

3rd Deliverable

Final draft

AFP Implementation Plan

11 October 2018

Summary

Within the framework of the Regional Certification Mechanism (RCM) of the International Conference on the Great Lakes region (ICGLR), chain of custody (CoC) systems are applied to attach documents or tags to tin, tungsten and tantalum (“3Ts”) concentrates in order to facilitate mineral traceability from the extraction site to the point of exports. However, these systems are inherently susceptible to fraud attempts by illegitimate actors aiming to misrepresent the mineral origin (mine site). The Analytical Fingerprint (AFP) method might fill this gap as it represents a forensic tool developed by BGR to independently verify the documented origin of minerals without relying on any artificially added traceability information (e.g., tagging). Application of the AFP method as an optional tool to assess mineral origin may substantiate standard supply chain due diligence procedures envisaged in the RINR mineral certification framework thus providing additional credibility for ICGLR oversight at an international scale.

Technical AFP prerequisites and related mineral flow framework scenarios are analyzed in order to identify potential AFP control sampling targets which would demonstrate the practical benefit of AFP and facilitate its implementation in the regions due diligence framework. Concentrates mixed with material from different mine sites (mixed concentrates) cannot be tested by AFP. However, it is assumed that concentrates are often tagged or processed separately to facilitate a reasonable payment of mineral providers according to the grade of minerals. This separation of concentrates allows sampling of unmixed concentrates from the stock of mining companies, from tagging stations as well as processors and maybe even some exporters. Implementation should start on known terrain such as mine sites’ stocks and evolve along the different levels of the supply chain. Concerning the two initial application scenarios, it is suggested to i) aim only at positive validation for proactive requests of due diligence adherence by a company and ii) aim at both positive and negative validation for supplement information in an investigation case.

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1. Introduction

Tin, tungsten, and tantalum (coltan) ore has been mined in Africa's Great Lakes region for more than 100 years, both by artisanal and semi-industrial means. In recent years, mining and trading of these minerals has partly contributed to catalyzing the conflict prevailing in the eastern Democratic Republic of the Congo (DRC) thus coining the term "conflict minerals". Consequently, international mineral and metal producers and processors were facing reputational risks and increased costs when sourcing minerals from the Great Lakes region which may render minerals from the region internationally less competitive thus depriving the local populations from a significant livelihood base.

In 2000, UNSC resolutions 1291 and 1304 called for an international conference on peace, security, democracy and development in the Great Lakes Region. Later in the same year, the Secretariat of the International Conference on the Great Lakes Region (ICGLR) was established in Nairobi, Kenya, under the umbrella of the United Nations and the African Union. On 30 November 2006, Heads of State and Government signed a PACT on Peace, Stability and development in the Great Lakes Region which included the Dar es Salaam Declaration and Programmes of action and Protocols (e.g. the Protocol Against the Illegal Exploitation of Natural Resources). In May, 2007, the ICGLR Secretariat was established at its headquarters in Bujumbura, Burundi and entrusted with the responsibility to coordinate, facilitate, monitor and ensure the implementation of the PACT. In 2009, the steering committee on the Regional Initiative against the illegal exploitation of Natural Resources (RINR) was formed and six tools were developed to curb illegal exploitation of natural resources. Among these is the Regional Certification Mechanism (RCM) which represents the central mechanism allowing to identify conflict-free supply chains of tin, tungsten and tantalum ("3T") mineral concentrates.

The international credibility of the RCM depends upon the efficient implementation of robust oversight and integrity control measures. The proponents of the ICGLR mineral certification framework have anticipated the need for decisive action on these matters by envisaging mineral traceability schemes, regular multi-level audit systems, on-going monitoring activities, as well as by installing a special investigator (the "independent mineral chain auditor") to follow up on any anomalies on his/her own initiative.

Several chain of custody systems have been developed to facilitate 3T mineral traceability in the Great Lakes region which provide standard procedures practical for everyday usage. However, these systems usually generate traceability by attaching additional information, through documentation or tags, to a mineral shipment which make these systems inherently susceptible to fraud attempts by illegitimate actors aiming to misrepresent the mineral origin (mine site). Application of AFP has the potential to overcome this traceability gap as it just uses the traceability information *contained in the minerals themselves* and information on the supposed origin of a mineral shipment. Hence, AFP is widely independent of shipping documentation and tagging procedures and thus produces an independent line of evidence with regards to the mineral source.

