# AMETHYST ENTICEMENT

## The Draw of BRAZIL & URUGUAY

Reinhard Balzer
*Germany*

Amethyst-lined cavity, 39 cm wide
Rio Grande do Sul, Brazil
Canadian Museum of Nature collection
(Cat. No. CMN 52998)
Michael Bainbridge photo

Brazil gained its independence from Portugal in 1822. A huge realm, now the largest country in South America, Brazil sought European immigrants to help settle "the enticing country overseas." The thinly populated country, with virgin, primeval forests and a mild climate (at least in the southern provinces) attracted many Germans, particularly those from the Hunsrück, Eifel, and Palatinate mountain regions, to which decades of war, robbery, pillage had brought endless suffering.

Brazil was new territory: farming, handicraft, trade could unfold freely there. In their wake, science, art, and culture also blossomed. The country had an open class system, and did not levy the same excruciating taxes as were charged in Europe. Farmers without land were allocated a plot as well as start-up capital and the seeds to grow their first crops. Individuals were the masters of the land that their own work had cultivated. German laborers and farmers left their homeland in droves to build a new life in the Brazilian promised land.

After many years of arduous work and a lifestyle that was distinctive for its deprivation, most of the immigrants were rewarded, for the fertile land in Brazil brought above-average yields, and the mountains abounded in raw materials, including gemstones. The first Brazilian states in which Europeans found gem deposits were Rio Grande do Sul, Minas Gerais, Bahia, and Espírito Santo. The finds were like a gift from heaven for the lapidary industry in Hunsrück,


**Above**: Life was not easy for the nineteenth century immigrants who came to South America to seek freedom and fortune. The conditions are exemplified in this circa 1923 photo of a miner's shelter in Uruguay.
Rheinhard Balzer collection

**Right**: Map of South America; William Besse cartography

The various lava sheets the vast Paraná Basin have different makeups and thus erode at different rates, making for some dramatic, stepped waterfalls such as the world famous 1.7-kilometer-long Cataratas do Iguaçu on the border between Argentina and Brazil.
Marcio Cabral photo, 2010

suffering as it was from a lack of raw materials. Consequently many young people from the gemstone carving and cutting center of Idar-Oberstein (page xx) were drawn to Brazil to secure rough material for processing back in the old country.

## GEOLOGY

The gem deposits had been evolving since ancient times. Some 200 million years ago in the early Jurassic, the southern hemisphere was dominated by the Gondwana supercontinent. About 185 million years ago, Gondwana began to break up, and the modern day landmasses of South America and Africa slowly separated as the southern Atlantic Ocean opened. The opening of the ocean was accompanied by a massive outpouring of flood basalts, which began around 135 million years ago. These basalts can be found in South America's Paraná Basin and Africa's Kalahari Basin (in Namibia).

