GeoBlock

UNIL | Université de Lausanne

A presentation for the workshop on gold traceability, UNIL., 02.05.2023

Who is GeoBlock?

- GeoBlock is an independent Swiss Start-up, specializing in precious metals traceability.
- GeoBlock offices are located in Zürich, Switzerland and Medellín, Colombia (so far).
- GeoBlock's mission is to build and offer an affordable traceability solution, covering the entire gold production chain

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Who is GeoBlock?

Our expertise:	Switzerland:	Dario Biedermann	(Co-founder, Geophysicist ETHZ)
		Bruno Regli	(Co-founder, Economist)
		Stephan Knecht	(Engineer/Entrepreneur ETHZ)
		Pascal Aellig	(Geochemist ETHZ)
	Colombia:	Carlos Zapata	(Lawyer for artisanal mining)

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The Transparency Problem in Mining

Extraction

Vein rock

Grinding

Sand

Trade

Physical separation

Concentrate

Trade

Chemical separation

Concentrate

Trade

Dore melt

Doré

From here, we know

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The Transparency Problem in Mining

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We need to know the entire chain. How do we objectively capture the entire production line and verify the origin cost-efficiently?

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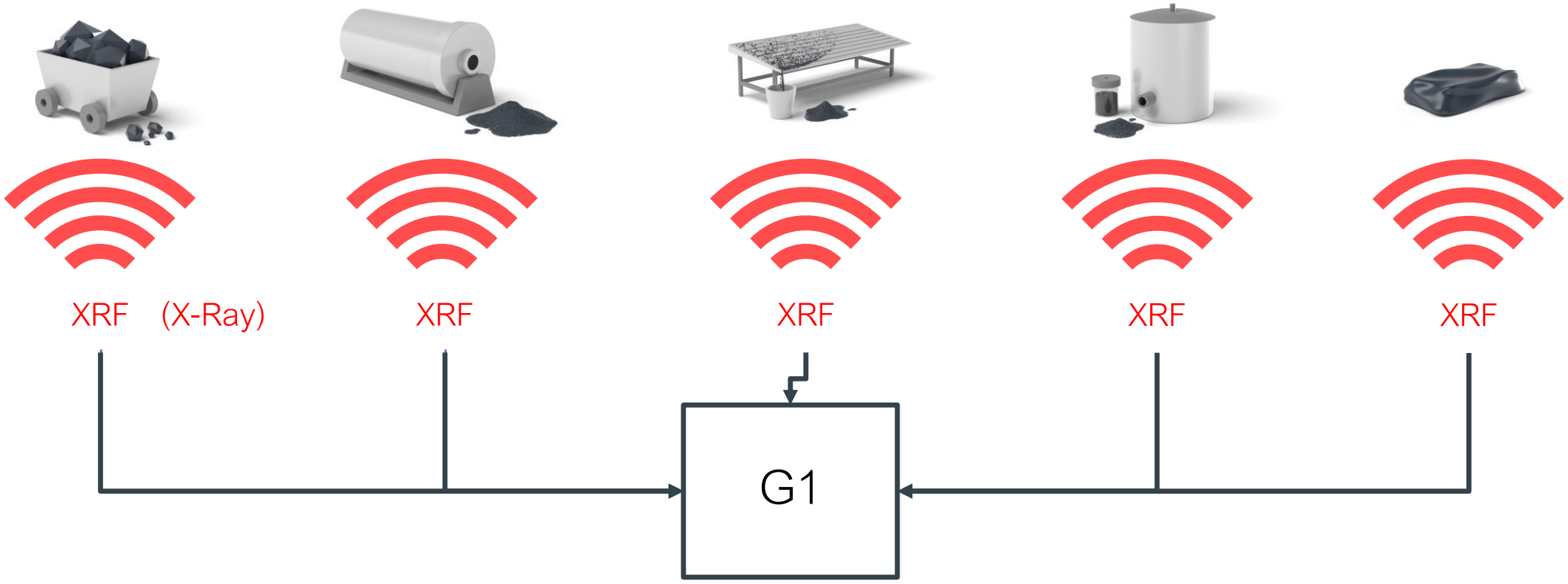
GeoBlock Fast Fingerprint Verification



XRF: Rapid X-ray fluorescence that yields the elemental distribution. Between 5 and 500 measurements per product needed.

