2010 Graduation Field Trip

Portugal and Spain
May 3rd to 17th 2010
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Introduction

Within recent history the necessity of recognizing the size and complexity of the world around us has become an important educational quality. It is apparent that anyone in today’s world must truly be a global citizen. Hence, the Norman B. Keevil Institute of Mining Engineering at the University of British Columbia has begun the tradition of sending 4th year undergraduate students on trips that allow them to truly recognize the importance of mining around the world and the effects that these projects can have on the economy and the world.

The recognition of these facts has brought previous classes to Brazil, Poland, China, Chile, and Australia. All the students involved with these field trips have learned valuable information for furthering their education and enhancing their skills as mining engineers in today’s world. They have visited a wide variety of mines and smelters and have learned about the cultures of these countries. It has brought a newfound respect for cultural differences and divides that mining must encounter in everyday life.

In 2010 the UBC mining engineers travelled to Spain and Portugal. The engineers visited three mines, one smelter, two universities, and the historical Rio Tinto mining district while on this trip. Among these mines, one underground operation and two open pit mines were visited. This year marked a first for the students as they had the opportunity to communicate with other universities and other mining engineering students at the University of Huelva and the Madrid School of Mines.

The cost of this trip was paid for by the fundraising efforts of the students of UBC. They put in a tremendous amount of time and planning to ensure the success of this trip. The students attempted a variety of events including club events, 50-50s, bottle drives, and industry fundraising. The large majority of the fundraising was done through industry and a special thanks need to be given to those who gave money and time to help the students.

Also, the students would like to extend a special thanks to some of those that took a larger role in the planning of the trip. Among those we would like to thank are Rita Tsai, Jeffrey Duck, Brian Lai, Ryan Fuzi, Pat Lee, and Diederik Kroondijk. A special thanks to Malcolm MacLachlan for his hard work regarding this trip.
Global Citizens

By visiting mines within new countries with different histories, cultures, and attitudes towards mining, the students had an opportunity to become more aware of the world around them and realize the ways in which they can affect the world. Portugal and Spain both have rich histories which proved to be new and informative for the mining engineers of UBC.

Portugal is an old country with a rich history and interesting culture. Portugal is a smaller country than Canada in both size and population. It has a much longer history than Canada and is the westernmost country of mainland Europe. The country has had long histories in cod fishing and tiles. The country had a large role in the age of discovery and has since moved towards the high tech industries. In Portugal the afternoon siesta is still an important tradition with later dinners being a large part of their culture.

Spain has a similar history to that of Portugal. The two countries speak similar languages but Spain had a more powerful imperial history. Specifically, Spain has had a major influence on the South American continent. Spanish is one of the most spoken languages in the world and to learn from such an interesting culture can have enormous benefits. There are many mining developments in South America and as a result it is an area of high interest to mining engineers. It can be very beneficial to learn from related cultures. This will increase our understanding, awareness, and compassion when traveling the world.

The grad class agrees that learning about these two cultures has been hugely beneficial for their future careers. It will heighten their awareness and make them better global citizens.

Peer Communication

The trip provided UBC students with the chance to communicate with peers at other universities. There were two schools visited by the UBC mining engineers. They visited the University of Huelva and the Madrid School of Mines. At both of these schools UBC mining engineers made a presentation about their school, experiences, and country. A similar presentation was shown to the UBC students and the mining engineers had the chance to learn more about their peers from around the world.

After the presentations students from both schools were given the chance to communicate with each other. They had the opportunity to share a meal and get to know students from another past and experience. These important experiences enhanced the students’ communication abilities and allowed students to learn to communicate with their peers from other nations. These opportunities were invaluable and have been a great learning experience, helping to broaden the horizons of students from the UBC mining engineering department.
Global Mining Methods

During the trip UBC students visited three different mines in Spain. It gave the mining engineers the chance to see the mining and production methods that have been employed on the Iberian Peninsula. These mining methods were significantly different than what many students had been previously exposed to largely due to rock mass and geological differences. Students had the opportunity to see what has worked in different mining situations and learned of different techniques that they may be able to use in their future careers.