AFP may be applied proactively by a mining company or their customers wishing to demonstrate a conflict-free origin of their minerals, or as a forensic tool in the frame of chain of custody risk assessments and supply chain due diligence audits (e.g., as part of the RCM). In the

latter case, it may be applied as a regular or optional (i.e., reserved for special investigations) spot check procedure to verify supply chain integrity and standard mineral traceability measures. The purpose of this document is to elaborate in detail possibilities of how AFP at the present state could be implemented in the region's traceability framework. Thus, some procedures are only discussed briefly. A more detailed description on AFP procedures can be found in the AFP manual.

2. What is AFP and how does it work?

The term Analytical Fingerprint¹ (AFP) refers to a combination of scientific techniques which might be used as a traceability tool to check whether or not the alleged origin of 3T concentrates as declared in accompanying documents can be verified. AFP compares a sample from a shipment in question (control sample) to samples of the documented origin stored in a database (reference samples). This is done by analyzing characteristic geochemical features preserved in mineral concentrates which reflect the source-specific mineralogical and geochemical features related to the unique geological context of each deposit. The final comparison of these features between control and reference sample is achieved by applied statistics and evaluates whether or not the declared origin given in the documents of a shipment in question is plausible.

Applying AFP generates geochemical mineral traceability information which is widely independent of shipping documentation and tagging procedures thus allowing the robust verification of the integrity of these standard traceability measures. However, AFP is designed as an optional proof of origin within the certification framework of 3Ts and does not represent an alternative to everyday mineral traceability techniques (e.g., tagging). Instead, AFP shall be used on a spot check base to verify the integrity, and thus credibility, of the applied traceability scheme.

Four main steps constitute the AFP method which are described in the following.

AFP sampling and sample preparation

AFP sampling refers to sampling of mineral concentrates (coltan, cassiterite, wolframite). AFP samples represent mineral concentrates sampled at mine sites, storage sites, processing centers, and along the mineral supply chain.



Figure 1: *Left:* Miners washing materials with water in order to get mineral pre-concentrates. *Right:* AFP mineral sampling.

¹ AFP is a method situated in an environment with many different actors. According to the specific focus and insight into the mining business, usage of a homogeneous terminology concerning all aspects of 3T mining activities is difficult to achieve. The definitions of relevant terms (e.g., mine site) used in relation with AFP might therefore vary from those of others stakeholders or institutions. The most significant terms and definitions are presented in the appendix.

AFP sampling has to be carried out by accredited samplers from the national geological surveys in AFP pilot countries, BGR or AMU staff according to AFP sampling procedures as stipulated in the AFP manual (see appendix). There are two types of AFP sampling:

- *AFP reference sampling*, that is, sampling to integrate a specific mine site into the AFP reference sample database and
- *supply chain “AFP control sampling”* to verify the supposed origin of a mineral shipment.

AFP reference sampling has been conducted in coordination with the *Direction Générale de Géologie et Mines* (recently changed to *Office Burundais des Mines, OBM*) under the Ministry of Energy and Mines in Burundi, the Geology and Mines Department of Rwanda Natural Resources Authority in Rwanda (recently changed to *Rwandan Mines, Petroleum and Gas Board, RMB*) and with different national stakeholders such as the *Cadastre Minier* (CAMI), the *Division des Mines* and *Service d'Assistance et d'Encadrement du Small Scale Artisanal Mining* (SAESSCAM) in DRC.



Figure 2: Left – Typical AFP mineral concentrate sample (ca. 50 g; diameter of flask = 4 cm); Center – Grinding machine used to prepare mounted AFP sample for polishing. Right – Polished section of sample for AFP analysis.

After sampling, the AFP samples are prepared as polished sections in the respective AFP preparation laboratories in Bujumbura (Burundi), Bukavu (DRC) and in Kigali (Rwanda). A representative sample size should correspond to 50-100 g which is reduced to about 5 g by representative sample splitting in the laboratory. These grains are then embedded into epoxy resin on a sample mount (1 inch in diameter) and polished such that their grain interiors are exposed for subsequent analysis (Figure 2).

Mineralogical analysis

The mineralogical composition of an AFP sample is assessed by scanning electron microscopy (SEM) with attached automated particle analysis software. All mineral grains exposed on the sample surface are automatically analyzed and the information is compared to a calibrated standard mineral reference database. The software automatically identifies individual minerals and quantifies their respective proportions.