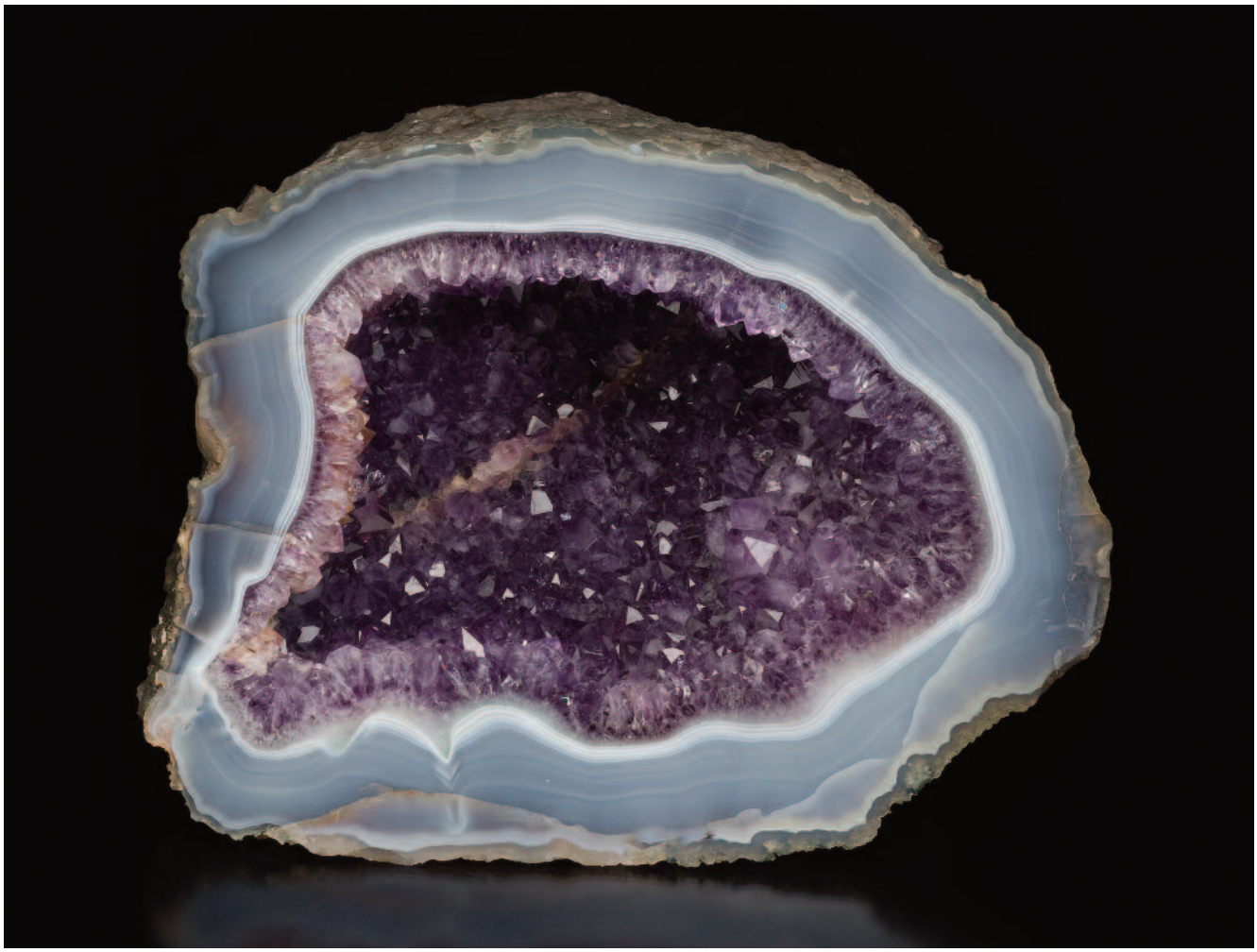
In South America the basalts extend across the Brazilian states of Rio Grande do Sul, Santa Catarina, Paraná, São Paulo, Mato Grosso do Sul, and portions of Minas Gerais, as well as parts of Uruguay, Paraguay, and Argentina. The scale of the flood basalts is impressive: they cover some 1.2 million square kilometers—an area 3½ times larger than that of Germany! Their total volume is estimated to be at least 1.8 million cubic kilometers. The basalts are made up of layers of individual flows, some up to 100 meters thick, that record a 10-million-year eruptive history.

Earlier studies suggested that circulating hydrothermal waters driven by the cooling of the thick lava pile precipitated the amethyst, but as described by Dr. Gilg on page xx, the infilling of the geodes has been shown to have occurred long after and quite independently of the cooling of the host lava. Mineral deposition is more likely related to tectonic events that ultimately flooded the basalts with seawater. The seawater leached the various minerals, including silicon dioxide ($SiO_2$), from the basalts and upon crystallization produced fine-grained, cryptocrystalline chalcedony and agate. The fine-grained silica was often reactivated and redeposited as larger crystals, including amethyst.

