

**CHRYSOS
CORPORATION**
Assays at the speed of light

A REVOLUTION IN ASSAY SERVICES

Real-time analysis in the field or lab

Our unique Chrysos™ PhotonAssay technology, developed over the past fifteen years by the CSIRO, provides rapid, accurate, non-destructive and fully automated analysis of ore grade.

PhotonAssay

- Rapid analysis, taking just a few minutes from sample presentation to final result
- Sensitive and accurate analysis of metal grade in bulk samples of 0.5 kg or more
- No toxic or caustic reagents required
- Highly automated, delivering reliable and repeatable results
- Minimal sample preparation
- Performance is insensitive to the physical or chemical form of the sample
- Non-destructive technology allowing retesting and referencing
- Ability to assay for gold and silver concurrently with additional elements to be added including Cu, Pb, Zn

Our Products

Chrysos™ PhotonAssay Max

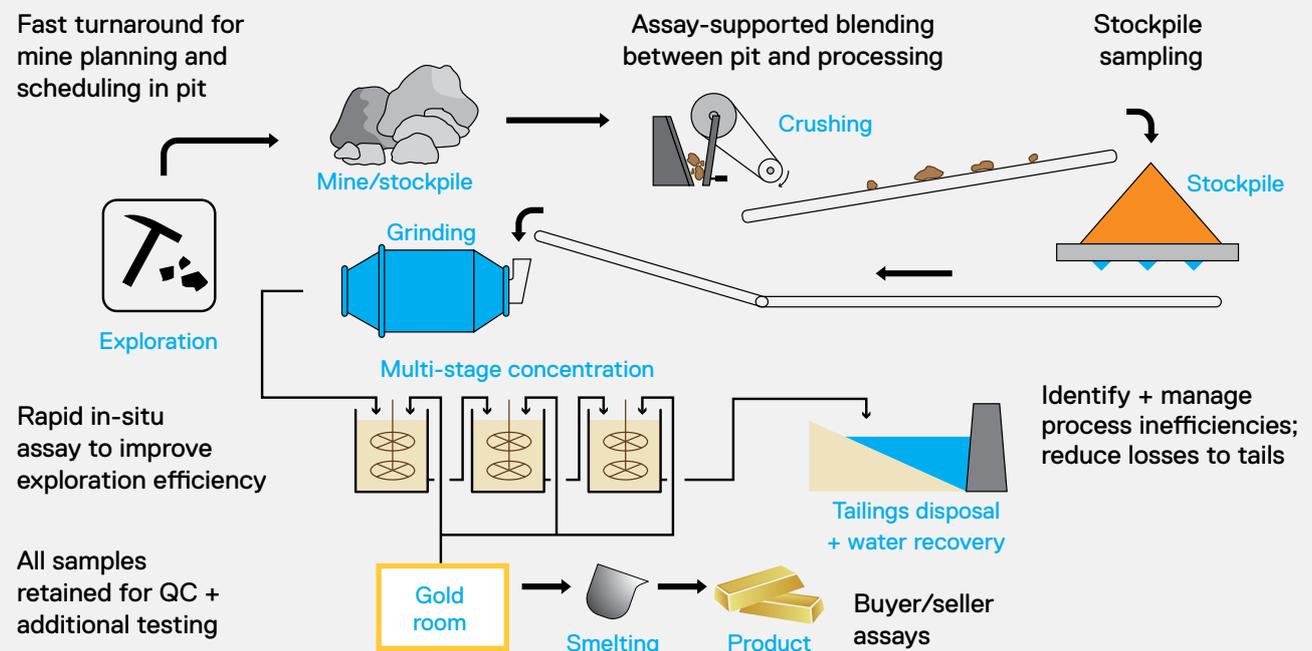
- Fully automated analysis system capable of handling up to 50-60 thousand gold samples per month (80 samples per hour)
- Designed for accuracy and maximum throughput in centralised assay laboratories

Chrysos™ PhotonAssay Mine

- Throughput of up to 12-14 thousand samples per month (20 samples per hour)
- Designed for rapid deployment on mining and mineral processing sites

REAL-TIME ASSAY THROUGHOUT THE MINERALS VALUE CHAIN

The ability to provide rapid, reliable assays delivers value to exploration, mining and processing operations.



Comparison to Fire Assay

PhotonAssay offers significant advantages in turn-around time, sample size and accuracy compared to conventional analysis methods such as fire-assay.