	Name	Area %
	Mn-Columbite	21.64%
	Cassiterite	14.38%
	Almandine-Spess...	13.58%
	Albite	13.33%
	Fe-Columbite	10.04%
	Mn-Tantalite	5.29%
	Pyrite	5.01%
	Goethite	4.60%
	Quarz	3.71%

Figure 3: Left - Automated particle analysis image of a polished section prepared from a cassiterite-coltan ore concentrate; Right – Legend and mineralogical composition

Mineral geochemistry and geochronological analysis

Based on the automated SEM screening of the whole polished section, about 50 individual grains are randomly selected and are analyzed for major and trace elements by laser ablation inductively coupled mass spectrometry (LA-ICP-MS). By this method, 30, 42 and 50 elements are analyzed in cassiterite, coltan and wolframite respectively. The measurement includes uranium and lead isotopic analysis in order to calculate U-Pb model ages to constrain the geological timing of mineralization. Thus obtained are unique for each mineral deposit.

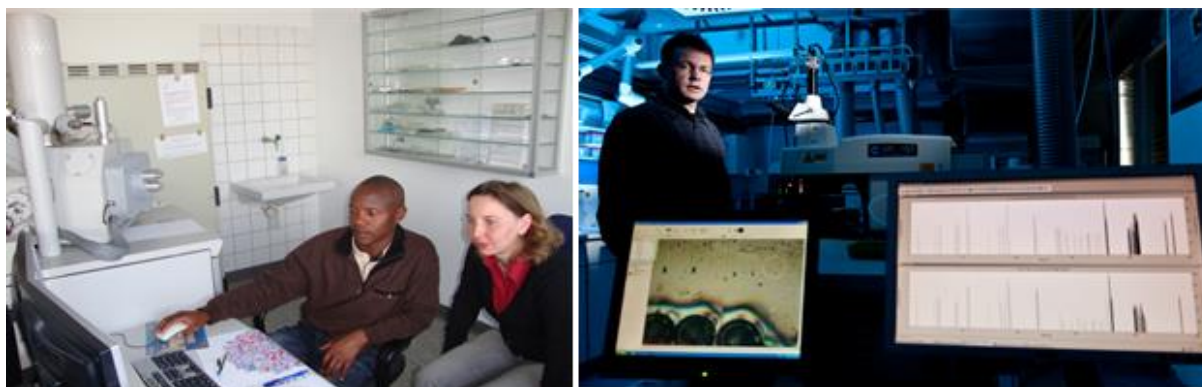


Figure 4: AFP measurements at BGR (Hannover, Germany). Left – Scanning electron microscopy (SEM) to obtain quantitative mineralogical information on mineral concentrates. Right – Laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) to obtain mineral-specific compositional data (geochemistry and isotopes).

Both mineralogical and geochemical analyses of polished sections from the Great Lakes region will be conducted by the African Minerals and Geosciences Centre (AMGC) in Dar es Salaam, Tanzania where the AFP analytical laboratory had been setup. All polished sections from AFP preparation laboratories to be subject to AFP analysis will pass through AMU for quality control prior to analysis at AMGC.

AFP data evaluation

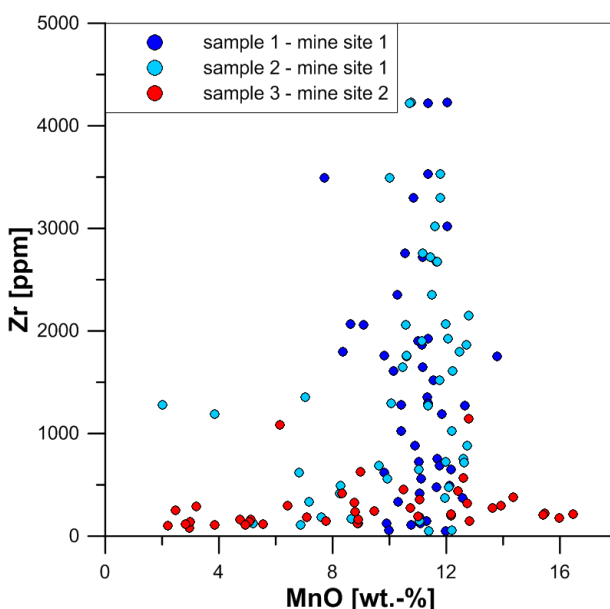


Figure 5: Example of data variability for two samples with common origin (blue) and one sample with different origin (red) for MnO and Zr.

AFP data evaluation aims to check the integrity of mineral traceability measures along a given supply chain by verifying the documented origin of a mineral shipment. This is done by comparing geochemical data from a mineral shipment in question to data from a reference sample of the supposed origin stored in the AFP reference sample database. A degree of statistical similarity in the geochemical composition of the two samples has to be established and evaluated bearing in mind the special nature of ore concentrate data like huge variability, not normal distribution of the data, and others. A detailed description of this procedure is given in Gäbler et al. (2017) for wolframite and can be applied for coltan and cassiterite as well.