In addition to silica, cavities in the basalt host a suite of other minerals including calcite, gypsum, anhydrite, barite, goethite, and various zeolites. Through history the cavities were pulsed with fluids, resulting in an abundance of pseudomorphs as one mineral was replaced by another. The pockets are typified by green to blue-green clinochlore rinds, which are covered with a microcrystalline layer of quartz or chalcedony, and then lined with larger crystals. Quartz crystals occur in a variety of colors, but amethyst dominates.

Individual basalt flood events were separated in time by hundreds of thousands of years, and the weathering of the surface during quiet times resulted in a sedimentary horizon that was often covered by subsequent flood basalts. These sedimentary layers are rich in quartz pods and opal.

It is not well understood why the flood basalts in the Paraná Basin in South America are an order of magnitude larger than those in the Kalahari Basin in Africa. One theory suggests that after the Gondwana breakup and separation, Africa moved more swiftly away from the fixed hotspot, or mantle plume, which was responsible for the flood basalts, than did the continental mass of South America. The volcano above the hotspot is active today. It is situated on the island of Tristan da Cunha on the mid-oceanic ridge.



## THE SEARCH FOR PRECIOUS STONES IS ON!

Legend has it that in 1827 the son of one of the stonecutters who had emigrated from Idar-Oberstein happened upon some agate pebbles in a riverbed in Rio Grande do Sul. The find was a godsend for the cutters in the old country because toward the end of the eighteenth century, their local stocks of agate rough had been depleted.

The first consignment of agate material was shipped over the Atlantic in 1834. Initially it was considered dead weight, since at the time there were few cargo shipments for Europe. Later it became regular freight, which was offloaded to barges and transported up the Rhine and Mosel rivers, then carried by oxcart to Idar-Oberstein. The finds in Brazil not only rescued but also revived the industry in Idar-Oberstein, helping to make the region the international carving and cutting center that it is today.

Gemstone cutters from the Hunsrück region sailed to Brazil to secure sources of raw materials. The ensuing systematic exploration resulted in discoveries not only of the much-sought agates but also of large amethyst deposits. And it was not long before even more valuable gemstones—the aquamarine and emerald varieties of beryl, tourmalines to span the spectrum, spodumene, topazes, and even diamonds—were discovered in Brazil's northern states.

Prospecting quickly led to finds in the adjacent "Provincia Oriental," which is present-day Uruguay. A German scientist, Dr. Sellow, was among the first to find agate and amethyst in the province. Unfortunately, the precise knowledge of the localities was lost when Sellow drowned while he was traveling through the province. The deposits in Uruguay were later rediscovered in 1857 by August Becker (Falz, von Menschen, and Steinen 1939).

The fact that some amethyst can be heated to create the saturated yellow quartz variety "citrine" has been known since ancient times, but was anecdotally discovered in Brazil in the early 1880s. Legend has it that German August Lamberts and a group of other Idar-Oberstein prospectors were in Brazil in search of cutting material. The group used pieces of amethyst to contain their campfire and woke in the morning to find that the amethyst had changed from purple to yellow. The process of heating amethyst to produce citrine has since become a commercial enterprise; the formulas for burn times and temperatures are trade secrets.