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G1: The Statistical Mine Profile

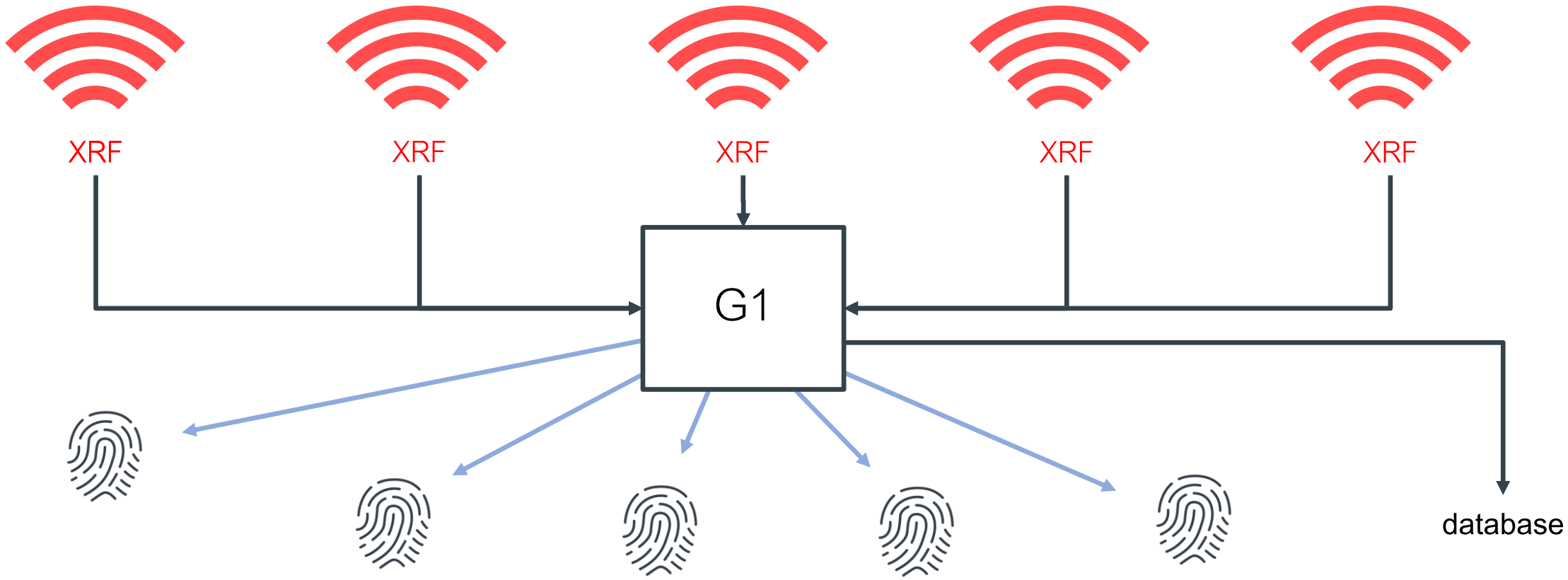
G1 statistically connects all x-ray scans of all products into a mine profile:

- G1 finds the most unique elements and element ranges for each mine
- G1 finds the optimal number of elements for each mine
- G1 incorporates the effects of the production
- G1 takes intra- and inter-mine variability into account

The output of G1 are benchmarking statistical values for easy feasibility testing of a new sample

The initial measurements for a mine profile only need to be done once – or again, if the geology changes over time