The nature of the AFP data evaluation process is best illustrated by considering the following example: Figure 5 shows the concentrations of manganese (Mn) and zirconium (Zr) in three coltan concentrates. Mn as a major element in coltan is traditionally given as the oxide MnO in weight-%; Zr as a trace element is usually given in mg/kg also known as part-per-million (ppm). Each data point represents the analysis of one coltan grain. In this example, two samples were taken on the same mine site (mine site 1) and a third sample was taken on a different mine site (mine site 2). As shown in the left image, sample 1 and 2 share a similar distribution field with the majority of the grains plotting between 6 and 13 weight-% MnO and between 10 and about 5000 ppm of Zr. In contrast, the values of sample 3 display a wider MnO spread between 2 to 16 weight-% and significantly lower Zr concentrations between 10 and 1000 ppm.

Cumulative frequency diagrams can be used to uncover similarities and differences between data sets. Fig. 6 presents such diagrams for the three samples using the parameter MnO and Zr. Similarities and differences between the samples are now expressed by calculating the Kolmogorov-Smirnov statistic (often called “Kolmogorov-Smirnov distance”, KS-d) which is defined as the maximum vertical distance between two cumulative frequency diagrams. As two samples with a common origin are supposed to be geochemically similar to each other they should yield a small KS-d whereas two samples with different origin will most likely be geochemically different to each other and show a large KS-d. This can also be observed in the given example where the maximum vertical distance between the blue curves (same mine site) is smaller than the distance between any blue and the red curve (different mine sites).

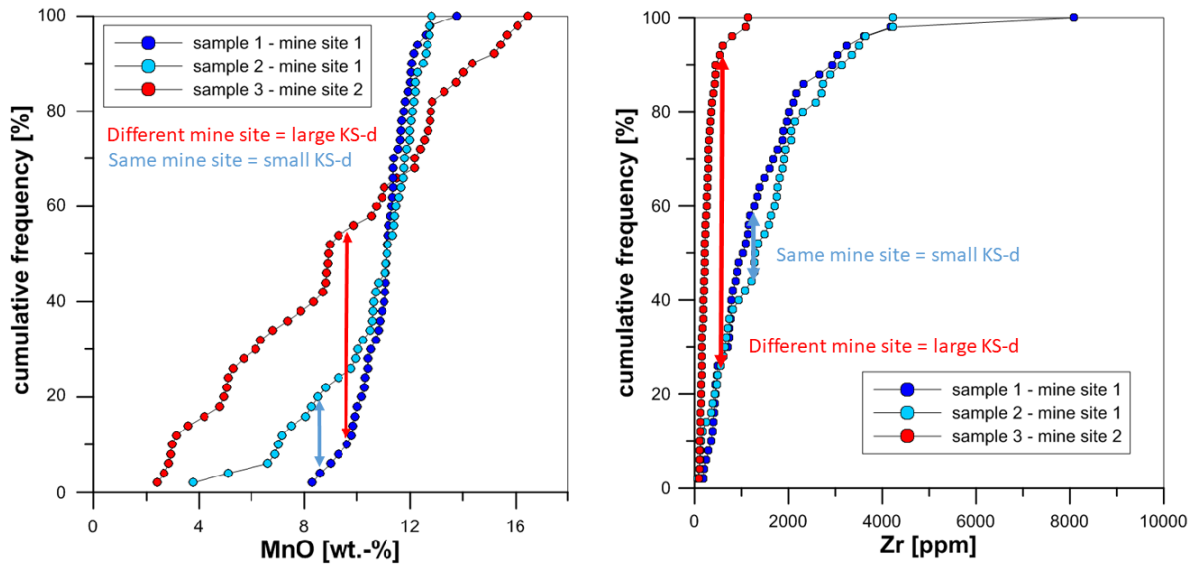


Figure 6: Example of data variability for two samples with common origin (blue) and one sample with different origin (red) for MnO (left) and Zr (right).

In the above example only two elements have been used to illustrate what AFP data evaluation is based on. In practice, AFP combines statistical evaluations of up to 42 different elements (for each of the ~50 grains to be analyzed) and evaluates the results based on the knowledge of the typical behavior of ore concentrates originating from the same or different mine sites. If the documented origin of a sample (e.g., from the supply chain) is in doubt, the statistical comparison of geochemical data between this sample in question and the reference sample (related to the documented origin) must result in small Kolmogorov-Smirnov distances or the doubt on the origin is persisting.

Additional geochronological and to a minor extent mineralogical data evaluation is carried out for AFP to check whether the sample in question and the related reference sample share the same geological age and mineralogical features typical for a given mining region and the processing steps along the associated supply chains.