It continues to be beneficial to UBC mining engineers and the mining community to have students taking part in field trips such as this. The learning opportunities encountered on this trip create better and more rounded mining engineers capable of communicating with people from around the world in a more meaningful manner. In turn this encourages future worldly connections in the mining industry and reinforces the message of interconnectedness; an important lesson for any global citizen.
**Spanish Mining Industry**

Spain is home to some of the world’s largest mineral reserves including celestite, mercury, and sepiolite. It is one of the leading European Union (EU) countries in terms of output for lead, zinc, pyrites, amongst other nonferrous and precious metals. Spain is one of the most self sufficient countries in terms of raw materials amongst the EU. Its rich mineralized territory includes more than 50% of the Iberian Pyrite Belt (IPB), which is comprised of volcanogenic massive sulfide (VMS) deposits. The IPB extends from southern Spain to the southwestern coast of Portugal and contains a number of deposits that range from 10 to 100 Mt. The IPB alone contains 1,700 Mt of massive sulfide ore making it the world’s largest. Production of lead was 110,100 tonnes (t) in 2006, while 502,800t of zinc was produced. 8,700 t of copper was mined, and refined copper totalled 263,700 t in 2005. In 2006 aluminum metal production was 591,600 t with production of gold totaling 5,300 t.

![Figure 1 – The Iberian Pyrite Belt](image)

Many economic minerals can be found in Spain resulting in a long history of base-metal mining. With the recent surge in technological advancement, Spain has attracted a renewed interest in metal exploration and extraction. Foreign investments have the opportunity to take advantage of the highly prospective geology, the transparent legislative framework, the available skilled work force, and the comprehensive mining tradition. The Spanish Mining Industry has potential to grow.
Rio Tinto Mining District
Minas de Ríotinto and Nerva are towns located in the heart of the Rio Tinto Mining District, the area so named because of the red tinted water that runs through the area. Throughout history, sulfides have naturally leached into groundwater resulting in natural acid rock drainage into the river. The pH of the river is roughly 2.5 resulting in an absence of life in its waters. Plants in the area have been forced to adapt to the acidic water.

History
Mining activities have been present in the district since 3,000 BCE when the Phonecians discovered jarosite. The Iberians were amongst the first to mine the area for copper, silver, and gold followed by the Greeks and Romans. During the early 1st millennia the Romans set up a vast network of underground mines employing thousands of slaves that were shackled and chained to their working stations. Children grew up working in the mine playing an important role in developing small exploration drifts. In 711 the Romans were defeated by the Moors leading to a significant decrease in mining activity.

After a period of abandonment, the mines were rediscovered and then mined by the Spanish government during the renaissance. A multinational Rio Tinto Company was then formed in 1873 to
operate the mines in the district, developing the earliest forms of modern open pit mining methods. While utilizing modern technologies they left an indelible mark on the landscape leaving in the mid 1900s with very little cleanup. The Rio Tinto mine ceased production in 2001 and is now currently owned by EMED Mining plc.

**The Rio Tinto Mine Project**

EMED Mining is an international junior company and is currently trying to restart the operation after buying into the property in 2004. The production was shutdown in 2001 after a decline in the copper price. In 2010 they are hoping to receive final permitting from the Spanish government and begin production in 2011. There are 3 open pits from previous operations, one of which will be expanded in the new project.

The site tour consisted of a visit into two old open pits and a tour through the existing mill facility. We were accompanied by the chief geologist, chief metallurgist, and head of exploration. EMED plans to utilize Cat 777 haul trucks and then ramp up to larger trucks in the next few years. Much of the old mill is still in working condition and will be used for future production (including the gyratory crusher and ball mills). An interesting feature we were shown were overturned truck beds, scattered throughout the property, that were used as flyrock shelters. In the past this was a necessary precaution to take during large casts blasts.

The huge environmental footprint from centuries of mining in the region has created the need for much reclamation work. Spanish law states that any current mining company has no responsibility to reclaim work completed before 1982 by former companies. Reclamation of work completed since 1982 by former companies falls under the responsibility of the current land owner, the Spanish government. Therefore the current operator, EMED, will only be responsible for reclaiming any areas that are mined in the future. This law structure differs greatly from Canada’s where any lease holder must cleanup any environmental issues from all previous owners.