## MINING DISTRICTS

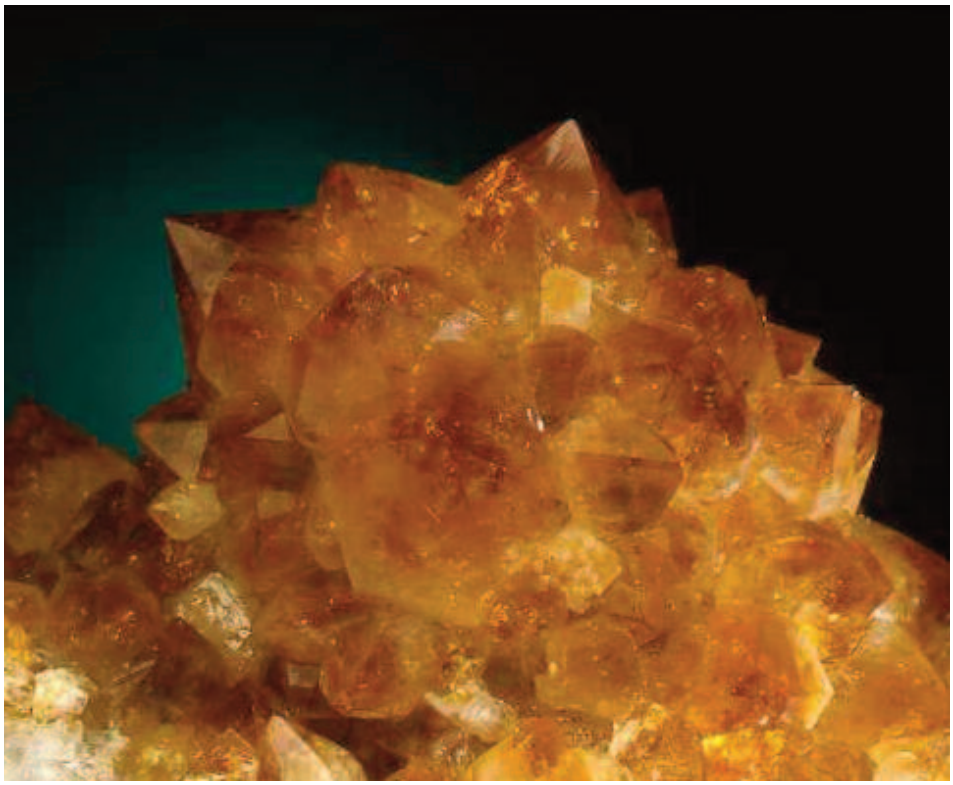
The amethyst that has made the region famous comes primarily from three districts. The Médio Alto Uruguai district crosses the Brazilian state of Rio Grande do Sul, reaches into the state of Santa Catarina, and includes the towns of **Frederico Westphalen**, **Iraí**, **Ametista do Sul**, **Planalto**, **Rodeio Bonito**, and **Trindade do Sul**. The Salto de Jacuí district encompasses the mines at **Campos Borges**, **Salto de Jacuí**, and **Santa Maria** and around **Espumoso**, and **Soledade**. The Fronteira Sudoeste district includes the area

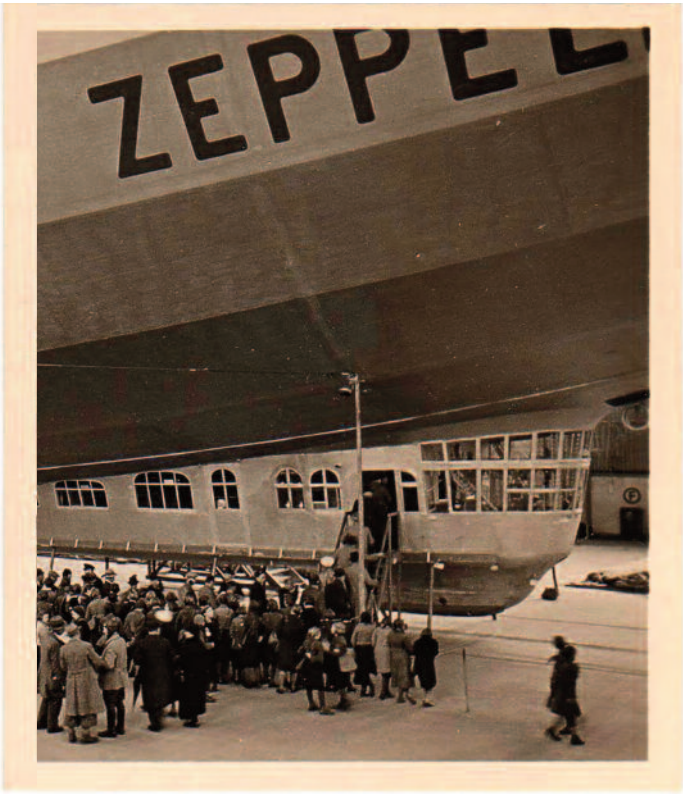
**Upper left**: Quartz variety amethyst on calcite, 5 cm tall
Dos Irmaos, Bortoluzzi, Iraí, Rio Grande do Sul, Brazil
Christian Weise collection
Jeff Scovil photo

**Upper right, middle right**: Amethyst gems cut from rough from Rio Grande Do Sul, Brazil
The **upper** 11.12 carat stone is amethyst heated treated to citrine; the **lower** 16.35 carat stone was cut from natural amethyst. Both stones are in the collection of Ekkehard Schneider; both are Jeff Scovil photos.