GeoBlock Fast Fingerprint Verification



Individual statistical profiles

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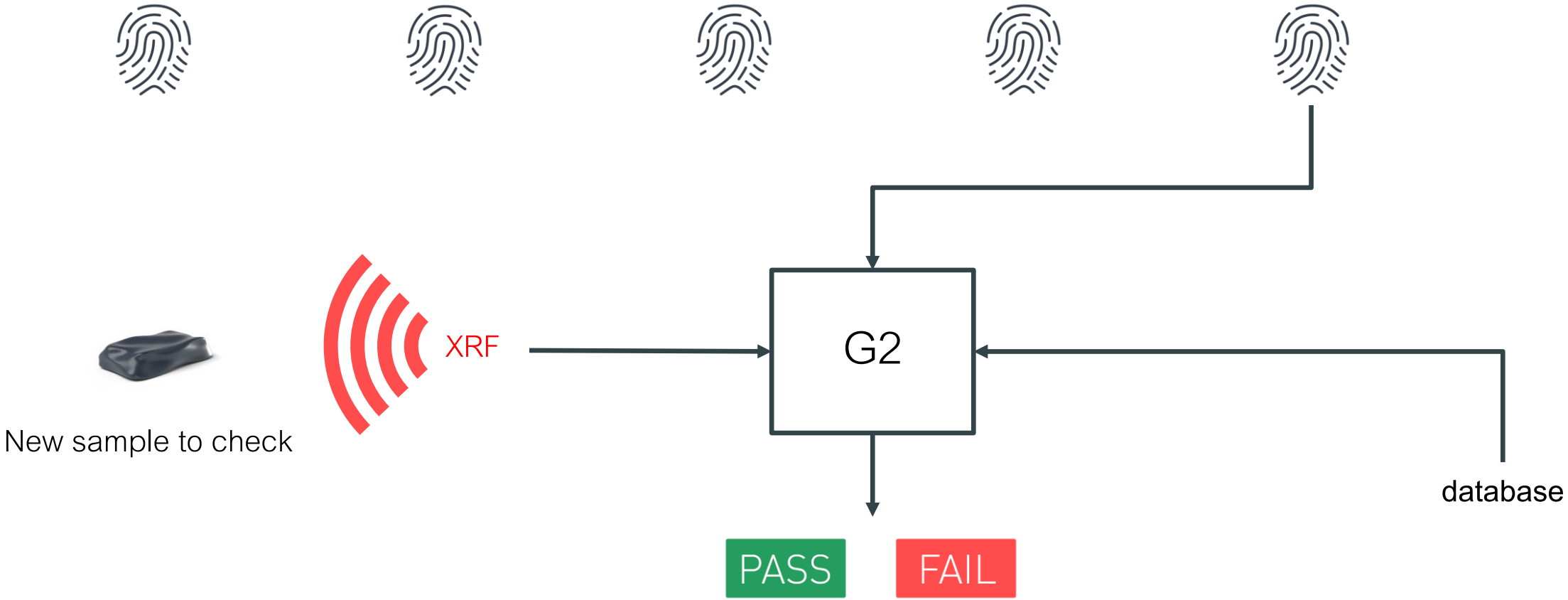
GeoBlock Fast Fingerprint Verification



