

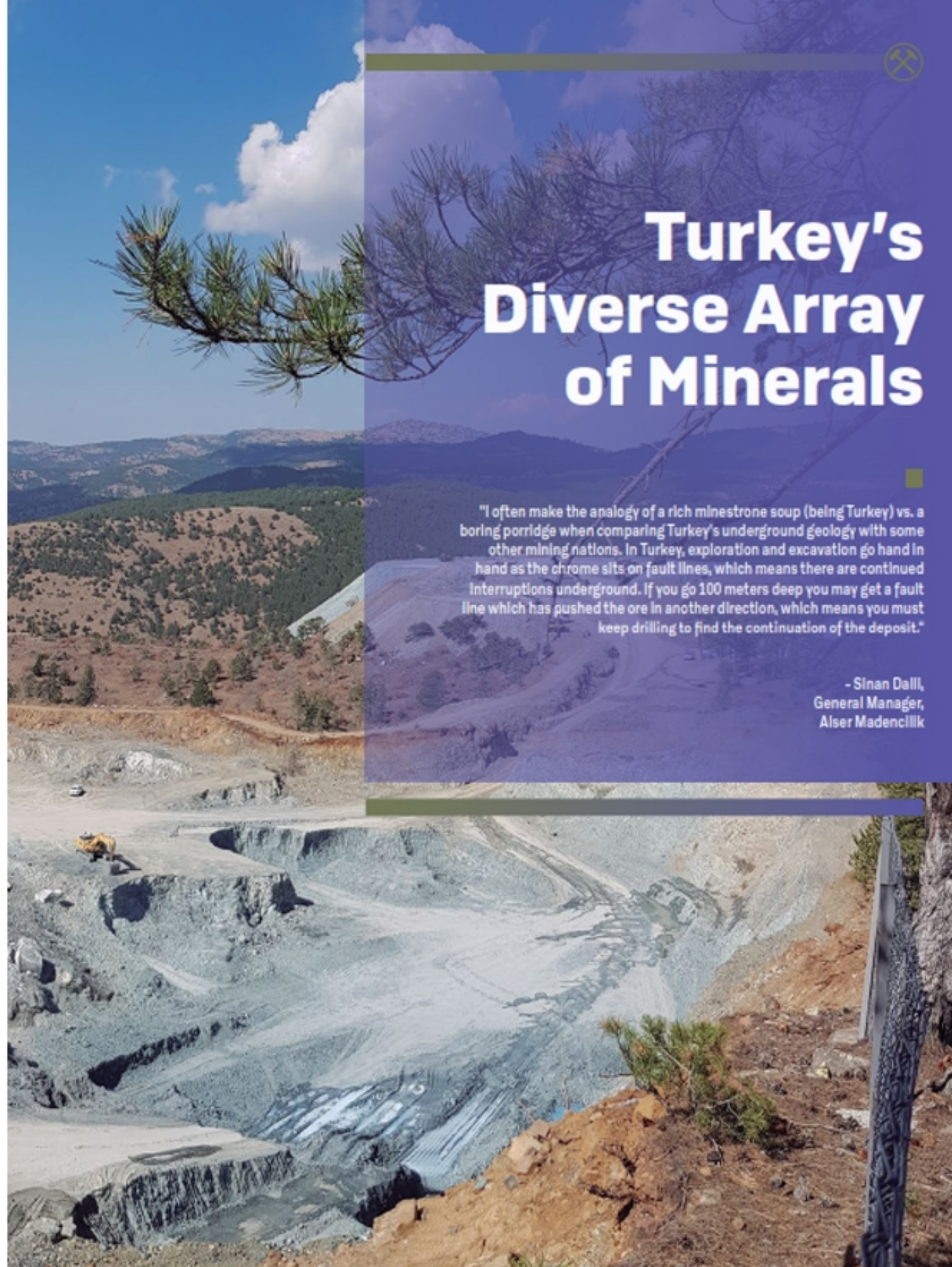




# Turkey's Diverse Array of Minerals

"I often make the analogy of a rich minestrone soup (being Turkey) vs. a boring porridge when comparing Turkey's underground geology with some other mining nations. In Turkey, exploration and excavation go hand in hand as the chrome sits on fault lines, which means there are continued interruptions underground. If you go 100 meters deep you may get a fault line which has pushed the ore in another direction, which means you must keep drilling to find the continuation of the deposit."