**Right**: Amethyst heat-treated to citrine, field of view 6 cm wide
Rio Grande do Sul, Brazil
Herb Obodda collection
Jeff Scovil photo

**Facing page**: Agate and Amethyst-lined cavity, xx cm wide
Rio Grande do Sul, Brazil
Canadian Museum of Nature collection (Cat. No. CMN 52998)
Michael Bainbridge photo






around the Rio Grande do Sul town of **Quaraí** and the famous **Artigas Mine** in Uruguay's Artigas Department.

Agate and amethyst deposits are strewn throughout the Paraná Basin; it is thus difficult to assess the economic reserves. There are, however, patterns: mining concentrates primarily on amethyst geodes in the Médio Alto Uruguai and Fronteira Sudoeste, and agate geodes are targeted in the central Salto de Jacuí district.

## MINING IN THE TWENTIETH CENTURY

In spite of the richness of the deposits, business between Hunsrück and southern Brazil was frustratingly bipolar between from 1860 to 1933. Numerous uprisings and civil wars in South America, problems between Germany and France that culminated in Franco-Prussian War of 1870, then World War I and the ensuing inflation interrupted the trade between central European and South America. But between the times of strife, the bounty of the New World flowed.

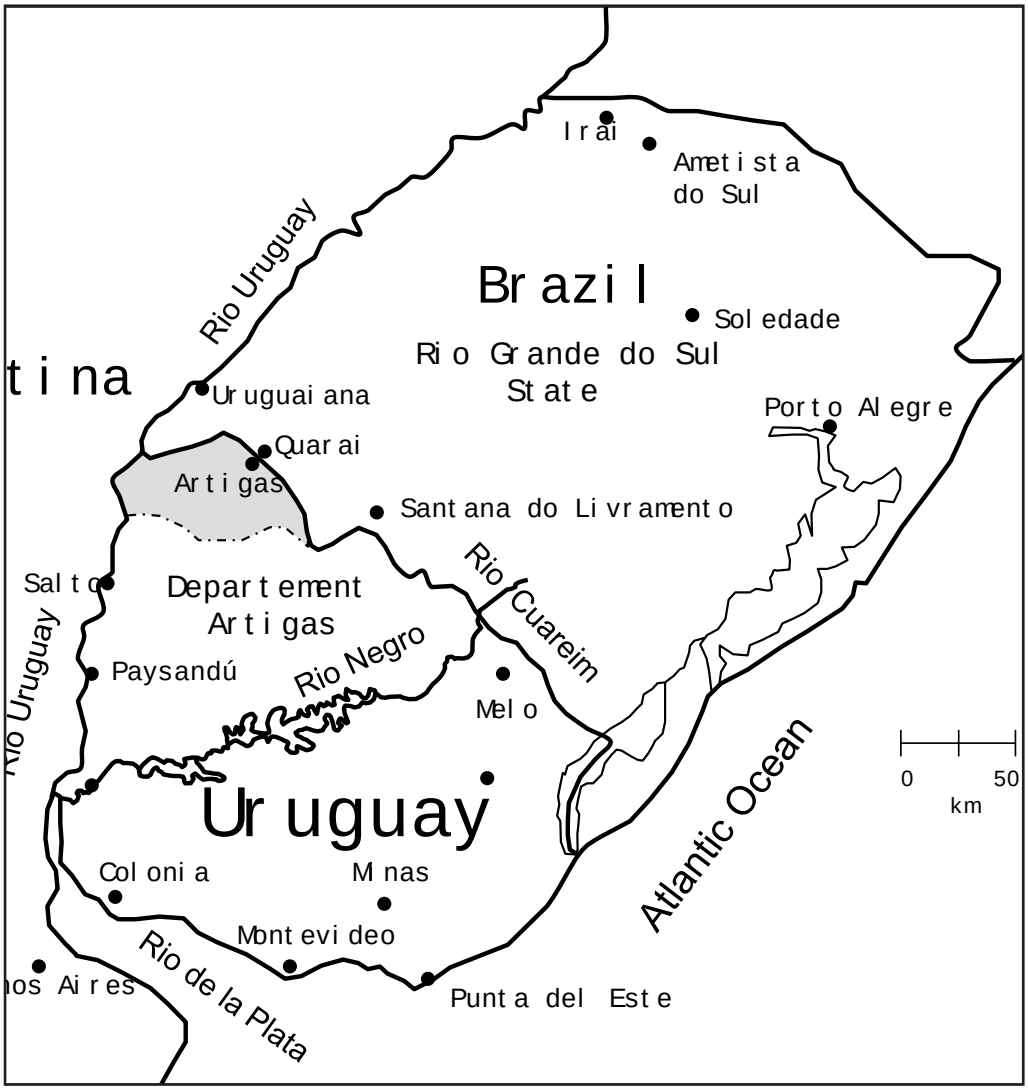
During the first third of the twentieth century, the Uruguayan peso was one of the hardest currencies in the world. It was even more stable than the U.S. dollar, prompting people to refer to Uruguay as the "Switzerland of South America." However, given the slow means of communication between the two continents, the shifting political climates in both Uruguay and Germany, and the