**The Mining Museum**

The Mining Museum of Minas de Riotinto was originally a hospital for workers of the Rio Tinto Company Limited. Exhibiting the geology and history of the region, it also showcases the mining and metallurgy activities from different eras. One of the many items on display is the Maharajah’s coach, the most luxurious narrow-gauge railway coach in the world which was built for Queen Victoria of England. It was brought to Riotinto to be used by King Alfonso XIII as a tribute to his visit.

In the museum a mock roman underground mine is setup, depicting the harsh working conditions roman slaves were forced to endure. This included wearing a 5kg shackle around the neck and ankles. The Romans had an elaborate system of pumps and human powered water wheels used to dewater the mine. The museum showed the progression of mining throughout the ages, giving examples of mining equipment, artifacts, and mine development in relation to the town site.
The Mining Railway
Originally running alongside of Rio Tinto (Red River), the railway was used by as many as 143 engines, 2000 tipping skips and 1300 coaches. It was a symbol of technological advances introduced by the British which transported ore to the Huelva port. Twelve of the 300 kilometer track has been restored and turned into a tourist attraction. The restored tracks run through astounding sceneries, including the core of the industrial areas and natural landscapes following the Rio Tinto. The railway weaves its way along the banks of the river, before stopping and giving visitors a chance to walk along the red waters. A great deal of history is presented during the ride as visitors pass by old Rio Tinto Company buildings and infrastructure.

Figure 3 – The Bank of the Rio Tinto River
**Peña de Hierro (Iron Crag) Mine**

An open pit mine ranging to about 150 meters deep, the Peña de Hierro Mine is known for the great seam of iron that runs on top of the pit. Although it was known for its purity near the late 19th century, it has been mined since the ancient Roman times. The site is known for its magnificent scenery. It is also where Astro-Biology Centre and NASA are doing research for the MARS project.

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*Figure 4 – The Historic Mining Site at the Peña de Hierro Mine at Rio Tinto*
Aguablanca Open Pit Mine

The Aguablanca copper-nickel mine is owned by Lundin Mining Corporation, a Canadian mining company, and is located approximately 100 km north of Seville. It consists of an open pit mine and an on-site processing plant. The mining operation utilizes conventional open pit methods using shovels and haul trucks. In 2009 the mine produced 8,029 tonnes of nickel concentrate and 6,989 tonnes of copper concentrate. The copper and nickel that is produced is sold as one concentrate to smelters in China and the average grade of both nickel and copper are between 6 and 8%.

History
The exploration for nickel and copper deposits in the area has been carried out since the 1980’s. In 1994 the Pesur/Rio Tinto joint venture discovered the Aguablanca orebody through an extensive diamond drilling program. During 1996 Freeport McMoRan acquired Rio Tinto’s assets and later transferred them to the newly formed subsidiary Atlantic Copper. In 2001 Rio Narcea Recursos (RNR), a subsidiary of Rio Narcea Gold Mines Ltd (RNGM), acquired a 100% interest in the Aguablanca project. Commercial production of nickel-copper concentrate started in January 2005 by RNR. The Aguablanca Mine was acquired by the current owner, Lundin, in 2007.

Reserves and Geology
The Aguablanca Nickel-Copper deposit is located in the south-eastern part of the Ossa-Morena lithostructural Zone. The deposit is hosted by gabbroic massif, consisting principally of quartz-diorite, granodiorite and monzogranite. The Aguablanca deposit is an example of typical magmatic sulfide mineralization. It consists of disseminated to semi-massive mineralization with the highest grades occurring within magmatic breccia. The disseminated mineralization consists of interstitial sulfides within silicates of plagioclase. The higher grade gabbro and breccia consists of variable sized fragments of pyroxenes, gabbro-norites, skam, hornfels, and marble.

The orebody is divided into two sub-parallel parts. The larger South or Main Zone is approximately 600 m long, over 100 m wide and can be traced for 400 m along N115 strike. The North Zone also strikes at N115 and is approximately 125 m long in the strike direction, 50 m to 100 m thick and extends to a depth of more than 300 m.
The classification of the mineral resource was completed by Golder Associates. Lundin uses the cut-off grade of 0.25% Ni as an economical cut-off of ore mined and fed to the process plant.