- Sinan Dallı,  
General Manager,  
Alser Madencilik



# Small but Packs a Punch

Turkey's high-grade deposits across diverse minerals

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The world did not give Turkey a bounty of any one or two minerals, it is no Chile with its copper, for example, but it did give it an incredible diversity of minerals. While gold may steal the limelight, and coal is assuming more importance as Turkey aims to become more energy self-sufficient, the country has a thriving industry in a plethora of other minerals. Not only does Turkey have significant mining activities in more standard commodities such as copper, zinc and nickel, but it also is a world leader, and strong export player, in less renowned minerals like boron, trona, magnesium, and chromite.

A common pattern emerges across Turkey: other than for gold, it has no projects with large mineral reserves (by international standards) but instead small projects with often very high-grade deposits. "Turkey is located on the Alpine-Himalayan belt, a quite active tectonic zone. The location of the country resulted in the formation of many different medium and small sized ore deposits that usually have complex structures," explained T. Kemal Türeli, mineralogist and petrographer of Argetest Mineral Processing, R&D and Analysis Services.

## High grade zinc for global markets

Turkey's zinc potential is a good example of this phenomenon. Through a 50:50 joint

venture with Akmetal AS, Pasinex produces direct shipping ore at its Pinargozu mine in the Adana province, southern Turkey. It is the highest-grade zinc mine in the world. "We have three different ore bodies: oxide, sulfide and mixed. The oxide ore body is on average 35% Zn, which is very high," explained K. Soner Koldas, country director, Pasinex. Yet, with a predicted 200,000 mt reserve, as per the mineral resource estimate of June 2017, the deposit is small. By comparison, the top four producing zinc mines in 2015 all mined more zinc than the entirety of Pinargozu's total deposit.

In another example, Meyra, part of the Delta Group conglomerate, has a proven 4 million mt lead and zinc deposit in the Bursa province, although it believes it could be much bigger and therefore very significant for Turkey.

As is so often the case in Turkey, miners must go to great depths to recover Turkey's zinc reserves. Esan Eczacıbaşı opened the Balya Balıkesir zinc and lead plant in 2009, which has a total gallery length of 30,000 meters and is 700 meters deep, making it the deepest lead and zinc mine in Turkey. Despite this, the rise of the zinc price in recent years (although it has been declining in the last three quarters) has seen more interest in mining the commodity in Turkey, especially as chrome prices have faltered. Dedeman Mining, which began life producing high grade carbonate zinc and lead

ore from Kayseri and exporting it to world markets, plans to invest more in both lead and zinc production, eventually producing zinc ingots.

## Chrome me a river: prices cause headaches

Turkey is much better known for its chromium production, which helps feed China's voracious demand for stainless steel, than for zinc or any other base metals. Here the pattern is not quite as neat, and that is good news for Turkey: Turkey not only has high-grade chromium, it has relatively large quantities of it. In fact, it is the fourth largest chromium producer in the world, with an annual production of around 2,100 mt in 2017. By comparison, South Africa's chromium production was 15,000 mt in 2017. However, while South Africa has huge reserves and big mines, its chromium has a lower chrome to iron ore ratio compared to Turkey's.

There is still the sense that Turkey's mineral endowment in chrome makes it a smaller but tastier fish. Again, this is due to Turkey's geology. "In South Africa, Australia or Canada there are large basins of deposits for different types of metallic ores and once you have done the drilling and defined reserves with 3D measurements, it becomes only a matter of excavation. I often make

the analogy of a rich minestrone soup (being Turkey) vs. a boring porridge when comparing Turkey's underground geology with some other mining nations. In Turkey, exploration and excavation go hand in hand as the chrome sits on fault lines, which means there are continued interruptions underground," regaled Sinan Dalli, general manager, Alser Madencilik.

Alser, also part of the Delta Group, has discovered the largest lumpy chrome ore deposit in Turkey in the last 20 years. With the mine producing chrome ore of between 42% and 50%, it is particularly significant for Turkey because it was found in the west of the country where the conventional wisdom had been that the ore was of lower grade. "We have only drilled 20% of the prospection area so there is huge potential. The deposit can become a replica of the Elazığ area in eastern Turkey," continued Dalli.