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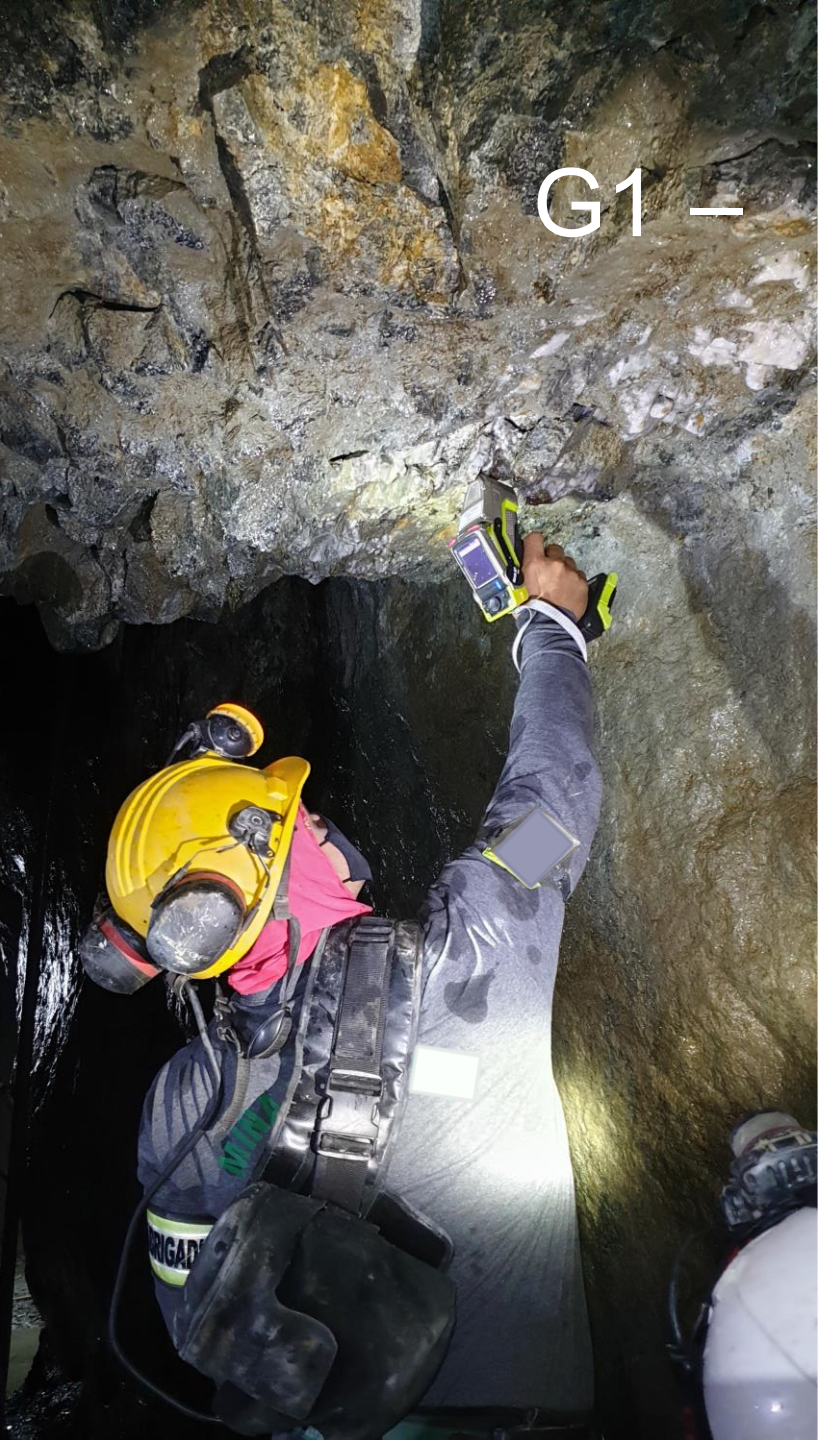
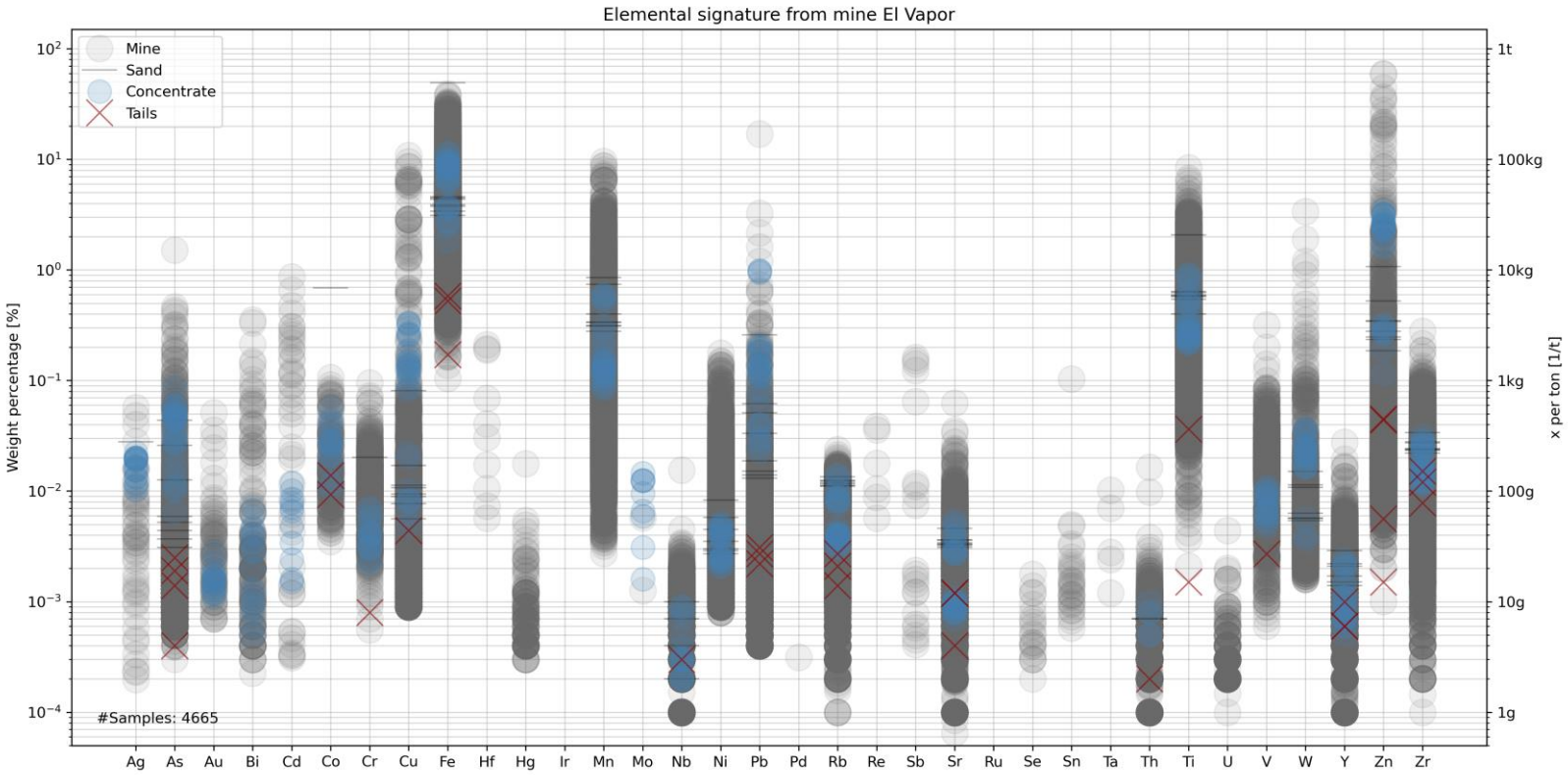
GeoBlock Fast Fingerprint Verification