With the support of BGR, AFP data evaluation is carried out by the AFP Management Unit (AMU) established at ICGLR headquarters in Bujumbura. AMU thus provides the link between the compositional data generated through AFP measurements and the practical application of AFP in a supply chain due diligence/mineral certification framework.

The interaction of the different entities and key stakeholders during the process of AFP testing is illustrated in figure 7.

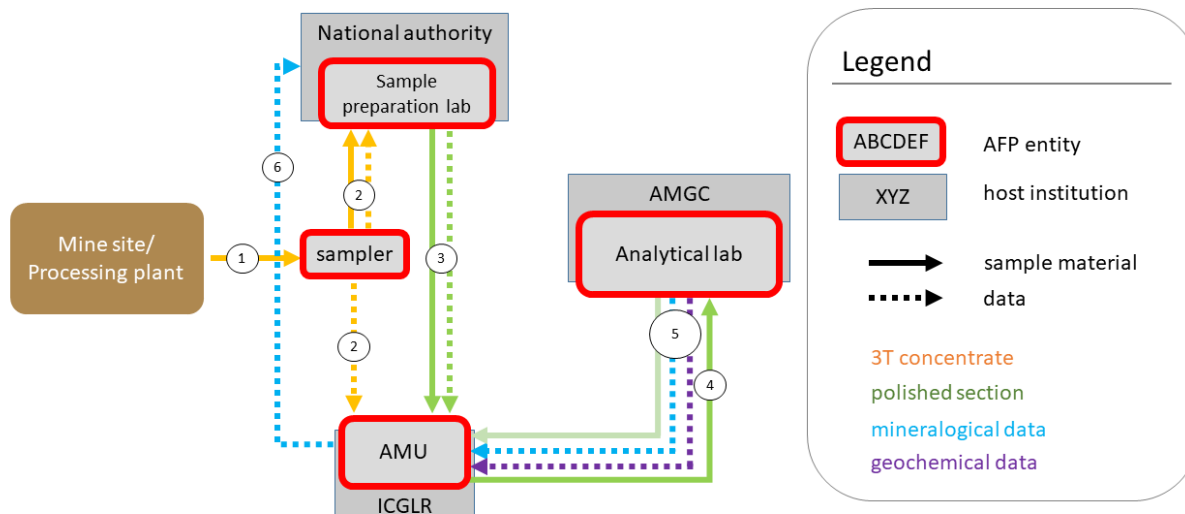


Figure 7: Flow sheet of sample material and data between AFP entities and key stakeholders of AFP testing: 1) sampler takes a sample of an ore concentrate; 2) sampler forwards sample material and sampling data to the sample preparation laboratory and to AMU (data only); 3) the sample preparation lab provides AMU with prepared polished section and related data for documentation; 4) AMU checks quality of polished section and forwards the polished section to the analytical lab hosted at the premises of the African Minerals and Geosciences Centre (AMGC); 5) after analysis, the analytical lab provides AMU with mineralogical and geochemical (incl. age) data for statistical data evaluation. The polished section remains in the analytical lab's custody for eventual re-analysis; 6) data sharing: AMU provides national authorities with mineralogical data of reference samples to improve member states' overview on valuable minerals.

3. Feasibility of AFP implementation

Technical considerations

AFP is a method based on scientific analyses and several prerequisites are essential to its applicability. First and most important, it is crucial to understand that AFP is comparing a sample composed of at least 50 grains of a 3T mineral to an equivalent reference of the AFP database. This also implies that AFP is not a standalone tool and is depending on accompanying documents indicating the origin (i.e. mine site) of the respective sample. In order to allow AFP testing, a sample to be tested hence must contain at least 50 grains of either cassiterite, coltan or wolframite AND the respective reference data of the indicated origin must be included in the AFP database.

Secondly, AFP is a tool to strengthen the credibility of a given supply chain by verification of the alleged origin. In this way, AFP is similar to DNA paternity testing: Both methods require a test material (AFP: 3T mineral concentrate; paternity testing: e.g., hair of a child) and a reference material (AFP: 3T reference sample; paternity testing: hair of the potential father). Test and reference material are analyzed for specific features (AFP: distribution of geochemical parameters; paternity testing: DNA profile). The similarity of these features is evaluated by statistic methods to state whether both materials may have a common origin or not.

In the end, DNA paternity testing supports or rejects the hypothesis of a man being the father of a specific child. Likewise, AFP supports or rejects the assumption that a tested 3T concentrate was derived from a parental ore body as indicated in accompanying documents.