<table>
<thead>
<tr>
<th></th>
<th>Tonnes (Kt)</th>
<th>Ni (%)</th>
<th>Cu (%)</th>
<th>Pt (g/t)</th>
<th>Pd (g/t)</th>
<th>Co (%)</th>
<th>Au (g/t)</th>
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</thead>
<tbody>
<tr>
<td>Aguablanca</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proven Reserves</td>
<td>8,668</td>
<td>0.65</td>
<td>0.48</td>
<td>0.222</td>
<td>0.208</td>
<td>0.017</td>
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<tr>
<td>Probable Reserves</td>
<td>370</td>
<td>0.30</td>
<td>0.29</td>
<td>0.088</td>
<td>0.090</td>
<td>0.012</td>
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<tr>
<td>Subtotal</td>
<td>9,038</td>
<td>0.63</td>
<td>0.47</td>
<td>0.218</td>
<td>0.203</td>
<td>0.017</td>
<td>0.105</td>
</tr>
</tbody>
</table>
**Mining Operation**

Aguablanca mine utilizes conventional open pit mining methods using shovels and haul trucks. The mining cost of ore is US$ 2.433 per tonne and the mining cost of waste is US$ 1.384 per tonne. The summary of design parameters is shown below.

<table>
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<tr>
<th>Item</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Ramp Width (*)</td>
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<tr>
<td>Gradient</td>
<td>10%</td>
</tr>
<tr>
<td>Bench Height</td>
<td>16 m</td>
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<tr>
<td>Bench Face Angle (**)</td>
<td>90°</td>
</tr>
<tr>
<td>Inter-ramp Angle</td>
<td>58°</td>
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<tr>
<td>Overall Slope</td>
<td>55°</td>
</tr>
</tbody>
</table>

*Figure 7 - Aguablanca Design Parameters*

The pit design sets the mine life to 6 additional years. In total, the mine will produce approximately 9.0 Mt with an average grade of 0.63% Ni and 0.47% Cu with the strip ratio of 7.1:1. The diagrams below show the pit design optimized in relation to the current resource estimate. Additionally, there are plans to begin underground mining in the next few years. Development is currently beginning on a ramp down to the orebody.

*Figure 8 - Section 5300 North*
Mineral Processing
The Aguablanca mineral processing plant (Figure 10) has been designed to produce bulk copper/nickel/PGM concentrate, with the flexibility of producing separate copper and nickel concentrates with minimal losses. The designed treating capacity is 125,000 tonnes per month of ore. The plant consists of a primary jaw crusher with storage, primary semi-autogeneous grinding (SAG) mill, secondary ball mill and flotation cells with re-grind mill.

Figure 10 - Aguablanca Flow Diagram
The comminution process consists of two stage milling using semi-autogenous (SAG) and ball mills. These two processes are required due to different characteristics of the ore. The breccia ore is characterized as exhibiting low competency, low abrasivity and requiring below average amounts of grinding energy, hence requiring a high ball-loading grinding. The Aguablanca disseminated ore is characterized as exhibiting high compressive strength, medium to high competency, high abrasivity and requiring average to above average amounts of grinding energy. This ore is suitable for a SAG milling operation.

In the flotation process the two different ores exhibit similar characteristics, therefore, the ore is first run through pre-flotation that recovers approximately 40% of the copper to a clean concentrate with minimal nickel losses. Then, rougher, cleaner and re-cleaner flotation stages are performed. The flotation area also includes a re-grind mill for improvement in flotation recovery. It should be noted that CMC’s and gum are applied in the floatation process because magnesium, in the form of MgO, is the only known penalty impurity for smelters.

Figure 11 – Touring the Smelter at the Aguablanca Mine
Huelva Copper Smelter

History
Huelva is a historic port town with a long tradition of exporting copper and pyrite ores. The current smelter and refinery were brought online in 1970 by Rio Tinto Company Ltd. In 1993 Freeport McMoRan Copper and Gold bought the property and quickly invested €200 million to double the capacity to smelt over 800 000 tonnes of copper concentrate. The expansion project was carried out over 19 months while the smelter continued to operate.

