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THE LONG PULL

Podcast Notes: Tomasz Nadrowski, Amvest Terraden

By Brandon Beylo

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Tomasz Nadrowski is a CFA charterholder with over 25 years in metals and mining, spanning operational roles at the former world's largest gold company to equity investing across precious metals, bulks, base metals, and critical minerals.

Since 2022, he has led the Terraden Critical Minerals Fund at Amvest, which focuses exclusively on smaller, strategically vital materials—rare earths, battery metals, and specialty metals—**outside the Chinese value chain.** He is also the author of *Mineral War*, a book chronicling how China monopolized critical mineral supply chains and what the West must do to rebuild them.

Executive Summary

This episode is a masterclass in critical minerals investing from one of the few fund managers globally who devotes **100% of their portfolio to the space**. Tomasz describes the geopolitical architecture behind China's mineral dominance, why the West's response is structurally handicapped, and how he builds a portfolio designed to profit from the ongoing bifurcation of global supply chains.

The conversation spans three major areas:

1. **China's Monopoly Game:** China's deliberate, multi-decade strategy to monopolize refining and processing of critical minerals.
2. **The West's Structural Challenges:** The structural challenges facing Western nations as they try to rebuild those supply chains.
3. **Tomasz's Investment Process:** How Tomasz actually invests—from defining criticality to managing duration risk to valuing junior mining companies in metals most investors have never heard of.

What I love about Tomasz is his ability to connect high-level geopolitics to granular, actionable investment decisions. As much as I love big, macro topics (more of Alex's speed), my focus is on individual stocks.

Let's dive in!

Part I: China's Mineral Stranglehold

The 2010 Rare Earth Crisis vs. Today: Why This Time Is Different

In 2010, China's system was fragmented enough that smuggling undermined the Japanese embargo. Japan was, and still is, the largest consumer of rare earths and the second-largest producer of permanent magnets (the most important downstream product). Prices spiked 10x or more, but collapsed almost immediately as private operators found ways to move material out of the country.

> *"The prices skyrocketed following the embargo... At that time, China could not prevent smuggling out of the country. These prices represented sufficient incentive for private operators to try and somewhat bypass the restrictions."*

Yet even after 16 years of concerted Japanese diversification, Japan **still imports roughly 30% of its magnets and 60–65% of its rare earth oxides from China.** Tomasz uses this as a sobering illustration: unwinding these dependencies is extraordinarily difficult.

Today, China has sealed much of the "leakage" within the rare earth market. Over the past 15 years, Beijing has consolidated the rare earth industry into essentially three state-controlled enterprises: China Northern Rare Earth, China Southern Rare Earth, and Shanghai Resources (Shenghe).

China accomplished this by encouraging acquisitions between state-owned enterprises, absorbing private operators through domestic production quotas, and centralizing control over the most critical node in the value chain: oxide separation and refining.

> *"The Chinese system has become much more sophisticated... If China today says you're not allowed to export any product to Japan, or anywhere else, chances are the system will leak much less than it did in 2010."*

Think of it like a giant bathtub. Without the leakage, China can shut off the water and stop countries from "filling the tub" with critical minerals and rare earths. Something they couldn't do two decades ago.

> *"It's in the interest of the Chinese Communist Party that this reindustrialization in the West does not proceed. And of course, to reindustrialize, you need to have a certain price incentive."*

Geo-Economic Monopoly

One of the most valuable conceptual frameworks Tomasz offers is the distinction between a **textbook monopoly** (maximizing marginal revenue against marginal cost) and a **geo-economic monopoly** (using economic levers to achieve strategic, often non-economic, goals). China's mineral strategy falls squarely in the latter category.

The best illustration is graphite.

A dominant Chinese producer allows *just enough* material to flow out to keep the battery anode value chain under Chinese control. Prices are kept at or below the cost of production, functioning as strategic dumping to prevent the rebuilding of Western supply chains. Tomasz explains:

> *"It's not about earning maximum marginal revenue about marginal cost, if you remember that graph from school. It's about geo-economics. It's about using these economic levers to achieve strategic goals that are not necessarily economic."*

There is one producer, and everyone else is dependent on it. Here's the other important part: the traditional NPV-driven investment framework breaks down when the counterparty is a state actor optimizing for strategic leverage rather than profit.