The GeoBlock Fast Fingerprint Verification

- Requires a one-time profiling of chain.
- Can verify any product from that mine using instruments most companies already have
- Additional information: Production efficiency, gold/silver/etc. content, mercury usage, machine quality, etc.
- Most objective and autonomous solution on the market.
- Can be used to continuously monitor every product.



G1 – a case example, Colombia



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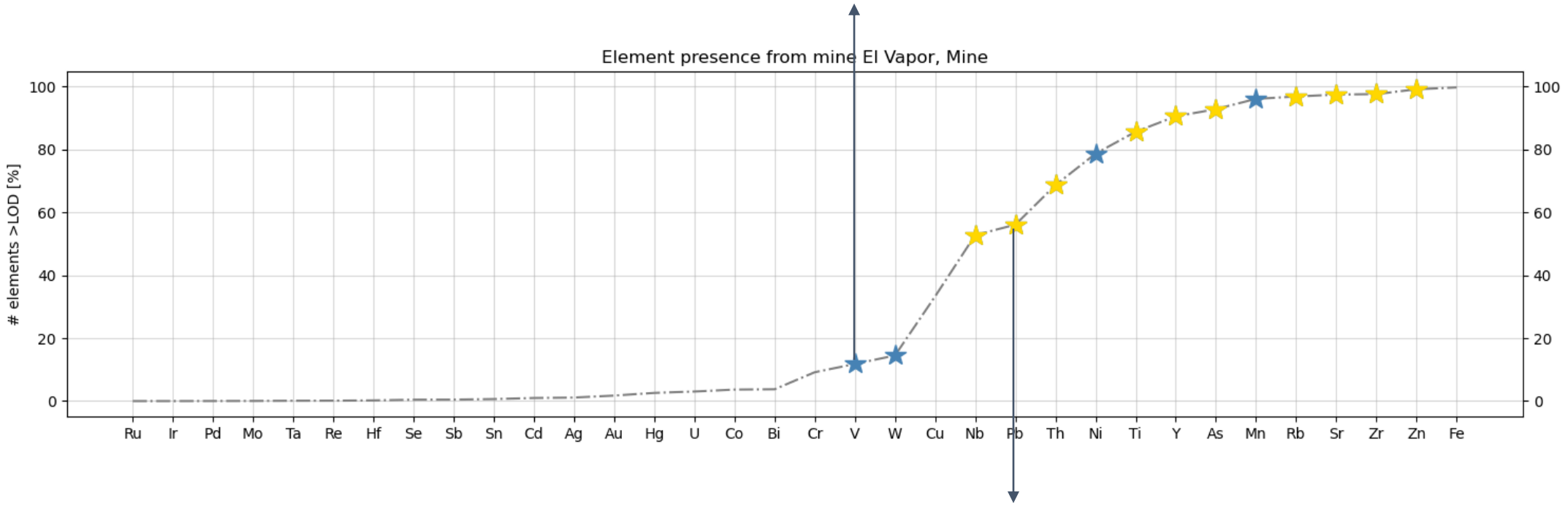
G1 – a case example