**Above**: Regular Zeppelin service between Germany and Brazil in the 1930s eased travel and communication between traders in the old and new worlds.

**Right**: Map of the Brazilian state of Rio Grande do Sul and the country of Uruguay, and that country's Artigas department
The major amethyst mining regions–Medio Alto Uruguai, Salto de Jacui, and Fronteira Sudoeste–and principle mining towns are indicated.
Bill Besse cartography (after Besse and Currier, 1997)

**Facing page, upper**: An emu investigates a pile of agate geodes
Reinhard Balzer photo, 2007

**Facing page, lower**: A river divides the road en route to the mines
Reinhard Balzer photo, 2007



fluctuating German and U.S. currencies, it was all but impossible for Germans and Uruguayans to engage in meaningful trade. As a result only people who owned the land on which stones were found were able to sustain regular exports. This portion of the population included a few German families and companies, but many of the Germans living in Uruguay slipped into poverty.

In time, however, catapult aircraft and the Zeppelin brought airmail, and the telegraph connected the two countries. As a result, it became easier to react to market changes and more effectively negotiate prices.

While communication between the continents improved, the infrastructure within South America remained primitive. There were no roads or bridges. In the wet and rainy season, it was impossible to reach the mines. The beginning of the twentieth century saw the first automobiles and even a regular bus route between Artigas and the border city of Rivera; yet horses, donkeys, and ox-carts were still the most common means of transport.

## MINING TODAY

These days reaching the mines in and around the provincial capital of Artigas is relatively easy. There are flights from the Uruguayan capital of Montevideo and from Porto Alegre in Brazil. Good roads connect Artigas to the established mines in neighboring Rio Grande do Sul. But access to many of the mines such as Catalan Grande, Catalan Chico, and Tres Cerros in the 100 square kilometers around the Catalan River southeast of Artigas requires all-wheel drive vehicles with high clearance.

The mines in the Catalan region are reached by dirt spurs off of the main paved road from Artigas. The spurs are impassable during the rainy season as the bridgeless Catalan Grande and Catalan Chico rivers are too high to cross. When water levels are low or the rivers dry, however, small to medium-sized geodes and tumbled agate, amethyst, and other quartz varieties litter the riverbeds and tracks. To reach many areas, it is necessary to cross pastures and private property. Permission to cross or collect on private property and respect for local laws and customs are obviously required.