The Smelting and Refining Gap: The Numbers That Matter

Tomasz also revealed how "hollowed-out" the West's smelting and refining capacity is versus China:

- **Aluminum smelters:** 89 in China vs. 4 in the United States
- **Copper smelters/refineries:** 68 in China vs. 2 in the United States
- **Zinc smelters:** 48 in China vs. 1 in the United States
- **Nickel refineries:** Not a single one in the United States

This is the result of **30 years of NPV-driven globalization and playing the short game.**

Western companies optimized for shareholder returns and offshored processing. China optimized for the next 3-5 decades.

China in Africa: The Two-Lever Strategy

Tomasz explained China's relations with Africa starting with Zhou Enlai in 1963, when China first attempted to muscle into Africa. Not against the United States or Europe, but against the Soviet Union.

China successfully positioned itself as part of what we now call the Global South. This ideological campaign took about a decade, and China won it by building early infrastructure projects like the Tazara railway line from Zambia through Tanzania, long before Deng Xiaoping's economic reforms.

> ***"This is not a recent phenomenon. I have to go back to Zhou Enlai in 1963 and the first attempts by China to muscle itself into Africa, not against the United States or Europe, but against the USSR."***

Modern Chinese engagement in African mining operates through two complementary levers:

The Top-Down Lever: Government-to-government infrastructure deals bundled with resource extraction agreements. Critically, the infrastructure projects and the EPC/EPCM construction of the mines themselves are all performed by Chinese state-owned enterprises whose accounts are opaque (on purpose!).

> ***"They're basically run on revenue rather than profit... It's just not possible to do this [for Western companies]."***

The Bottom-Up Lever: Private Chinese operators won't let radioactive waste near a critical water supply get in the way of a good time. Nigeria is a prime example: Chinese companies export radioactive monazite (a rare earth mineral) under different names to bypass restrictions, something no Western junior could or would do within legitimate regulatory frameworks.

> *"This is how lithium or rare earths have been not found but exploited in the last couple of years by Chinese companies... in places which were completely not on the Western radar screen."*

Tomasz used the DRC and cobalt as a case study on China's relationship with Africa.

The Cobalt Case Study: DRC

Six years ago, Freeport-McMoRan tried to sell its DRC copper-cobalt assets because they didn't fit the portfolio, and the Chinese were the only buyers. Today, roughly 80% of cobalt production in the DRC is controlled by Chinese companies.

The dominant Chinese state-owned company in the DRC chose to overproduce and stockpile cobalt even when exports were restricted, leaving a massive overhang over the market. Combined with growing Chinese-controlled cobalt production in Indonesia, this drove prices to levels at which the DRC's royalty revenues became insignificant—effectively wasting a finite national resource at fire-sale prices.

> *"You're essentially wasting a national treasure... The reason why DRC is turning to US interests is that they realized the royalties they receive on a finite wasting asset are insufficient at the current prices."*

The Reversal of Capital Flows

The capital flows between China and Africa have now reversed. Since late 2024, Africa has been paying back more to China than China is investing in Africa.

Here's the catch.

This creates a structural trap: Africa would need a trade surplus with China to generate the renminbi to service these debts. But Africa's trade deficit with China has skyrocketed, particularly in 2025, as Chinese manufacturers redirected exports away from U.S. tariffs and flooded African markets with cheap goods. The trade account deficit widened dramatically, compounding the debt burden.

The Illusion of African Processing

African leaders have been clamoring at forums like the Indaba mining conference for Western and Chinese companies to build downstream processing on the continent. Tomasz isn't optimistic about it.

> ***"This is not going to work because the structure of the Western mining industry is such that for a majority of these commodities... the industry is dominated by small junior miners. Those junior miners have absolutely no capacity, no balance sheet to attract massive spending on refining or smelting."***

The only entities with sufficient balance sheet capacity to build processing in Africa are Chinese state-owned enterprises, which deepens the very dependency Africa is trying to escape.