Operation
The Huelva copper smelter, owned by Freeport McMoRan Copper and Gold, and operated by Atlantic Copper, receives its concentrate feed from Grasberg, Indonesia via bulk shipping at an average grade of approximately 30% copper. The annual production capacity of the smelter is 330 000 tonnes of cast copper consisting of both anode and cathode products.

After transporting the concentrate from port to warehouse, three dryers, two rotary and one natural gas, are used to lower the humidity to 0.2%. At this stage the concentrate can be fed into the flash furnace. The flash furnace produces a transitional product known as matte that is composed of 62% copper. Convertors separate the copper from sulfur and iron producing blister copper and yielding slag as a byproduct. The convertor product passes through one of three refining furnaces that displaces residual oxygen and sulfur in the blister copper. The liquid copper is then cast on a casting wheel into 1m by 1m copper anodes consisting of 99.5% copper. The final step in the smelting process is production of copper cathodes. The anodes are dissolved in an electrolyte solution where pure copper is deposited as copper cathodes and impurities fall to the bottom of the cells as slimes. These final copper cathodes are greater than 99.999% copper and each weigh 47kg.

A number of valuable byproducts produced during the smelting process are sold producing supplementary revenue. Slag is produced in both the flash furnace and convertors and is treated in an electric furnace where the copper content is reduced from about 5% to less than 1%. The concentrated copper is then recycled to the beginning of the process while the stripped slag is sold for use as an aggregate in a variety of construction applications.

Sulfur dioxide is an important byproduct of the smelting process. Sulfuric acid, used extensively in fertilizer products, is produced in three acid plants by combining sulfur dioxide with vanadium and cesium catalysts. The Huelva facility recovers 99.8% of all produced sulfur and is the second largest European producer of sulfuric acid. In addition to the sulfuric acid, weak acid produced in the plant is used to produce gypsum at a rate of 240 tons/day.
Figure 12 – Gross Flowsheet of Huelva Smelter
Las Cruces Open Pit Mine

The Las Cruces deposit is located in the Andalucia region of Spain, 20 km northwest of Sevilla. This high-grade copper deposit is currently ramping up into full production, while first production began in mid 2009.

| Location: | Spain |
| Ownership: | 70% |
| Type of mine: | open pit |
| Type of ore body: | volcanogenic massive sulphide deposit |
| Primary metal: | copper |
| End product: | copper cathode |
| Mining method: | open pit |
| Expected mine life: | 2009 – 2023 |
| Average reserve grades: | copper – 6.2% |
| Infrastructure: | well maintained all-weather paved roads provide excellent access to the site |
| Employees: | 215 |
| Contractors: | 1,076 |

Figure 13 – Inmet Mining’s Las Cruces Statistics

History

Rio Tinto Plc discovered the Las Cruces deposit in 1994, completing the first feasibility study in 1998. Mining rights were granted to the deposit in 2003 when MK Resources had a second feasibility study and series of environmental studies completed on the deposit. MK Resources subsequently sold a majority ownership of 70% to the now operator Inmet Mining. In early 2007 at the beginning of construction, the estimated capital cost of the project was €380 million which has since escalated to €504. Since that time, the mining development work and plant construction has been completed. Over the first quarter of 2010 throughputs were increased significantly and operating experience gained, that will prove valuable when full production is reached later this year.

Reserves and Geology

The Las Cruces deposit occurs on the eastern edge of the Iberian pyrite belt that stretches from southern Portugal to south central Spain. The massive sulphide orebody was deposited in a marine environment and later covered by up to 150m of calcareous mudstone creating a large volume of overburden. Post deposition, the deposit underwent secondary copper enrichment creating the mineralized area of interest.

The deposit generally trends east-west with a dip to the north of 30 to 35 degrees. The orebody extends 1000m along strike, 500m down dip, and is on average 35m thick. The orebody is not completely delineated at depth. Currently, the proven and probable reserves are 17.6 million tones of chalcopyrite.
and chalcocite at an average grade of 6.2% copper. This makes it one of the highest grade not yet mined copper deposits in the world.