These elements fulfil the conditions for statistical testing <u>for this specific dataset</u>



These are the optimal elements and number of elements for statistical testing <u>for this specific mine</u>, chosen by G1

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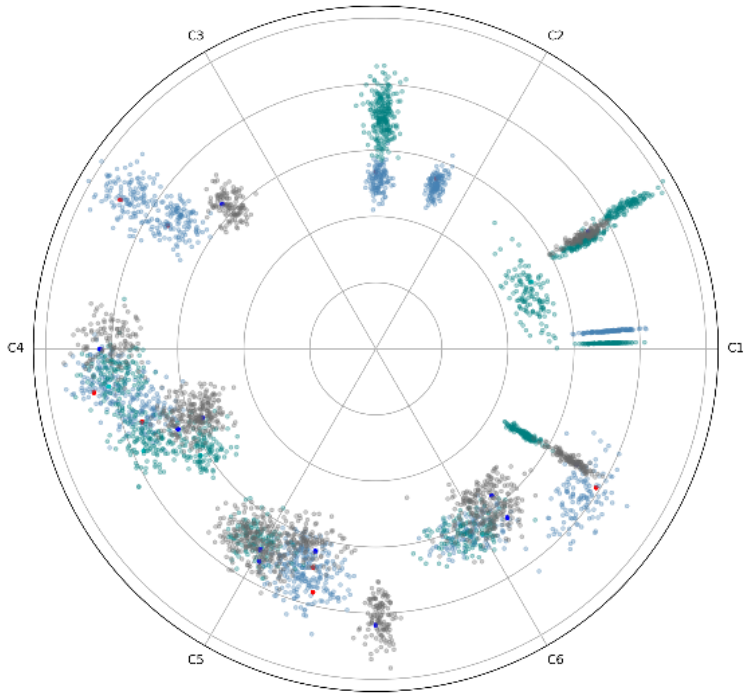
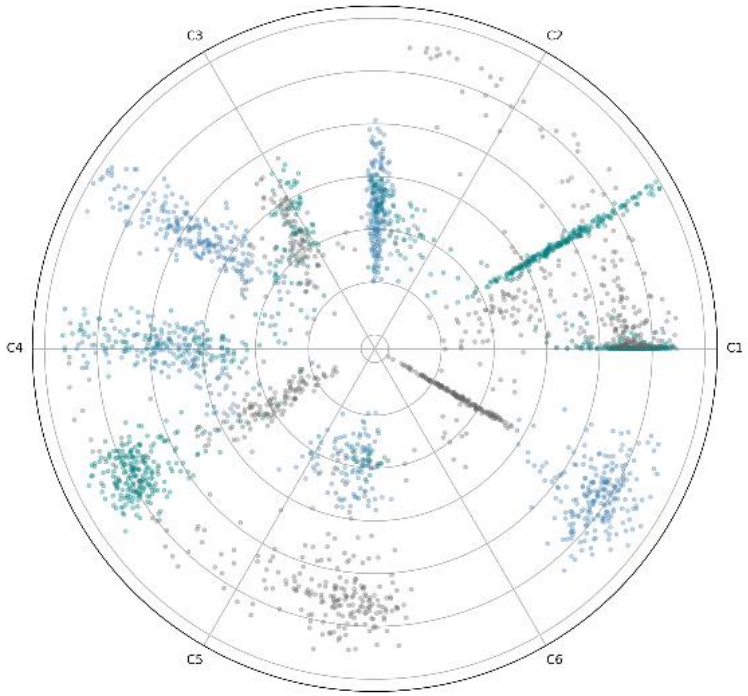
G1 Fingerprints





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GeoBlock's objectives

- Build up an independent global database for mines.
- Help to simplify the legalization of precious metals mining.
- Provide macro analysis of data for countries (prospection and environment).
- Increase transparency for both governments and buyers of mining materials.
- Increase countries' volume of green and fair-trade gold.