The parallel to Middle East oil is instructive: OPEC nations eventually gained leverage through cartel formation, but Africa's critical minerals are not fungible commodities controlled by a handful of producer states. The refining bottleneck sits entirely outside Africa's control.

I wrote more about the Africa/Middle East comparison here.

The Export Control Escalation Timeline

Tomasz then traced the escalation of Chinese mineral weaponization from its legal architecture to present-day enforcement:

- **October 2020:** China passes the Export Control Law, with extraterritorial application provisions. This was the signal Tomasz used to conceptualize the fund.
- **2022–2023:** Consolidation of the rare earth industry into three major state-controlled entities is effectively complete.
- **Summer 2023:** First metal-specific restrictions target gallium and germanium.
- **2024:** Graphite restrictions and expansion of controlled materials lists.
- **February 2025:** New restriction preventing Chinese companies from purchasing mixed rare earth carbonate from Western companies unless they co-own the entity. This controls both inflows and outflows.

Each step tightens the grip until China doesn't *just* control what comes out, but what goes in, who buys it, and at what price. It is supply chain warfare.

After setting the historical and contextual background for Tomasz's fund's investment landscape, he spent the rest of the podcast dissecting his Investment Framework, Idea-generation Process, and Portfolio Management skills.

Part II: The Amvest Investment Framework

Next, we explore Tomasz's investment framework, which hinges on three main steps:

1. Defining "Criticality" by metal.
2. Duration management and defining the path towards first cash flows.
3. Comparative Analysis (against the opportunity set) and due diligence.

Step 1: Defining Criticality

Tomasz's process starts with the metals. The fund ranks each element along three dimensions of criticality across roughly 20 different commodities (metals, metalloids, and potentially noble gases):

Structural Demand: *Is there a secular shift driving consumption?* AI and data center buildout represent what Tomasz calls a "potential Kondratiev wave" … a multi-decade technology-driven demand cycle. The question is which specific materials benefit from the physical hardware requirements (not just the software narrative). Smaller, niche materials used in **multilayer ceramic capacitors**, **semiconductor substrates**, or **power electronics components** matter here.

Supply Concentration: *How concentrated is current production?* China controls 99.9% of gallium production. The fund only invests outside the Chinese value chain, betting on the scarcity premium that emerges from bifurcation. This means many opportunities lie in newer, less proven companies, since the **existing mining industry was built to supply China.**

Substitution Risk: *Can this material be replaced?* This requires following technological developments down to the component level—understanding the specific chemistry of a

ceramic capacitor to know whether demand for a given element is structural or at risk of substitution. The criticality ranking drops if substitution is feasible and imminent

Step 2: Duration Management

Once criticality is defined, the fund applies a "fixed-income concept" to mining equity: **duration**. The key question is: *how many years stand between today and cash generation from a specific project?*

This matters for two reasons:

1. In a higher-interest-rate environment, longer-duration projects are penalized more by the market. Capital that must wait 10–12 years for a multibillion-dollar project to reach production suffers substantial time-value erosion.
2. The critical minerals market will likely consolidate into oligopolistic structures within 5–10 years. When the West successfully rebuilds supply chains for a given metal, it won't need 100 producers, but a handful. Being invested in projects that cross the finish line in the first cohort is the entire game. The 15th project in line may never get built.

> ***"You'll have to be invested in things that will get there in the first bunch... not a pharaonic multibillion-dollar project that would look like the best thing underground but is going to take 10 or 12 years to development."***

Step 3: Comparative Analysis and Due Diligence

With a target metal selected and duration parameters set, the process becomes more recognizable to traditional mining investors, with a few nuances.

For well-known metals like tungsten, the universe of producing Western companies is small (currently two or three), making comparisons straightforward. For niche metals like cesium or tellurium, the challenge is **building an internal database from a much smaller set of comparables.** Tomasz is emphatic: **don't enter specialty metals without a database**.

The geological analysis goes deep. Take tungsten as an example. Mineralization could be hosted in a porphyry, skarn, or greisen deposit. Each has different implications for delineation, mining methods, and metallurgical recovery.