Figure 14 – Las Cruces Long Section

Mining Operation
The Las Cruces mine is an open pit, truck and hydraulic shovel operation. Pre-strip of the large soft marl overburden zone using a free-digging method has been completed on the early pit phases. This sedimentary overburden zone of the pit is mined using 10m benches at an overall wall angle of 28°. This contrasts to the deeper, stronger ore zones which are mined in 5m benches using an overall wall angle of 45°. Using these smaller bench heights means that even with the unpredictable grades associated with the deposit, the need for highly selective mining will not likely be a concern over the life of the mine. Currently the mine life sits at 15 years with in pit backfilling beginning around year 9. The relatively high strip ratio of 12.7:1 is offset by the high grade copper in the deposit and a high ore recovery of 97%. As a result, Inmet hopes that this operation, when fully producing, will be one of the lowest cost producing copper mines in the world.

In May 2008 mining was suspended by the Spanish government over concerns with the open pit dewatering and re-injection system. It was determined that some extraction wells had to be relocated outside the mineralized zone to fully capture the water inflow. During the suspension, mining was stopped in mineralized zones while limited pre-strip continued in un-mineralized areas. After rectifying the situation the first copper cathode was produced in June 2009. Currently the mine has finished pre-
stripping the early phases of the deposit and is ramping up into full ore production. The outlook for 2010 is to increase production and reach the final goal of approximately 11 Mtpa. Problems with startup of the processing facility meant focus could be shifted from ore production to early pre-stripping of phase three of the pit.

The presence of 150m of clay overburden creates a unique challenge for the operation during the wetter winter season. When the haul roads get wet they become extremely slick preventing trucks from going up the ramp. This means that during any significant rain event the mine must shut down. Each safety bench is lined with a plastic cover and topped with soil and vegetation to prevent erosion of the pitwall from runoff. An aquifer located just above the orebody complicates the mining operation because it is a clean water aquifer that is important to the area and must be preserved. Because of past practices in the area, the Spanish government is very concerned about the dewatering of the mine and the health of the region.

Mineral Processing
A sulfide ore such as the Las Cruces deposit is typically recovered using a flotation circuit. However, because of problems with past tailings impoundments in the region, the Spanish government did not
allow Inmet to build the necessary tailings impoundment required for a flotation circuit. Instead a leach process was developed.

The processing at Las Cruces is done by a relatively new atmospheric ferric-leach method followed by more conventional solvent extraction electro-winning (SX/EW) technology. The SX/EW process is a common method of upgrading chalcocite rich ore and allows for the production of copper cathode on site. The first copper cathode was produced on June 3, 2009, with full production of 72 000 tpa copper cathode expected in 2011. Metallurgical recoveries are expected to average 91%.

Prior to leaching, the ore is crushed in three stages and ground in a ball mill. The ore is then leached with ferric sulfate, sulfuric acid and oxygen in agitated tanks. The ore passes through thickeners on its way to SX/EW where the copper is dissolved and subsequently recovered through electro-winning. Problems with the corrosion protection of the agitators and leach thickeners were encountered during the plant trial in 2009 and new stainless steel components were installed in early 2010. While troubleshooting these startup issues, the operation was able to stockpile more than 100 000 tonnes of plant feed.

The tails from this facility are stored in a plastic lined tails pile that will be completely sealed at the end of mine life. The Spanish government made this unique situation a requirement because of past environmental issues in the region regarding acid generation. Because the deposit is so high grade, and the new process technique is still being adjusted, the tailings contain a copper grade of approximately 1%, meaning reprocessing of the tails is a very real possibility in the future.
Almadén Mercury Mining Museum

Almadén, Spain has a long and storied mining history. Almadén, meaning “the mine” in Arabic, has been the site of cinnabar mines for over 2000 years, producing more mercury than any other region on the planet. It is still the largest known cinnabar deposit in the world.