From the view of AFP, a mine site is defined as an area of mineral extraction of limited lateral extent which mines a single ore body. However, sometimes mine sites are very large, the mineralization is quite complex or more than one mineralization is present. Each of these circumstances will make it necessary to take more than one reference sample in order to catch the geochemical variability of the mine site.

Another factor which has to be taken into account is the time needed for an AFP test result. Sampling, preparation of polished sections, analyses and evaluation cannot be accomplished on the spot and require several days.

Implications of mining and processing techniques, mixing and blending

3T ore is mined and processed by various techniques that mainly aim to produce a high grade ore concentrate (concentration of valuable ore minerals, reduction of country rock components). In the Great Lakes region, this is overwhelmingly accomplished by physical means, which do not alter the valuable ore minerals by chemical treatments. This keeps the original geochemical signature of the valuable ore minerals, which is the relevant information for AFP. Mineral extraction is done using explosives, hammers, shovels and sluice boxes, which will at most reduce the grain size. Similarly, the stages of processing mostly comprise the application of crushers, jigs, spirals and shaker tables without any AFP-relevant geochemical effect on minerals. A processing technique with a limited impact on AFP analyses is the potential application of magnetic separators, used e.g., to reduce the content in the Sulphur-containing and value-diminishing mineral pyrite. However, this will only derive a slightly different SEM analysis and has no influence on the subsequent geochemical AFP evaluation.

According to the AFP definition of mine site, “mixing” occurs where 3T minerals from different geological ore bodies are combined. As the latter are relatively small, a concession often hosts more than one mine site and 3T minerals from different geological ore bodies are therefore often combined (mixed) before they leave the concession. With regards to tagging and the related different definition of mine site by, e.g. CoC service providers, this means that a tagged bag leaving the concession often represents a mixture of multiple mine sites according to the AFP definition.

In contrast to mixing (which basically just means combination of minerals from different mine sites), blending is not only a combination of “mixed” concentrates but moreover means a homogenization of specific amounts of concentrates to meet a certain mean grade (for export). Both mixing and blending have a significant impact on AFP applicability and similar to DNA testing, the results of any AFP evaluation become less reliable the more complex the mixture is. At the moment, mixed/blended concentrates can only be checked if the variability and the complexity of the mixture were found to be suitable for AFP.

Supply chain framework - overview

A mineral supply chain is a system including “... all the activities, organisations, actors, technology, information, resources and services involved in moving the mineral from the extraction site downstream to its incorporation in the final product for end consumers” (OECD Due Diligence Guidance).

This definition implies that all sources of minerals that constitute the shipment are known and any alteration of the minerals’ such as processing or mixing is documented. The extraction site as the first level (=source) could be a single mine site or a combination of mine sites within a common mining concession. The last logical level of the supply chain is the smelter because