Eti Krom, which Turkish conglomerate Yildirim Group purchased in 2004, is the world's biggest hard lumpy marketable chrome ore producer and has pumped much

investment into Turkey's chrome and ferrochrome production. Yilmaden, Yildirim's mining and metals holding company, now operates in multiple countries including Russia, Kazakhstan, Sweden, the US and Colombia. "Our Turkish business has continued to flourish, and we are now thinking about increasing our production volumes at Eti Krom's mines," remarked Alp Malazgirt, CEO, Yilmaden Holding. "This year we are carrying out pit optimization at Aladağ near Adana where there are a lot of chrome reserves. This involves much computer modeling and simulation and, based on this, we will be able to start planning the mine. It will require millions of dollars of investment in Turkey."

Overall, the market has been far from rosy for chrome producers in recent years due to volatile global prices and this has stalled further investments. Lower chrome price, caused by less demand from China, has induced some Turkish producers to downplay their high-grade chrome assets. Alser purchases lower grade material from other mines in the region and blends them with its

own production to achieve a better volume/price equilibrium. Meanwhile, Marmotek Madencilik, which produces high grade lumpy and concentrate chrome ore at its Denizli/Beyazgac site, is updating its concentrate facility to produce low siliceous and fine grain chromite which is suitable for the ceramics and glass industry, and foundry sand.

Turkey is also making strides to vertically integrate the supply chain to produce more ferrochrome, following in the footsteps of other top chrome producers South Africa and Kazakhstan. Currently, Turkey has two ferrochrome facilities, one in Elazığ and another in Antalya. "These facilities are strongly affected by electricity prices, which is why the government is prioritizing coal power plants," said Baris Sokmen, deputy general manager of chrome producer Madkim.

Dedeman Mining plans to up Turkey's game in ferrochrome production. "We would like to increase the volume of our chrome production from 50,000 mt/y to 150,000 mt/y. We plan to invest in drilling

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Alser Madencilik is amongst the top 3 mining companies in Turkey producing lumpy chrome ore from our underground galleries as well as open cast operations. We have various types of grades beginning from 32% up to 48% at our Tolenni/Burdur pits. We are able to enrich our ROM and produce tailor-made solution thanks to our sorting and jigging facilities. We are able to offer different sizing options ranging from lumps 32%-48% (25mm-300 mm), jigs 34%-45% (4mm-25mm) and fines/concentrates 42%-50% (0mm-10mm). All of our products have high Cr-Fe and MgO/Al<sub>2</sub>O<sub>3</sub> ratios. Alser Madencilik continues to invest at full throttle in order to achieve an annual 100,000 tons of lumpy and concentrates. (info@alsermaden.com)

In addition, Delta Star, the group trading arm is a well-established household name in supplying all kinds of chrome ore globally, with a proven track-record to meet its clients specific demands. (trading@deltastar.com.tr)

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**Delta**

Image courtesy of Alper Madencilik



between 800 meters and 1,000 meters in depth to find new reserves and increase our production. As a final stage our target is to produce ferrochrome," said Yunus Soysal, technical group director, Dedeman Mining.

#### Turkey's niche minerals

Turkey also holds rich deposits in minerals used in niche applications and which command a high price on global markets. The unsung hero of Turkey's mining industry is boron - Turkey is the largest producer of refined boron products globally. With 3.3 billion tonnes of reserves, representing 73% of the global total, it also has the largest boron deposits in the world. Boron is mostly used in glass (such as insulation type fiberglass, textile-type fiberglass, borosilicate glass and glass panels), ceram-

ics, agricultural and detergent-cleaning industries. Looming large in this niche is state-owned Eti Maden, which strikingly met 57% of the world's boron demands in 2017. The largest deposits are in Eskişehir-Kırka, Kütahya-Emet, Bursa-Kestelek and Balıkesir-Bigadiç. Eti Maden and the MTA carried out a major exploration program as part of the Boron Master Plan between 2002-2013, increasing reserves by 1.3 billion tonnes. More exploration is ongoing, particularly to determine the potential of the Bigadiç basin.

Refined boron products promise to be a boon for Turkey's economy going forward. In June 2018, Eti Maden and China's Dalian Jinma, a world leader in boron technology, signed a MoU to develop a high-tech boron carbide production facility in Balıkesir, western Turkey. Boron carbide is highly sought after in the defense industry, being

used in helicopters, light armored vehicles and bulletproof vests due to its low density and high heat resistance. Speaking at the award ceremony of the MoU, former Energy and Natural Resources Minister Berat Albayrak (now Minister of Treasury and Finance) remarked: "Boron carbide is worth 2,000 times more than regular boron. A tonne of boron is worth US\$200, but once it is processed into a high-tech product, the value increases to nearly US\$400,000."