Developing a mine in this region is difficult, costly, and time consuming. Prospective miners must first negotiate permission from landowners and then gain consent from the appropriate environmental and mining authorities. Only then can roads be built and the appropriate equipment brought in.

Open pits are dug to recover crystals and agate from the weathered basalts. But amethyst-lined vugs and agate nodules

**Above**: Huge tunnels are driven into the lava sheets at the La Bolsa Mine Reinhard Balzer photo, 2004

**Left**: A cavity is illuminated so that it can be assessed Reinhard Balzer photo, 2004

**Below**: A amethyst-lined cavity frozen in solid basalt Reinhard Balzer photo, 2004

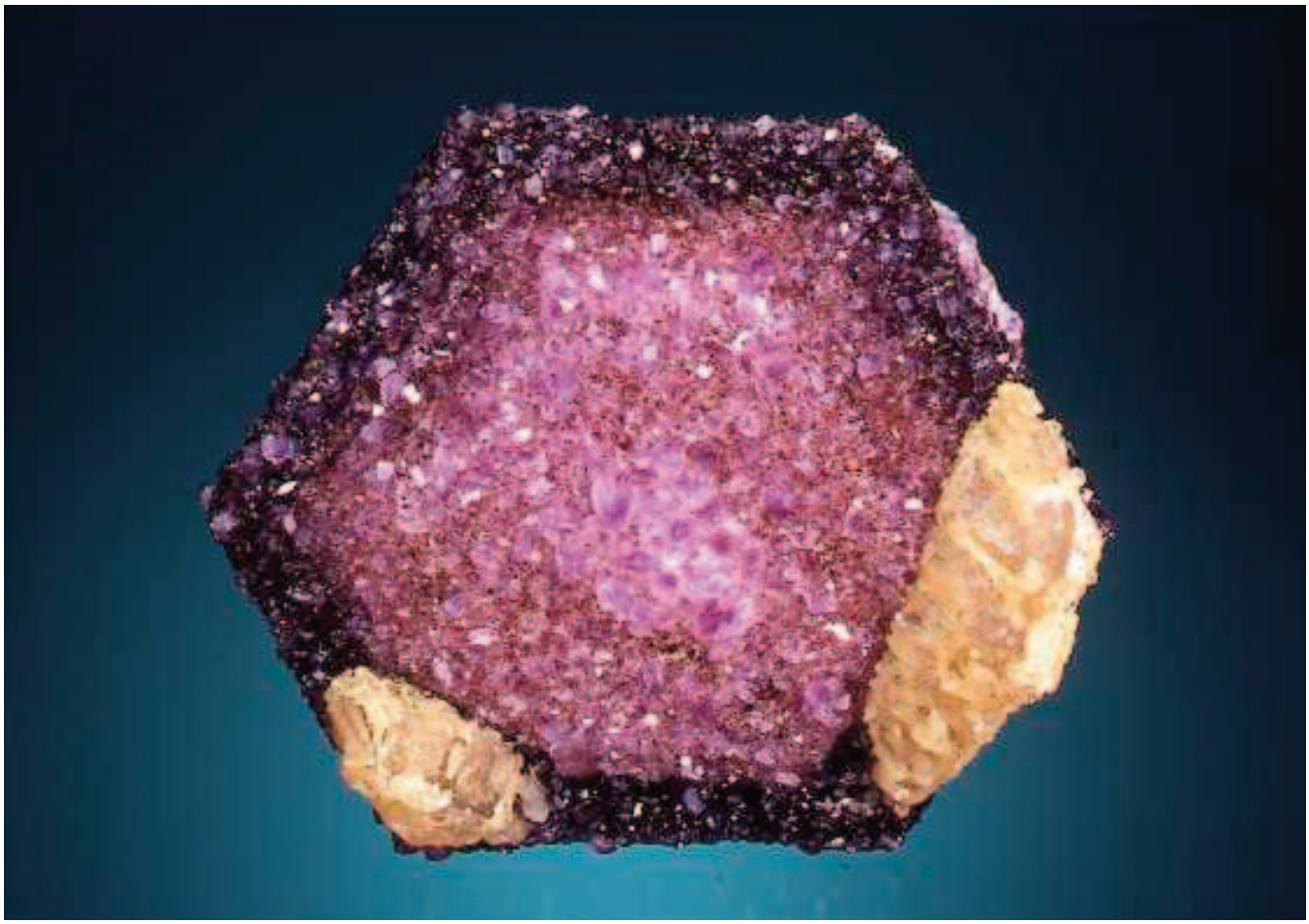
**Facing page, upper**: A man-sized crystal-lined cavity, which has been extracted intact, Reinhard Balzer photo, 2004