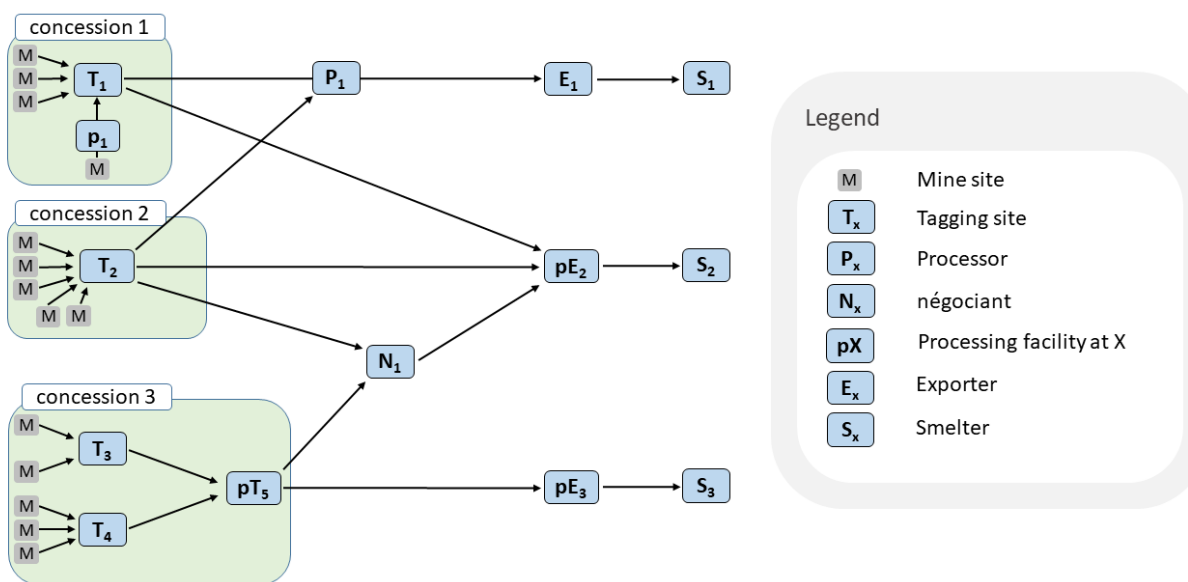


Figure 8: Overview on examples of possible upstream 3T supply chains

minerals are broken up during smelting. Intermediate traders (often called *négociants*), processors and exporters are in between and among those roles some individuals or companies might fill two or even all positions while in some chains one actor is missing (e.g. intermediate traders). As there is no smelter in the ICGLR region, exporters of 3T mineral concentrates currently represent the last actor of the 3T mineral supply chain framework considered hereafter.

As shown exemplarily in Figure 8, supply chains may be very complex. For example, there are several possibilities for the individual mineral flow before even leaving the concession level and several possibilities of where and when 3T ore is first processed. It could be either on the mine level (p1), on the concession level (p1, pT5), by an independent actor (P1) or by the exporters themselves (pE2, pE3). A special case is when the roles of concession holder, processor and exporter are filled by the same company. This might represent a modification of the situation described on concession 3 at pT5. However, this is usually only found true for big concessions (e.g. Rutongo in Rwanda). In particular in DRC, there are intermediate traders (N1) who purchase concentrates at the tagging sites and sell them to exporters.

Chain of custody

In order to facilitate traceability of minerals, chain of custody (COC) systems have been implemented referring to the chronological documentation of the disposition of minerals along a given supply chain. With regards to 3T minerals in the Great Lakes region, there is currently only one COC system in place called “bagging and tagging”. This manual system works by attaching tags on the 3T concentrate bags as they move along the supply chain. At each stage, a piece of information is additionally attached which thereby supports the traceability documentation.

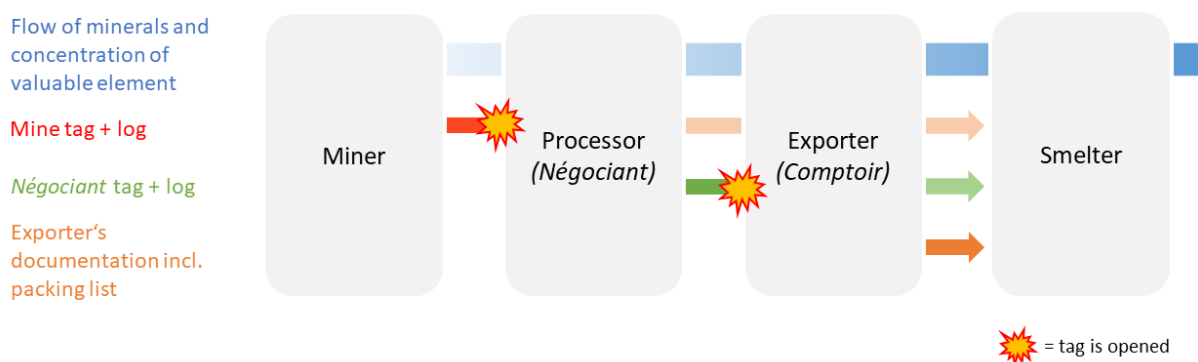


Figure 9: Schematic illustration of “bagging and tagging” along 3T mineral supply chains. The mineral concentrates produced at the mine site (miner) are tagged onsite to protect the bags against illicit material influx. The concentrate is transported to a processing facility (processor, or “négociant” in DRC) where the mine tags are opened in order to allow the concentrate of the bags being processed or mixed. The processed concentrate is put in big bags (along with the related mine tags) and marked with a “négociant tag”. The exporter (called comptoir in DRC) will open those tags, further upgrade and blend the concentrates before delivering concentrates, mine tags, négociant tags, all logs as well as his own documentation to the smelter.

There are two types of tags: the “mine tag”, attached to the bags (~50 kg) at the mine site or the concession and the “*négociant* tag”², attached to large bags (~50-500 kg) used by intermediate traders, transporters or processors. Both types of tags are opened during their movement along the supply chain but accompany the minerals to the smelter level. An illustration of the different tagging steps is given in Figure 9.