Turkey also aims to produce boron nitride, which currently sells at around US\$50,000 per tonne and could be used in atom reactors, aircraft and rocket engines due to its high-temperature resistance and high electrical insulation properties.

Another niche area where Turkey makes an impact on international commodity markets is magnesite and derivative magnesia. Most magnesia producers in Turkey focus on deadburned magnesia, which is used in refractory applications for basic bricks and granular refractories and is the most suitable heat containment material for high temperature processes in the steel industry. Caustic calcined magnesia (CCM) is also found in Turkey, a product more used in agricultural and industrial applications. Akdeniz Mineral Resources is the largest exporter of CCM from Turkey and one of the few producers of natural magnesia, which makes its material very pure with rates at 98%. "Mainly we produce CCM for hydro-metallurgy, and besides that, electro-fused magnesia (EFM), catalysts, water treatment, agriculture and animal feed," explained Akin Bayazit, sales and marketing manager of Akdeniz Mineral Resources. "We export almost 85% of our products. Our main export market is Africa and we also send products to United States and Central Europe, as well as small amounts to Asia and Oceania."

Turkey has deep potential across a staggering array of minerals, and likely there are more highly rich, if not huge, treasures to be found beneath its surface, for example in rare earths that will be in high demand in the world economy of the future. It is a geologist's dream, or nightmare, depending on one's perspective, which makes it vital that Turkey attracts the best expertise available to make the most of its mineral wealth. ■



## Sinan Dalli

General Manager  
**ALSER MADENCILIK**



Most deposits have been exploited using surface mining but this is extremely risky because once the surface level is excavated, all the data about a potentially much larger deposit is lost and, as the cost of production rises, developers lose interest but ten years later no one knows mining took place there.



### What have been some of the milestones since Delta Group acquired Alser in 2013?

Delta is new to the mining world and entered the industry in 2013. Chrome is our first area of focus in mining but we have also started to look at lead, zinc, gold and copper. Regarding our chrome deposit we spent our initial capital on exploration drilling. So far, we have done about 25,000 meters of drilling, which is substantial in an area of 890 hectares. We have discovered the largest lumpy chrome ore deposit in Turkey for the last 20 years. This is particularly significant because this part of Turkey was regarded to have lower grade chrome. We have only drilled 20% of the prospection area so there is huge potential. The deposit can become a replica of the Elazığ area in eastern Turkey. We have a couple of galleries where we immediately started production and have generated cash flow.

### Where does Alser's chrome production fit into the chrome value chain?

We are an independent player that produces for trading purposes. Alser has a diversified base of clients in locations like China, the Middle East, the UK, Germany and Sweden. Our products are of premium quality. However, chrome prices are volatile so we also acquire lower grade material from other mines in the region and have a blending operation to achieve a better volume/price equilibrium. We are now the largest trading company in western Turkey. Currently, we produce about 6,000 mt/y to 8,000 mt/y of lumpy chrome ore ranging from 42% to 50% grade from our own mine, and 15,000 mt/y of trade material from third party providers.

### Turkey has higher grade chrome compared to other major produces like South Africa. What makes the geology in Turkey special?

The geology in Turkey is very young and it is still evolving, as such it has a fragmented geology. In South Africa, Australia or Canada there are large basins of deposits for different types of metallic ores and once you have done the drilling and defined reserves with 3D measurements, it becomes only a matter of excavation. I often make the analogy of a rich minestrone soup (being Turkey) vs. a boring porridge when comparing Turkey's underground geology with some other mining nations. In Turkey, exploration and excavation go hand in hand as the chrome sits on fault lines, which means there are continued interruptions underground. As a result, drilling requirements are ongoing throughout the project life while the ore deposits are close to the surface and the grades are higher due to it being a volcanic zone.

### What is Alser's timeline for investments to increase production and reserves?

When we started we had the goal of 100,000 mt/y of chrome sales within three years and we have achieved that. Now we plan 150,000 mt/y of production from our own mine next year. We will spend most capex in exploration and acquiring new licenses. Alser is pursuing a 'hub mining' strategy where we leverage our existing people and equipment and acquire licenses which have synergies to reduce our cost of production. We will probably invest \$50 million to \$100 million in new licenses over the next three years and our capex spending for infrastructure and equipment will be \$15 million to \$20 million. Additionally, we need to do 100,000 meters of drilling over the next four years, costing about US\$10 million.