Figure 16 – Almadén located 200km southwest of Madrid

Regional History

The region was first mined in the 3rd century BC becoming an important source of cinnabar, used as pigment by both the Arab and Roman empires. Between the 8th and 13th centuries AD the Moorish people extensively mined in the area resulting in a great number of Spanish mining terms being of Arabic origin. At this time the use of cinnabar had moved from simple dyes to medicine and alchemy. By the 12th century the underground mine was 450m deep and employed 1000 miners.

In the mid 13th century the area was conquered by Christians, and continued to produce high amounts of cinnabar under lease to private businessmen until the 17th century. The 1500s saw the discovery of large quantities of gold and silver in the Americas leading to a high demand for mercury for use in the amalgamation process of the precious metals. As a result, the Almadén mines were a great asset for Spain during the exploration years that followed. During this time a penal colony was established in the area and many prisoners served their sentences as laborers in the mines. It was thought that this was reasonable treatment for prisoners who had committed small crimes, but often the problems with mercury poisoning meant that this was indeed a harsh punishment.
In the 17th century production in the region began to fall as the deposit became depleted. In January 1755 a fire raged in the mine that lasted over two years taking many lives in the process. Charles III pushed to modernize the mining techniques at Almadén to once again make the region profitable and founded the Almadén mining school in 1777. This push for innovation and growth proved successful resulting in technical advancement that allowed increased production through the 18th and 19th centuries.

In 1916 a special body managed the mines that once again introduced new mining techniques. After the Spanish Civil War of the 1930s, the mines reached a maximum production of 82 000 jars of mercury per year each weighing 76 lbs. Through the last half of the 20th century mercury price fell and the mines closed in 2000. In total the region has produced an estimated 250 000 metric tonnes of mercury over the last 2000 years.

Current Activities and Projects
While mining is no longer taking place mercury is still being sold from the site. This is expected to continue until the end of 2010. Much work has been devoted to preserving the rich history of the region and maintaining the infrastructure. Today the site consists of museums, the underground mine, the metallurgical facilities, brick furnaces, and a series of old management and residential buildings. Two museums have been created; one dedicated to presenting the mining history of the region and the other to teaching visitors about the use, science and dangers of mercury.

Self guided tours are available through the surface facilities, while a guided tour takes visitors into the underground mine to show what mining was like in the 15th century. The tour was highly informative, really highlighting the changes in mining technique, and safety awareness through history. The dangers associated with mining cinnabar in such an environment, and the production and use of mercury are emphasized when one sees the region first hand.

In 2005 the European Union created the EU mercury strategy that restricted the sale of mercury containing products, imposed a ban on mercury exports starting in 2011, and created new rules for mercury storage. In hopes to find solutions to these challenges the Mersade-life project is currently underway at the Almadén site. This project aims to safely design and construct a useable prototype storage system that will result in zero mercury emissions after closure.

The project has a local focus specifically on the Almadén site and also a global focus aimed at developing universal storage solutions that can be implemented at other sites. The mercury situation at Almadén was evaluated and great attention has been paid with regards to emissions and control procedures at the site. The current storage materials and techniques were evaluated and the design of a new storage system is underway. Additionally, since any storage system will have a finite life, a development project focused on creating a process for the stabilization of mercury is underway. It is hoped that conclusions from this project will be used in the design of new storage facilities and will become an integral piece of the EU mercury management strategy.
University of Huelva
The University of Huelva, located in Huelva, Spain is a public Spanish institution dedicated to academic research activities. It is a relatively young institution created in 1993. As a public institution, it offers various degrees and diplomas adapted to the social-economic and cultural characteristics of Huelva and its province. Due to the history of mining in the area, along the River Tinto, the university offers a degree in Mining Engineering.

Currently, around 14,000 students and 700 teachers comprise the University of Huelva, which offers 33 degrees, 22 doctoral programs, and 104 research groups.

Location
The University is spread over four sites. The main and newest campus is El Carmen, to the north of the city where the Faculties of Experimental Sciences, Law, Humanities, Education Sciences, Labour Sciences, the School of Nursing and the School of Social Work can be found as well as state of the art computing facilities and the central library. Eventually the University hopes to have all university centres and services located on the brand new Campus de El Carmen. Currently however, the Faculty of Business Science is housed in a building of architectural merit next to the cathedral in the heart of the city centre and is known as La Merced. The Polytechnic is strategically located to the west at La Rabida, high on a hill overlooking the Tinto estuary and the city’s industrial areas where strong links have been formed with the University. The University General Registry and administrative centre is located in Cantero Cuadrado.