The Missing Piece for Blockchain

GeoBlock has an additional method for blockchain solutions

- We are highly complementary to blockchain solutions
- We provide unique IDs for products before the doré bar, linking the virtual product to the real one

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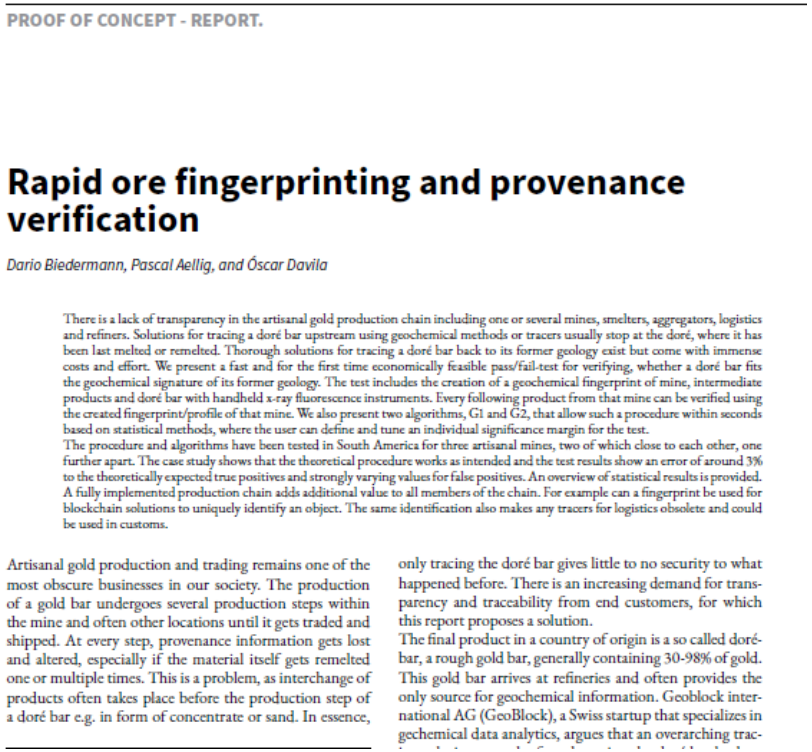
Our studies in Colombia



PROOF OF CONCEPT - REPORT.

Rapid ore fingerprinting and provenance verification

Dario Biedermann, Pascal Aellig, and Óscar Davila

There is a lack of transparency in the artisanal gold production chain including one or several mines, smelters, aggregators, logistics and refiners. Solutions for tracing a doré bar upstream using geochemical methods or tracers usually stop at the doré, where it has been last melted or remelted. Thorough solutions for tracing a doré bar back to its former geology exist but come with immense costs and effort. We present a fast and for the first time economically feasible pass/fail-test for verifying, whether a doré bar fits the geochemical signature of its former geology. The test includes the creation of a geochemical fingerprint of mine, intermediate products and doré bar with handheld x-ray fluorescence instruments. Every following product from that mine can be verified using the created fingerprint/profile of that mine. We also present two algorithms, G1 and G2, that allow such a procedure within seconds based on statistical methods, where the user can define and tune an individual significance margin for the test.
The procedure and algorithms have been tested in South America for three artisanal mines, two of which close to each other, one further apart. The case study shows that the theoretical procedure works as intended and the test results show an error of around 3% to the theoretically expected true positives and strongly varying values for false positives. An overview of statistical results is provided.
A fully implemented production chain adds additional value to all members of the chain. For example can a fingerprint be used for blockchain solutions to uniquely identify an object. The same identification also makes any tracers for logistics obsolete and could be used in customs.

Artisanal gold production and trading remains one of the most obscure businesses in our society. The production of a gold bar undergoes several production steps within the mine and often other locations until it gets traded and shipped. At every step, provenance information gets lost and altered, especially if the material itself gets remelted one or multiple times. This is a problem, as interchange of products often takes place before the production step of a doré bar e.g. in form of concentrate or sand. In essence, only tracing the doré bar gives little to no security to what happened before. There is an increasing demand for transparency and traceability from end customers, for which this report proposes a solution.
The final product in a country of origin is a so called doré-bar, a rough gold bar, generally containing 30-98% of gold. This gold bar arrives at refineries and often provides the only source for geochemical information. Geoblock international AG (GeoBlock), a Swiss startup that specializes in gechemical data analytics, argues that an overarching trac-

We have conducted several studies in Colombia, acquiring the full production profiles of three artisanal mines and up to ten other mines partially.

At this point we have acquired 19000 georeferenced elemental distributions from XRF measurements.

If interested, please read our study report of the most recent testing of the GeoBlock Fast Fingerprint Verification using G1 version 1.0 and G2 version 1.0.

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Ready for action!