> ***"Every single asset we're looking at is different... That's the distinction between us and the oil and gas folks. They have different sizes and depth, but roughly it's the same thing. Send the seismic wave, you more or less know what's there. We still don't have that magic thing. We haven't had our fracking, horizontal drilling moment technologically in mining."***

Here's how Tomasz compares companies. He finds analogs for the **deposit type**, goes **granular to ensure apples-to-apples** comparison, then engages in dialogue with the **technical people** on the asset.

By that point, he can surface gaps in his knowledge and reduce uncertainty to the point where he can adjust the project's risk discount.

A critical question Tomasz asks that most junior mining investors skip: *Who are you going to sell it to*? Here's his explanation:

> ***"Let's assume you're successful... You have a chance, metallurgy allowing, to take it off the ground. Who are you going to sell it to? In the West, we have that problem. There's just not many parties that could buy this product."***

Remember, Tomasz invests *outside* Chinese supply chains. Which means he doesn't invest in mining companies that sell to China. This significantly reduces his investable universe. But it's an important distinction because if Tomasz is right, if we're heading for a bifurcated world where the West only makes and buys from the West, and China cuts off everyone else, mining companies *must* "Sell Local."

Byproduct Opportunities and Cross-Metal Optionality

Some of the most interesting investment angles emerge from byproduct relationships. Several critical metals are not mined as primary products but are extracted as byproducts from larger commodity streams:

- **Tellurium** from electrolytic copper refining (potential from Korea Zinc's new Tennessee complex)
- **Indium** is a byproduct of zinc processing
- **Germanium** from zinc refining
- **Gallium** from alumina refining (Alcoa in Australia, Rio Tinto in Quebec)
- **Antimony** as a byproduct of gold mining—once considered a "pesky deleterious element," now a strategic material in its own right

For example, a gold-antimony project is easier to finance because banks can underwrite it on the gold component, **while investors get the antimony upside for free.**

This reminds me of the Apollo Minerals (AON.ASX) thesis. Buy the company for the gold and get the highest-grade historical tungsten mine for free.

Part III: Valuation and Risk Adjustment

Strategic Pricing as a Starting Point

Tomasz frames the valuation question with a crucial distinction:

> ***"Strategic pricing is the starting point, not the end of the work."***

For a metal like tungsten, the historical normalized MTU price is a baseline. But the relevant question is whether to assume a structural premium for non-Chinese supply over the next 3–5 years. If yes, plugging that premium into cash flow models makes even lower-grade projects significantly more valuable than historical pricing would suggest.

Risk Adjustment in the Numerator, Not the Denominator

Perhaps the most technically important insight in the podcast is Tomasz's approach to **risk adjustment in DCF models.** Most analysts adjust for project risk by **changing the discount rate** (the denominator). Tomasz argues this is fundamentally wrong.

His example: If Newmont has a mine in Peru and locals block access, cash flow goes to zero for a period. Nothing has changed about Newmont's cost of capital. What has changed is the cash flow itself. The correct adjustment is in the numerator: probability-weighting the cash flows to reflect the likelihood and duration of disruption.

> *"Most people get the risk adjustment wrong. It should not be done in the denominator; it should be done in the numerator... Nothing's happening to the cost of capital of the company, but a lot is happening to the cash flow."*

It forces the analyst to be explicit about what they think will actually happen to the project rather than hiding uncertainty behind an inflated discount rate. And the bias should be toward conservatism.

> *"As my mentor in South Africa used to say: in mining, jam doesn't happen very often, but shit happens a lot. So you have to factor it in."*

My rebuttal is that it's difficult to predict *when* a company will face challenges. Like, I have no idea when IDR will encounter a lower-grade vein that they'll have to mine, but it'll happen eventually. I just can't put that into my "Year 2028" in the DCF model.

The Information Asymmetry Challenge

Tomasz identifies two layers of information challenge unique to critical minerals:

1. **Disclosure Quality:** U.S. companies in the critical minerals space often have lower-quality disclosure than their Australian, UK, or Canadian counterparts. The traditional mining jurisdictions have more rigorous reporting standards (JORC, NI 43-101), and the institutional culture around technical disclosure is more mature.
2. **Quasi-Classified Information:** Some information that would normally be public is withheld for national security, economic security, or personnel safety reasons. This is a genuinely new challenge for public equity investors.

