collecting Localities," our agate specimens were collected near Soledade in the Brazilian state of Rio Grande do Sul. As Brazil's southernmost state, Rio Grande do Sul borders the state of Santa Catarina to the north, Argentina to the west, Uruguay to the south, and the Atlantic Ocean to the east. The state capital is Porto Alegre, a port city of 1.2 million on Lake Dos Patos, an inlet of the Atlantic Ocean. In the south of Rio Grande do Sul, grasslands support large ranches; in the north, a broad plateau of rolling hills is covered by subtropical pine forests. Soledade is located at an elevation of 2,000 feet in the north-central part of the state, 150 miles northwest of Porto Alegre and 600 miles southwest of Rio de Janeiro. Brazilian farmers and ranchers of Portuguese descent settled the Soledade region in the early 1800s. Soledade, which was formally organized as a municipality in 1875, is today a city of 30,000 residents with a mixed economy based on cattle ranching, farming, lumber cutting and milling, stone quarrying, and gemstone processing.

Soledade's tie to gemstones began in the 1820s with the arrival of German settlers, who discovered that local soils and weathered lava outcrops were rich in agate nodules. Aware of Idar-Oberstein's need for agate (see "History & Lore"), they began collecting the agate and shipping it to Germany. Since then, gemstone mining and processing has become such an important part of the local economy that Soledade's nickname is *Cidade do Pedras Preciosas*—the "City of Precious Stones."

Soledade is located near the center of a massive lava flow that covers most of Rio Grande do Sul and adjacent areas of Uruguay and Argentina. These formations of basalt and rhyolite were emplaced 135 million years ago when huge flows of lava extruded onto the surface to form immense sheet-basalt formations. Covering 463,000 square miles (an area nearly twice the size of Texas) and up to 3,000 feet thick, these continental flood basalts are second in size only to those of the Deccan Traps of India. In parts of this huge formation, gas cavities became filled with quartz, most often as agate and amethyst, which sometimes occurred together in the same nodule.

Initially, farmers at Soledade and nearby towns found nodules of agate and amethyst in their fields, sometimes in numbers that interfered with plowing. This was the agate that was shipped to Idar-Oberstein in the 1830s and 1840s. When the fields were depleted, agate miners dug into rich, nearby alluvial deposits to recover additional nodules. By the early 1900s, many agate and amethyst miners had turned to open-cut mining, drilling and blasting the weathered outcrops of rhyolite. Today, agate and amethyst are still collected from the surface in certain areas, but some miners have begun using pneumatic drills and homemade black powder to drive underground drifts through weathered rhyolite formations to find concentrations of agate- and amethyst-filled nodules.

Figure 1. Agate and amethyst filled nodules that have weathered out of the original lava flow.

Agate nodules and agate-amethyst geodes from nearby towns and mines are trucked to Soledade and sold to buyers representing dozens of local gemstone cutting-and-polishing operations. This agate is cut and polished and shipped by the ton to markets in North America, Europe, and the Far East. Each nodule can produce many slices of great beauty, each one slightly different from its neighbors. The popular gem-and-mineral tours that bring international visitors to Brazil's famed gemstone regions usually begin in the north in the pegmatite fields of the state of Minas Gerais and end with a visit to Soledade. Most tours allow visitors two days in Soledade, so there is plenty of time not only to visit the cutting-and-polishing operations, but just as importantly to sort through thousands and thousands of pieces of polished agate to find that special piece to take home and cherish!

Figure 2. Digging for buried nodules.

THE MANY TYPES OF AGATE

Nothing better illustrates the boundless spectrum of agate patterns and colors than agate's huge number of variety names. Worldwide, agate has hundreds and perhaps thousands of variety, trade, and scientific names that are based on everything from color and banding characteristics to source, genesis, light reflectance properties, and the resemblance of inclusions to familiar images. The following is a short list of some of the major agate types with their identifying characteristics:

Blue lace agate: lacy or wavy, light-blue bands
Botswana agate: fine, parallel pink-and-white bands, from Botswana
Crazy lace agate: twisting and sharply turning, multi-colored bands
Condor agate: brightly colored fortification agate, from Argentina
Eye (Orbicular) agate: numerous concentric, banded rings
Fortification agate: band patterns similar to the outline of medieval fortresses
Fairburn agate: attractive fortification agate from Fairburn, South Dakota
Iris (Rainbow) agate: slabs with multi-colored iridescence
Laguna agate: red-and-white agate from Ojo Laguna, Chihuahua, Mexico
Layer agate: patterns of straight, parallel bands
Onyx: straight, black-and-white, parallel bands of consistent thickness
Star agate: star-like banding patterns
Thunder Egg: agate-filled nodules with or without hollow centers
Tubular agate: numerous "escape tube" distortions in banding

Although generally classified as "agate," the following types lack the characteristic banding, but exhibit attractive inclusions which are sometimes caused by secondary manganese and iron staining:

Plume agate: feather-like, dark inclusions of manganese and iron oxides
Moss agate: moss-like inclusions of dark-green hornblende
Scenic agate: landscape-like inclusions of manganese and iron oxides
Fire agate: ferric and ferrous inclusions with a reddish iridescence
Dendritic agate: tree-like or fern-like inclusions of manganese oxides
Cloud agate: cloudy patches of inclusions
Sagenite agate: solid inclusions of other minerals

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Figure 3. A mound of nodules waiting for shipment to Soledade for cutting and polishing. Who knows what fascinating features are hidden inside?

Until we are all able to take tours of the gem-producing regions of Brazil, we will have to find our agates by visiting stores, shows, or by browsing the internet. Many of us may have first been attracted to the world of minerals by the colors and patterns of agate–do you remember a childhood visit to an old-time rock shop, museum, or store? Perhaps it was your first mineral show, with a parent or grandparent guiding you through the displays, where you were instantly drawn to a vividly colored, beautifully banded slice of agate. For many of us, after that first glimpse, life would never be the same! For others, the childhood passion for Earth's treasures was pushed aside by academic pursuits (and raging hormones), and later by family responsibilities and career interests. So many new Club members tell us of their love for minerals as a child, and how happy they are to return to their passion now that their circumstances allow for it! No doubt, the enthusiasm for agate and other minerals shown by older collectors will be recalled by their children and grandchildren when they reach the corresponding point in life!

Perhaps due to the ubiquity and low cost of most agate, some have adopted a "been there, done that" attitude and have lost appreciation for agate and its patterns, shades, and bands. Some sophisticated collectors even turn up their noses, dismissing agate as a stone just for new or inexperienced collectors. Happily, many longtime collectors never lose their gratitude for the unique qualities of a wonderfully banded agate. Some even make agate the focus of their collection! Large or particularly fascinating agates still command high prices among passionate collectors, and occupy places of high esteem in museums.

Examining your specimen with a light source behind it will allow you to discover some of the features described in our special section on agate genesis--why not reread it and look for eye patterns, escape tubes, associated fortification patterns, banding distortions, drusy quartz, and the other marvelous features explained there? The more we examine, the more we understand why agate is called by some the world's most recognizable and popular gemstone!

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