**Facing page, lower**: Mineral dealer Rock Currier stands in a warehouse full of amethyst "cathedrals" Photo courtesy of Rock Currier, year?

are also found solidly enveloped in unweathered basalt. To extract these, horizontal tunnels are driven into the lava sheets to reach the geodes. Explosives loosen the rock, but drills, hammers, and chisels are used to release crystal-lined cavities, locally referred to as druses (see page xx), from the matrix. The waste rock is tipped onto the rock pile in front of the mine. To keep the path to the dumpsite short, several gallery entrances are driven, one next to the other. Inside massive props secure the mine.

Once a druse has been partially freed, a small hole is drilled into it, and it is illuminated to enable a miner to evaluate the quality and decide whether it is worth the cost of careful extraction or whether it should be quickly broken up and removed in pieces for sale as rough or as wholesale material. If the druse is to be extracted intact, it is opened and stabilized. Minor damage and the initial drill hole are repaired with suitable crystal tips. Of the broken material, crystal tips to be used or sold as gem rough are broken out of the host stone and sorted by color and size. They are then "chipped" to remove the parts of the crystal that are unsuitable for faceting. Non-gemmy portions of larger crystals are removed with a diamond saw.

In order to evaluate the quality of the various pieces, everything first has to be cleaned. In general this is done chemically, under supervision of factory management in the town. Repairs are also carried out at the factory. The repair processes are not always in keeping with what collectors generally find acceptable, so it is important to inquire about repairs before making a purchase.



**From the Famous Artigas Department in Uruguay**

**Right**: Polished cross section of an amethyst stalactite, 21 cm tall
Tim and Holly Smith collection
Holly Smith photo

**Facing page, upper**: Quartz variety amethyst encrusting and associated with calcite
14.6 cm wide
Santiño Mine
Helmut Brückner collection
Jeff Scovil photo

**Facing page, lower left**: Calcite on amethyst, 20.5 cm tall
Santiño Mine
Stonetrust specimen
Joe Budd photo

**Facing page, lower right**: Amethyst pseudomorph after calcite stalactite, 14.3 cm tall
Scott Rudolph collection
Jeff Scovil photo

In earlier times prospecting was mainly concentrated on agates and amethysts that were worked into jewelry. Today, however, there is a huge market for decorative formations derived from the various stages of mineralization. For decades, miners only recovered the amethyst, discarding the wonderful calcite crystals that are frequently found in the near-surface vugs. With increased collector demand over the last 20 years, however, well-formed, intact calcite crystals are now gently removed from the druses and packed for the collector market.

Specific features of the amethyst geodes of the Artigas area are the so-called stalactites, which largely form on the bed and the ceiling areas of the cavities. They generally begin as carbonate stalagmites and stalactites, which are later overgrown by crystals as large as 5 centimeters. These speleothems are sometimes sliced and polished to produce attractive cross sections.

At times amethyst crystals envelop well-formed calcite crystals as well as stalagmites and stalactites. The calcite is later etched away, leaving amethyst-encrusted casts that can reach lengths up to 30 centimeters. Amethyst from the Artigas area can also selectively include tiny hematite or goethite crystals resulting in gray or red faces on some crystals. New techniques and collector interest are continuing to enhance the flow of mineralogical specimens from Rio Grande do Sul and the surrounding regions.