FACT SHEET

# PRECIOUS METALS ANALYSIS

**It's imperative to understand the process and in-depth analytical requirements involved in supporting precious metals mineral exploration, including resource estimation and the issues facing explorers when analysing for precious metals.**

Gold has played a significant role in history and still provides a backbone for the mining industry within Australia and around the world. A diverse range of techniques for the quantification of precious metals in mining and exploration samples are available at Intertek Minerals ranging from grassroots exploration, where sub ppb sensitivities are required, to accurate resource estimation, grade control and replication of processing plant recoveries.

The traditional methodology for total recovery of Au, Pt, and Pd is lead collection fire assay. PhotonAssay provides a relatively new technology for the non-destructive total quantification of Au for larger sample sizes. Bespoke options for partial digestion of Au through aqua-regia, accelerated CN leach, and BLEG are available. Finally, an extended precious metal suite of Au, Pd, Pt, Rh, Ir, Ru, and Os is available through a nickel sulfide collection method.

## Lead Collection Fire Assay

The application of lead collection fire assay for the concentration and collection of precious metals has been around for over 5000 years. Intertek Minerals has a more modernised and industrialised process but the concept remains the same. Samples are mixed with a lead oxide-based flux. A reduction reaction converts the lead oxide to lead, collecting the Au, Pt, and Pd and leaving everything else behind. The cupellation process is then completed in an oxidizing environment, converting the lead back to lead oxide. The high temperatures cause the lead oxide to melt away leaving a silver prill containing the Au, Pt, and Pd. A specialised formulation of the flux mixture ensures maximised recovery of Au, Pt, and Pd in diverse mineralogical matrices with additives available to deal with difficult sample matrices. The collected prill is parted through a chemical process and the Au, Pt, and Pd quantified with sub 1 ppb detection limits using ICP-OES and ICP-MS. Packages are available for trace level determining minimising cross contamination in the process.

## PhotonAssay™

PhotonAssay™ is a relatively new technology in the market, also capable of quantifying the Au in your sample. PhotonAssay™ excites the protons and neutrons within the $^{197}$Au nucleus to $^{197m}$Au with high energy radiation. $^{197m}$Au is a radioactive isotope with a half-life of 7.73 seconds and with gamma radiation emitted during the decay back to $^{197}$Au. The total energy of the gamma radiation emitted is directly proportional to the concentration of Au in the sample.

PhotonAssay™ is able to provide a total analysis for Au, only requiring crushing of the sample, therefore skipping a sample preparation stage in comparison to the traditional Fire Assay method. A larger sample weight allows for a better representative sample, particularly when dealing with a "spotty" gold deposit. The method is also non-destructive in nature, so the sample can be analysed as many times as required (in fact it is the jar that is the limiting factor on the number of assays).

The detection limit of PhotonAssay™ is higher than the traditional method at 30 ppb and therefore is more suitable for resource development and grade control samples. In addition, samples with the presence of interfering elements such as U, Th, and Ba increases the detection limit to a point where PhotonAssay™ is no longer effective.

## Nickel Sulphide Collection Fire Assay

Precious metals are not restricted to just gold but cover a wider range of elements such as Pt, Pd, Rh, Os, Ru, and Ir. Many of these elements are not suitable for quantification through traditional lead fire assay due to insufficient recovery in the lead collection or the volatility of the elements. The nickel sulfide collection method has been developed specifically for the quantification of Au and all of the platinum group elements (PGEs).

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**Utilising both traditional and innovative methodologies, ensures precise quantification of precious metals, aiding in efficient resource management and decision-making throughout the mining process.**

In this process, the samples are mixed and fused with a nickel oxide and sulfur containing flux. As with the lead collection fire assay process, the nickel oxide is reduced but in this case to nickel sulfide collecting the Au and PGE's.

The nickel sulfide button is collected, pulverized, the Au and PGE's separated from the nickel sulfide through a digestion process, and the subsequent solution analysed via ICP-MS. Despite the increased complexities in the process when compared to lead collection fire assay, nickel sulfide collection fire assay proves to be a valuable analytical tool for the quantification of Au and PGE's.

## Screen Fire Assay

Gold is particularly challenging in terms of assay, especially in the sample preparation area. Most minerals pulverize simply, but due to the malleable nature of Au, it tends to flatten as opposed to pulverize. This makes the task of obtaining a representative sample suitable for assaying often a difficult proposition, especially with coarse gold deposits.

A screen fire assay takes 1 kg of sample and passes it through a screen cloth. The coarse fraction and the screen cloth are assayed to provide the portion of the coarse gold. The undersize fraction is analysed in at least duplicate and the total gold calculated as a weighted average of the two fractions. In addition, the individual size fraction results are also reported.

## Aqua Regia Digestion

In some circumstances, you may require the quantification of the full suite of elements present in your sample in addition to the quantification of gold.

Aqua regia is a useful screening tool for grassroots exploration and is a cost-effective way to analyse for gold and other elements. Intertek Minerals offers aqua regia packages with relatively low detection limits for 52 elements, with the option of adding the 12 rare earth elements, and quantified via ICP-MS. Many minerals will digest effectively in aqua regia, however, silicate and refractory minerals will remain largely undigested. Aqua regia digestions are suitable for exploration purposes only and are not recommended for resource analyses.

## Cyanide Leaching

Generally speaking, cyanide leaching is the most prominent metallurgical technique for the extraction of Au from mineral samples. Cyanide is not always able to extract all of the gold therefore it may be necessary to determine the amount of cyanide leachable gold.

Intertek Minerals offers cyanide leach methods to provide information for grassroots exploration and resource method. Bulk Leach Extractable Gold (BLEG) is usually performed on screened stream sediment samples, providing detection of low level anomalies for regional exploration. High grade leaches utilise the LeachWELL™ accelerant to extract the cyanide extractable gold. This is an indication of what would be recovered in routine metallurgical processes. An analysis of the tails are available to quantify the amount of non-Cyanide leachable gold.

## Metallurgy

With the recent addition of Base Met Labs, Intertek can also help evaluate the metallurgical response of your ore through flowsheet development and optimisation. Intertek have several laboratories strategically located across the globe, staffed with experience metallurgists and engineers to help guide clients on the next phase of their project.

## Method Selection

There are numerous techniques available for precious metal analysis. Please get in touch with your Intertek representative to determine the most appropriate methods for your requirements.


**FOR MORE INFORMATION**

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