Part IV: Jurisdiction Analysis

Ukraine: Institutional Memory Over Mineral Potential

Ukraine's mineral pitch is narrower than headlines suggest. The real potential is in **titanium and graphite**, not rare earths (the best rare earth deposits are in Russian-occupied territory).

What Ukraine does offer is something harder to replicate: **deep institutional memory in metallurgy, preserved from Soviet times.** This extends to aerospace alloys, steel

metallurgy, and rocket science—human capital that matters as the West rebuilds processing capacity.

The challenge is that Soviet-era resource data uses a fundamentally different classification system (C-categories and P-categories rather than JORC/NI 43-101 reserves and resources). What may be presented as a resource in Soviet terminology might only qualify as mineralization under Western standards.

Greenland: Geology Without Infrastructure

Despite political attention, Greenland faces three structural barriers to becoming a major critical mineral source:

- **Metallurgical failure:** The three large rare-earth deposits in southern Greenland are all hosted in eudialyte, a phosphate-based mineral with an extremely complex metallurgy. No one has successfully extracted rare earths from eudialyte at commercial scale. As Tomasz notes: "*We should be a little more humble vis-a-vis Chinese excellence in metallurgy. Just because they are on the other side of the divide doesn't mean that we should not respect their talent and their dedication.*"
- **Power deficit:** Greenland's total power production is roughly 530–540 GWh annually. For comparison, **Escondida (BHP's copper mine in Chile) consumes about six times that amount.** Mining is only feasible for roughly three months per year. Building the energy infrastructure for large-scale mining would be an enormous capital project in itself.
- **Social license:** Greenland's local population opposes production involving significant radionuclides (thorium and uranium, which are commonly associated with rare earth deposits). This requires respect, just as community opposition must be respected in Colorado or the DRC.

Kazakhstan: Long Memory, Short Trust

Kazakhstan has genuine geological potential and a strategic incentive to attract Western investment (sandwiched between Russia and China, and is seeking to diversify its dependencies). However, Tomasz is cautious based on historical experience.

Multiple episodes of creeping expropriation or disenfranchisement of Western investors since the 1990s have created an unhelpful track record. The Astana International Financial

Centre (AIFC), modeled on Dubai's DIFC and based on common law principles, has been less successful than its twin because the commercial mentality remains post-Soviet.

The Metal Tomasz Is Most Excited About: Gallium

When asked directly what excites him, Tomasz points to gallium, a semiconductor substrate that replaces silicon in critical applications:

- **Gallium arsenide:** Used in optoelectronics
- **Gallium nitride:** Used in power electronics with a very wide band gap, essential for military applications

China controls 99.9% of global gallium production. The challenge is finding investable proxies. Primary gallium production exists barely outside alumina refining circuits. The best karst-type bauxite deposits (ideal for gallium extraction) are in Iran … and, well, for some reason, I don't think we'll see much exploration there anytime soon.

Current investable options are limited: **Alcoa's** Australian operations (building a dedicated gallium flow sheet) and **Rio Tinto's** Quebec alumina operations. This scarcity of investable proxies for a strategically essential material is itself a signal of the opportunity's immaturity and its potential.

Just for fun, I ran a screen for all mining stocks with "gallium" in their descriptions (market cap above $25M). Here are the results:

Ticker ↑	Name	Description	Market Cap
• AVL	Avalon Advanced Materials Inc.	Avalon Advanced Materials Inc.…	$ 36.89M
• AXTI	AXT, Inc.	AXT, Inc. designs, develops, ma…	$ 2.53B
• BYL	Baylin Technologies Inc.	Baylin Technologies Inc., toget…	$ 32.07M
• FWZ	Fireweed Metals Corp.	Fireweed Metals Corp. engage…	$ 682.42M
• NEO	Neo Performance Materials Inc.	Neo Performance Materials Inc…	$ 787.22M
• NVTS	Navitas Semiconductor Corporation	Navitas Semiconductor Corpor…	$ 2.50B
• PMET	PMET Resources Inc.	PMET Resources Inc. engages i…	$ 666.60M
• PTP	Pentixapharm Holding AG	Pentixapharm Holding AG, a cli…	$ 56.85M
• SOI	Soitec SA	Soitec SA develops and manuf…	$ 2.12B
• USAR	USA Rare Earth, Inc.	USA Rare Earth, Inc. engages in…	$ 4.60B
• WOLF	Wolfspeed, Inc.	Wolfspeed, Inc., a semiconduct…	$ 820.61M