### Why has there not been more chrome production in western Turkey already and what is your outlook for mining in Turkey generally?

Historically, most of the drilling activity in Turkey has been done to discover coal rather than metallic deposits. Chrome deposits have mostly been found sporadically, such as when a farmer brings a piece of material to a municipality office. Most deposits have been exploited using surface mining but this is extremely risky because once the surface level is excavated, all the data about a potentially much larger deposit is lost and, as the cost of production rises, developers lose interest but ten years later no one knows mining took place there. Therefore, there needs to be a joint effort by government and private industry to do longer and deeper drilling with long-term planning. ■

## Yunus Soysal

Technical Group Director  
DEDEMAN MINING



### What have been Dedeman's major accomplishments since it established chrome mining operations?

The first mining operations in Turkey were conducted by Dedeman. The late Mr. Kemal Dedeman started the mining operations 1947 in Pınarbaşı, Kayseri. His first mine produced chrome. Later he added three more mines and increased production from 3,000 mt/y to up to 150,000 mt/y. In the 1970s these mines were still ongoing, although the reserves started to be exhausted. Over the last 71 years, four to 5 million mt has been exported to global markets.

Our products are only found in specific areas of the world, as part of the special ferrochromium group. Right after it was founded, Dedeman also started to produce high grade carbonate zinc and lead ore from Kayseri, in the Aladağlar area. We were one of the first companies conducting exploration and after reserves started diminishing in Kayseri, we started to expand to other parts of Turkey. By 2013 we became one of the top three chrome miners in Turkey. Our main advantage is definitively our high grade minerals.

### How does Dedeman plan to increase its chrome, zinc and lead production?

Due to market conditions in recent years, we decreased our chrome production and made more investments into our lead and zinc business, increasing our volume in these minerals. So, we went from producing 5,000 mt/y lead concentrate, to around 20,000 mt/y. We plan to increase our production by 30,000 mt/y to 50,000 mt/y in the next three to four years.

Recently, we started drilling studies once again for chrome. For example, we plan to invest US\$22 million in Adana and plan to increase production by 100,000 mt/y in 2019 and perhaps by 150,000 mt/y to 200,000 mt/y in the next two to three years.

### What are Dedeman's core objectives in the years to come?

We would like to increase our lead and zinc production, but our ultimate goal is to invest in end products like zinc ingots. Also, we would like to increase our chrome production. As a final stage, our target is to produce ferrochrome. ■

## Sumeyra Esgun

Founding Partner and General Manager  
MEYRA



### Could you give us the main highlights of Meyra's lead and zinc project in Bursa?

We acquired the Bursa project in 2013, obtained the permissions within 15 months and then started to produce run-of-mine (ROM) sulfide lead and zinc ore which was sold to nearby flotation plants. In 2017 we drilled nine holes and cut ore in six drills and this year we plan to drill 2,000 meters. We have proven the deposit has 4 million mt of lead and zinc and we believe it is potentially 65 million to 80 million mt in size. Now we are awaiting permission for a flotation plant and have prepared a US\$6 million to US\$7 million capex, with a US\$4 million investment into the plant itself.

Other advantages of the deposit are that it is near Istanbul and the port of Gemlik, and the mineralization of the ore is very simple, it can float very easily, leaving gangue minerals at a rate of 300 microns. In early 2018 Delta acquired 60% of the shares of Meyra which is very useful given the potentially huge size of the project and Delta's high capital capacity.

### Do you expect zinc fundamentals to remain favorable going forward?

After we receive permission for the flotation plant, we will establish a plant and aim to

sell to lead and zinc smelters internationally, particularly in China. Galvanization rates are increasing and zinc is being used more for health purposes like Alzheimer's treatment.

### What is your outlook for base metals in Turkey?

Turkey has very complex geology but there are enormous opportunities in base metals, especially for mid-sized companies. Therefore, foreign investment will likely increase in this area. Although, investment has slowed down recently due to the elections. There was a large investment in a copper mine and flotation plant in Kastamonu.

### What challenges are there to operating in Turkey?

Engineering is not regarded highly enough in Turkey and it is very difficult to find mining talent, especially drilling professionals. The supplier base for drilling is not advanced enough and there needs to be more foreign players in the market that can drill to international, such as JORC, standards. Also, we are waiting for more operational legislation from the government. Currently we do not understand the mining regime completely as it is not clear. This reflects how Turkey is still new to mining. ■