The hunt for scandium

Scandium, and especially its opaque and tiny supply, have been propelled into the spotlight by two recent short-seller reports (by Hunterbrook and Crossroads Capital) that questioned Bloom's degree of independence from Chinese scandium supply. While we do not know where Bloom's scandium originates, we struggle (see last Crucible) to see where it could source the scandium we think it needs, without turning to Chinese supply.

One long-touted prospect for scandium supply outside China is nickel laterites, predominantly Indonesian but also from the Philippines and Papua New Guinea. Each of the latter two countries is already home to meaningful scandium oxide supply although we believe the PNG supply is directed to China for internal use by China Minmetals.

Large-scale nickel mining in the region generates tonnages of contained scandium that are enormous compared to today's global output of 60-80tpy of scandium oxide. Laterite mining processes around 200Mtpy of ore that we crudely estimate at 50ppm scandium oxide. In other words, these nickel operations are handling some 10,000tpy of scandium oxide. At first blush, this is an opportunity not to be missed.

Unfortunately, geology and metallurgy are rarely so generous. There are two main ore types within lateritic mines, namely limonite and saprolite. The former is characteristically lower in nickel and higher in scandium (say 1-1.5% nickel and 60-80ppm scandium oxide) and the latter is characteristically the opposite (say 1.5-2.5% nickel and 20-30ppm scandium oxide).

Most of laterite tonnage at present is saprolite, an ore that lends itself to ferronickel production via pyrometallurgy and leaves the scandium in solid residues that do not readily lend themselves to processing and recovery. Limonite, on the other hand, is amenable to high-pressure acid leach (HPAL) processing, in which the ore is digested under elevated pressure in hot sulphuric acid, to take nickel and accompanying cobalt, plus much of the scandium, into solution.

Moreover, the HPAL process assists in separating iron from the leach solution, a boon to scandium leachate recovery because iron and scandium are normally chemically quite similar in such systems and can be hard to separate, especially because the iron concentration in the ore may be 1,000 times the scandium grade.

Overall, and again estimating crudely, perhaps a third of the laterite tonnage mined each year is processed in HPAL plants, although thanks to the higher typical grades this represents about half of the total available scandium. Hence the region likely offers a throughput of around 5,000tpy of scandium oxide, which is still an enormous quantity.

But there are other barriers one must consider. If the entire leachate volume were to be processed to recover scandium, the volume of liquid would be very large (about 1,000 cubic metres per hour for a plant like Ramu) and therefore inevitably a large capital outlay would be required (the capacity recently installed by Rio at Sorel Tracy for scandium extraction from titanium acid streams cost about $2 million per ton of nameplate capacity).

In addition, the fact that there are significant recycle streams after the HPAL process step to improve nickel and cobalt recovery mean that changes to leachate chemistry to enable scandium extraction could interfere with the production of the operation's primary products. Then, one must consider any engineering

warranties, technology licensing agreements, and intellectual property rights, because many of the operating HPAL plants deploy standard engineering packages from third-party suppliers such as ENFI.

All of this suggests that despite the vast scandium tonnage available, the reality of scandium recovery is very different, and supply is likely to grow slowly and remain an incremental adjunct to operating mines.

The two major working projects, Sumitomo's Taganito project and the Ramu project, illustrate the problem (Gem and Huayou are both in the early stages of scandium recovery with Gem claiming modest recovery today).

Taganito receives and processes a side stream of barren liquor (leachate that has been stripped of nickel and cobalt) while Ramu ships nickel-cobalt hydroxide ("MHP") to its Caofeidan plant in China where the entrained scandium, grading 440ppm according to recent patent filings, is extracted from the MHP.

Neither of these approaches risks the primary nickel-cobalt production operation, although the Taganito output is less than 10tpy of scandium oxide (the barren liquor is reportedly very low-grade scandium) while the recovery from Ramu's MHP looks to be about 10% based on China Minmetals reports, delivering maybe 25tpy of scandium oxide, from a mine throughput of 220tpy contained scandium oxide.

Both these approaches could likely be replicated, although shipping a Ramu-style MHP requires a suitable treatment plant designed to recover separated nickel and cobalt at scale as well as the separate scandium recovery circuit.

Leaving that aside for now, the existing Ramu-technology operating laterites could plausibly deliver several hundred tons per year of scandium oxide if capital were committed to do so (subject to the specific chemistry of each processing plant and ore stream, something we are not qualified to opine on).

And by a happy coincidence, this is just the scale of supply OnG believes Bloom may be looking to procure for the early 2030s. Whether it is an achievable supply is a different question. The Ramu-type operations are predominantly Chinese controlled, and there are emerging alternatives such as Sunrise, NioCorp and of course Rio.

But it does paint a picture of the potential of lateritic scandium supply: small in comparison to the scandium in the ground, but potentially significant even in the context of a rapidly expanding market.

Published in The Crucible (Minor Metals Trade Association)
September 2026

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