Part V: Portfolio Management and Daily Workflow

Fund Structure and Team

Amvest Terraden runs lean with 8 people across the firm. The fund consolidated into its current onshore/offshore hedge fund structure in late 2023, giving it just under three years of track record. The timing coincided with China's escalating export restrictions, validating the thesis Tomasz conceived during COVID in October 2020 after reading about China's new Export Control Law in Party dailies.

The Daily Routine

The day begins with a review of commodity feeds, ticker movements, and geopolitical developments.

Tomasz reads across multiple languages and sources, including Chinese Communist Party publications, to identify pressure points before they appear in English-language media.

> ***"These days, geo-economics is one area where you can actually get an edge quickly... Historically, geopolitics didn't matter so much for investment other than that spike—say, oh, North Korea sending a missile again. For half a day you have excitement. Everybody forgets about it. This is changing now."***

This geo-economic intelligence gathering is, in Tomasz's view, **a genuine source of edge.** Another reason why we value Alex's interview with Mr. X this past weekend.

Historically, geopolitics was a transient factor in investing ... a spike from a North Korean missile launch that faded in hours. Today, with multiple state actors exercising agency over mineral supply chains, understanding geopolitical dynamics is structural rather than cyclical.

Company-specific work involves reviewing feasibility studies, engaging with management teams, and conducting site visits for more advanced projects.

Trading vs. Investing: A False Dichotomy

I asked Tomasz about the tension between patient long-term capital and the reality of volatile junior mining stocks. He pushed back:

> ***"Isn't that a false dichotomy? You can establish a long-term exposure to something that's going to take three or four or five years and then it's going to be volatile along the way... and you trade a portion of your exposure around that. This is not mutually exclusive."***

I love that response.

The Capital Market Opportunity

Tomasz frames the broader capital allocation opportunity with a striking statistic: the U.S. equity market is a $72 trillion pool of capital, yet **less than 1% of the S&P 500 is in mining.**

As capital flows into the space, driven by national security imperatives, tax incentives (which Tomasz wants), and rising awareness of supply chain vulnerability, early movers in critical mineral investing are positioned to capture disproportionate returns.

7 Key Takeaways for Investors

1. China's mineral dominance is not a market failure—it's a deliberate, multi-decade state strategy. The consolidation is tighter, the controls are more sophisticated, and the leakage is lower than in 2010. This is structural, not cyclical.
2. The critical minerals investment thesis is a bet on bifurcation. If you believe the West will rebuild supply chains outside China (and government policy is pushing in that direction), the scarcity premium on non-Chinese supply is the return driver.
3. Duration is the hidden killer. In specialty metals with small end-markets, the West won't need 100 producers. Being in the first cohort to cross the finish line is everything. Late-stage mega-projects with 10+ year development timelines may never get built.
4. Adjust risk in the numerator, not the denominator. Probability-weight your cash flows rather than inflating discount rates. This forces explicit assumptions about what can actually go wrong.

5. Follow the byproduct relationships. Gold-antimony, lithium-cesium, copper-tellurium, zinc-indium, alumina-gallium—the most financeable critical mineral projects often piggyback on a major commodity.
6. The off-take question is non-negotiable. Before investing in a junior mining company, ask: Who is going to buy this product in the West? If there is no specific refinery or end user under development, the geology is irrelevant.
7. Jurisdiction risk requires historical memory. Kazakhstan's scars from the 1990s matter. Greenland's power deficit is real. Ukraine's value is human capital, not deposits. Soviet-era resource classifications are not Western reserves.

I hope you guys enjoyed this *Podcast Notes Report* from my conversation with Tomasz Nadrowski.

