

Platinum group metals (PGMs) are high-value transition metals that include platinum (Pt), palladium (Pd), rhodium (Rh), ruthenium (Ru), osmium (Os) and iridium (Ir). PGMs exhibit distinctive chemical and physical characteristics that are favorable for use in many high technology applications, earning them a place in the rapidly expanding “tech metals” market. Their primary use is in the manufacture of catalysts used in oil refining, fuel cells, automobile emission control systems (catalytic converters), and electronics.

As global emission standards become ever more stringent, increased demand for PGMs is expected to drive the development of new sources of supply, which could include production from both primary and secondary sources. Outside of South Africa, PGMs are mainly produced as a by-product of nickel/copper refining and the economic viability of PGM resources is based on revenue from several economic metals contained within a bulk sulphide concentrate, including contributions from nickel, copper, cobalt, gold, silver, and PGMs. Major challenges for prospective developers include:

- ❑ The ability to produce bulk Ni-Cu-PGM concentrates meeting smelter specifications at high processing recoveries from complex polymetallic deposits;
- ❑ Low net smelter returns for marketing of concentrates to independent base metal smelters / PGM refineries, and;
- ❑ Barriers to vertical integration of mining and refining operations for conventional pyrometallurgical processes including a high degree of technical complexity, high capital investment and environmental sensitivity.



Figure 1: Platinum Group Metal Coating in Catalytic Converters for Automobile Emission Control

**Thibault & Associates Inc.** assists our clients in overcoming technological and economic barriers to project viability by:

- ☑ Employing advanced technologies for optimization of primary beneficiation flowsheets, such as:
  - High-resolution mineralogy for assessment of liberation and mineral association characteristics for base metals, PGMs and precious metals relative to gangue minerals.
  - Analysis of surface chemistry interactions in the selection of customized reagent schemes to improve on grade-recovery relationships and separation of PGMs.
  - Integration of magnetic separation, gravity and ore sorting within the primary beneficiation circuit to maximize recovery of PGMs and precious metals (PMs).

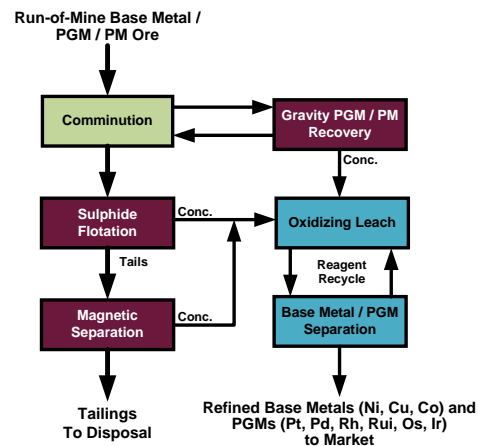


Figure 2: Thibault & Associates Inc. Approach for Vertical Integration of PGM Mining and Refining

- ☑ Developing customized hydrometallurgical flowsheets for integrated recovery of high-purity PGMs from bulk concentrates or secondary sources based on:
  - Optimized selection and recycling of reagents to reduce operating costs and improve environmental sustainability.
  - Use of alternative technologies for selective separation and recovery of high-purity (> 99.95%) PGMs.
- ☑ Offering process development and design services that are fully integrated with project economics through the use of a proprietary Dynamic Economic Model (DEM).

## Your Vision - Our Innovation™

For over 28 years, **Thibault & Associates Inc.** has applied process technology innovations to comply with our client's project development strategies, transforming natural resources to high value concentrates, ultra-pure metals, speciality chemicals, transportation fuels or power generation.

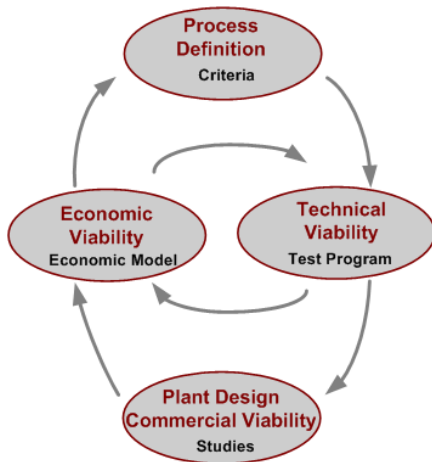
### Services

Our firm defines process technology based on the project's earning potential and compliance with product market specifications, environmental protocol and social factors.

We tailor develop process systems to support our client's business plans and our test programs are managed to quantify technical – process design parameters.

As an integral part of process development, we prepare economic models to assess the impact of technical parameters on the project's earning potential.

Our integrated technical and economic studies are based on fully defined process chemistry, equipment selection and plant layout for life of project, heavy industrial process control measures, cost assessment standards, construction and operating practices.



- ✓ Feed characterization and development of process chemistry.
- ✓ Bench scale and pilot test programs.
- ✓ Process simulation and dynamic economic modelling.
- ✓ Independent NI 43-101 technical / economic assessments and feasibility studies.
- ✓ Detailed engineering / multi-discipline plant design, commissioning and aftercare programs.

### Speciality

Our clients range from investment firms to heavy industrial producers of base metals, industrial minerals, speciality metals, inorganic chemicals, power, transportation fuels and petrochemicals.

Our project experience covers a wide range of commodities, including:

- ✓ Base metals (Cu, Pb, Zn)
- ✓ Precious metals (Au, Ag)
- ✓ Platinum group metals (Pt, Pd, Rh, Ru, Ir, Os)
- ✓ Oxide metals (W, Sn, Fe, Ti, Al, Cr, Sc)
- ✓ Metals for electronics (In, Y, REO's, Te, Ga, Ge)
- ✓ Specialty chemicals (Sb, V, Mg, K, Si)
- ✓ Battery-grade elements (Graphite, Li, Co, Mn)

In addition to our technical and economic assessment of production opportunities for various commodities, we have specialized in GAP analysis, independent assessment of process development test programs and the transfer of test program data for commercial process plant design, procurement and definitive engineering.

Our most recent platinum group projects include:

Development of Chloride Media Purification Unit Operations

Conceptual Technical and Economic Assessment of PGM Recovery from Nickel Ores

Preliminary Design and Cost Assessment of PGM Hydromet

Assessment of Technologies for Catalytic Converter Recycle



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