Mining and Mineral Processing Department
The Mining Engineering Program at the University of Huelva had an equal focus on mining and processing, similar to the program offered at UBC. A distinction between the two schools is that the University of Huelva seemed much more focused on research. Dr. Domingo Carvajal was our main contact at the university. He was an amazing help in organizing things for not only the school but the Rio Tinto Mining District and the smelter as well. He taught a project management course at the university which seemed similar to the feasibility course taken at UBC.

From the mining side, the department has a large focus on sustainability and environmental responsibility. Unlike Canada, there are not a lot of large scale mining operations in Spain, however, Spain does have a rich mining history. Therefore, students focus more heavily on reclamation and tailings treatment as there are more jobs in these areas.

With regards to processing, they do a lot of work on cements which was an application of processing that UBC does not consider. Furthermore, many of their students study metallurgy as the Atlantic Copper Smelting facility is located only minutes away from the school. The graduating class had the opportunity to visit the universities processing lab. It was learnt that the mining department at Huelva works very closely with the civil department specifically with regards to cements.
Huelva

Huelva is where Christopher Columbus made his preparation and departure for his first trip to discover America. Furthermore, Huelva is recognized as an ancient city of Europe according to the archaeological findings of Tartessos. There is a large presence from many historical cultures in Huelva including that of the Romans, Visigoths, Muslims, and British.

The province of Huelva is situated in the south-west corner of Spain. Huelva, the capital city of the province is located in a very important position nestled between the estuaries of the Rivers Tinto and Odiel. The city is a short drive away from the province’s spectacular 120-kilometre coastline of fine sandy beaches.
Technical University of Lisbon

The Technical University of Lisbon, or Universidade Técnica de Lisboa (UTL), was established in 1930 from the merger of four existing schools. Today, there are seven faculties: institutes of veterinary medicine, agricultural sciences, economics and business administration, engineering, social and political sciences, architecture and human kinetics. Despite being one of the largest Portuguese universities, the UTL has always adopted a decentralized organization model. Currently, around 19,000 undergraduate students and 3,500 postgraduate students attend this public university and some notable alumni include: Antonio Guterres (former prime minister of Portugal and current UN High Commissioner for Refugees), Bento de Jesus Caraça (influential antifascist resistent, mathematician and economist), and Jose Mourinho (current manager of Italian football team Internazionale Milano nicknamed “The Special One”).

School of Engineering

The School of Engineering, or Instituto Superior Técnico (IST), is the largest and most prestigious engineering faculty in Portugal. It was originally founded in 1911 before it was merged with other institutes to form the UTL. Historically, a significant number of engineers from IST were projected to enter into Portugal’s numerous major engineering works, promoted by the second Director of IST Duarte Pascheco, who was once the Minister of Public Works. Today, IST provides various engineering programs in undergraduate, master and doctoral degrees. Amongst the 11 engineering departments, the department of Mining and Geological Engineering aims to train professionals with thorough knowledge in mining engineering, geosciences and in engineering sciences. An interesting fact about the IST is that they benefit from an IBM supercomputer, built in 2007, which is one of the most powerful in Portugal.
Mining and Geological Engineering Department

At UTL mining and geological engineering are merged as one department. This department does also include mineral processing. After listening to a presentation from the department head the class got the chance to tour their processing lab and their mineral collection. Due to the fact that there are few mines and processing plants in Portugal, the school has started to focus on the processing of recyclables. This has never been researched at the UBC mining department, so it was very interesting to learn about the technologies and potential uses that they were studying. Some professors from the university explained to us that separating recyclables including metals, plastics, and glasses, is very similar to separating minerals. The university is currently looking at ways to separate different types of plastics from one another. The class also had the chance to view the school's very impressive mineral collection. The department has a much heavier focus on geology compared to the mining department at UBC so this difference was interesting to see.