	PhotonAssay	Fire assay
Sample preparation	Coarse crush and split. Load into barcoded container	Drying, coarse crush, sampling, pulverisation and further Sub-sampling
Sample mass	Typically 400-600 g	Typically 10-50 g
Labour	Low-skill process, loading and unloading of packaged samples	Complex, multi-stage process that requires highly-trained laboratory technicians
Turnaround time	Result in less than 10 minutes	Minimum turnaround of 2-3 hours under ideal conditions; 24-48 hours typical
Accuracy	3% error at 1 ppm, improving to < 1% for high-grade samples	Typically 5-10% errors at grades significantly above detection limit
Re-analysis	Non-destructive technique allows samples to be stored and re-assayed if required	Destructive technique; no further validation possible on processed samples
Detection Limit	Approximately 0.03 g/tonne	0.01-0.03 g/tonne for routine assays. Lower detection limits possible with special finish

How the Technology Works

Chrysos™ PhotonAssay provides a unique, chemistry-free approach to material analysis. It hits samples with high-energy X-rays, causing short-lived excitation of atomic nuclei of targeted elements. These excited nuclei atoms then give off a characteristic signature that can be detected and used to calculate metal grade.

Samples for analysis are presented in sealed plastic jars holding up to 300 mL of material. As both the X-ray beam used to excite the samples and the resulting elemental signature gamma-rays are very penetrating, the full sample volume can be measured, not just material on the surface. A single rock or section of core can be measured just as easily as a powdered or crushed sample, and solutions or slurries can also be directly analysed.

HOW IT WORKS

Different metals are counted atom-by-atom on the basis of the unique signatures produced after excitation using an X-ray beam.



How does the technology work?

Chrysos™ PhotonAssay uses high-energy X-rays to measure elements in bulk samples. An intense X-ray beam excites atomic nuclei of target elements, and a sensitive detector system measures the gamma-rays subsequently emitted by the excited nuclei. We refer to this as 'atom-counting', as we measure a signal that is directly proportional to the number of atoms of the chosen element contained in the sample. The more target atoms present, the more nuclei excited, the stronger the gamma ray signal detected.

How is this approach different from X-ray fluorescence?

X-ray fluorescence, or XRF for short, is another widely used X-ray technology for measuring elemental composition. However, XRF uses a much lower energy X-ray source, typically about 200 times lower than the one used for Chrysos™ PhotonAssay, and relies on measuring a signal from atomic electrons rather than the atomic nucleus itself. XRF is much less penetrating, making it impossible to measure bulk samples directly, and commercial units do not have the sensitivity to measure elements at gram-per-tonne concentrations.

What sort of materials can be measured?

The physics of the Chrysos™ PhotonAssay process mean that it is completely agnostic to the physical or chemical form of the sample being analysed. Single rocks or pulverised ore; feed, concentrate or tailings materials; slurries or solutions: all can be measured with equal felicity. Indeed, we have conducted tests showing that the technology can even be used to measure the gold content in electronic waste without any special sample preparation.

Can the technology distinguish between different metals?

Yes! Each element gives rise to a gamma-ray signature with a unique energy. For example, the gamma-ray energy for gold is 279 kiloelectron volts (keV), and for lead it is 570 keV. The high resolution detector system that we use and our proprietary analytical software is easily capable of distinguishing between these signals, allowing grades in polymetallic materials to be separately reported.

Can you perform multi-element analysis?

Chrysos™ PhotonAssay can be tuned to measure different sets of elements in samples. The technique is particularly sensitive for gold, and this is our first target. Elements that can be reported simultaneously with gold include silver, barium, hafnium, yttrium and selenium. By adjusting the operating conditions, different ranges of elements can be measured. For example, we have demonstrated the simultaneous detection of copper, silver, lead and zinc in complex polymetallic ores. See our website for more details.

Does your technology include a radioactive source?

No! A Chrysos™ PhotonAssay unit includes no radioactive source. Instead, the X-rays are generated electronically using an electron linear accelerator. Similar accelerators are widely used in industry for medical product sterilisation and other applications; they are also found in the radiotherapy units of most hospitals. When the source is powered off, it produces no radiation.

When will the Chrysos™ PhotonAssay technology be available?

We are planning a staged delivery of our three technology platforms. Our first Chrysos™ PhotonAssay Max unit will be available in 2017; the on-site 'Mine' and field-ready 'Mobile' units are scheduled for delivery in 2018 and 2019 respectively.

Contact us

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