Tagging provides a complete chain of custody of minerals as the documents travel with the shipments from the mine site to the point of export. The credibility of the system is cross-checked by tagging agents affiliated to COC service providers and national authorities. Other COC systems that are completely electronic, are currently under development. Some confusion regarding the implementation of AFP in context with the COC framework arises from the varying definitions of terms, in particular *mine site* or *mine*. In context with AFP, a mine site is defined as a location of mineral extraction of limited spatial extent. For large or more complex mine sites with several separated spots of ore extraction and apparent and reasonable spatial relation to each other (which allows to assign them to originate from a mutual ore body) sub-mine sites are defined which refer to individual tunnels or small open pits (in the dimension of a few meters) from which ore is extracted. Additional confusion is created by the incoherent use of the term “mixed concentrates” describing the mixing of ore concentrates with different

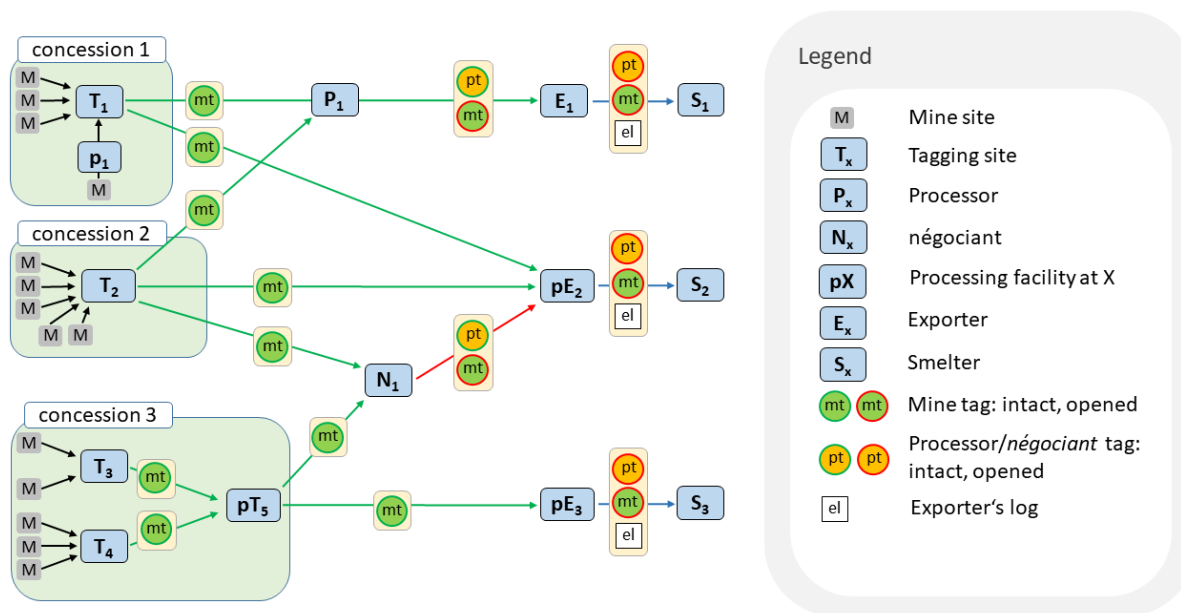


Figure 10: Simplified illustration of possible upstream supply chains of 3T minerals and related application of a chain of custody traceability scheme (tagging).

origins. However, from the view of AFP it is crucial to know if a “mixed concentrate” contains ore concentrates from different mine sites of the same concession or if the mixture is comprised of ore concentrates from different concessions. The issue is closely related with

² *Négotiant* tags enclose processed material in general OR separate, mine-tagged bags

tagging sites because (theoretically) there should be one mine site per tagging site but due to the small size of many mine sites, there are mostly at least two mine sites per tagging site. However, in that case, the specific mine site should be declared in the documentation. An illustration showing some examples of upstream mineral supply chains and the relation to an applied “bag and tag” CoC scheme is shown in Figure 10.

AFP-relevant mineral flow

As a result of prerequisites and technical considerations for AFP as described in Implications of mining and processing techniques, mixing and blending, information on the lowest levels of the supply chain and accompanying CoC documents are crucial for a potential AFP application and are therefore discussed in detail in the following. Usually, concession holders employ subcontractors who do the actual mining and are obliged to sell the mined concentrates to the mine owner, i.e. the concession holder or the concession holding company. There is often only one subcontractor per mine site who is organizing mining activities in different teams comprising an own hierarchy (team leaders, group leaders, diggers, carriers, etc.). Processing is often applied both before and after initial tagging (p1, pT5) and usually concentrates leave the concession in mine-tagged bags. The essential question concerning AFP application is when and where mineral concentrates from different mine sites are mixed and what is the relation between them (same concession/ different concession). Generally, mixing mostly occurs at tagging and processing sites but tagging and processing of each subcontractor’s production is often done separately (i.e. per mine site) in order to facilitate a reasonable payment according to the grade of the unprocessed concentrate (see figure 11).

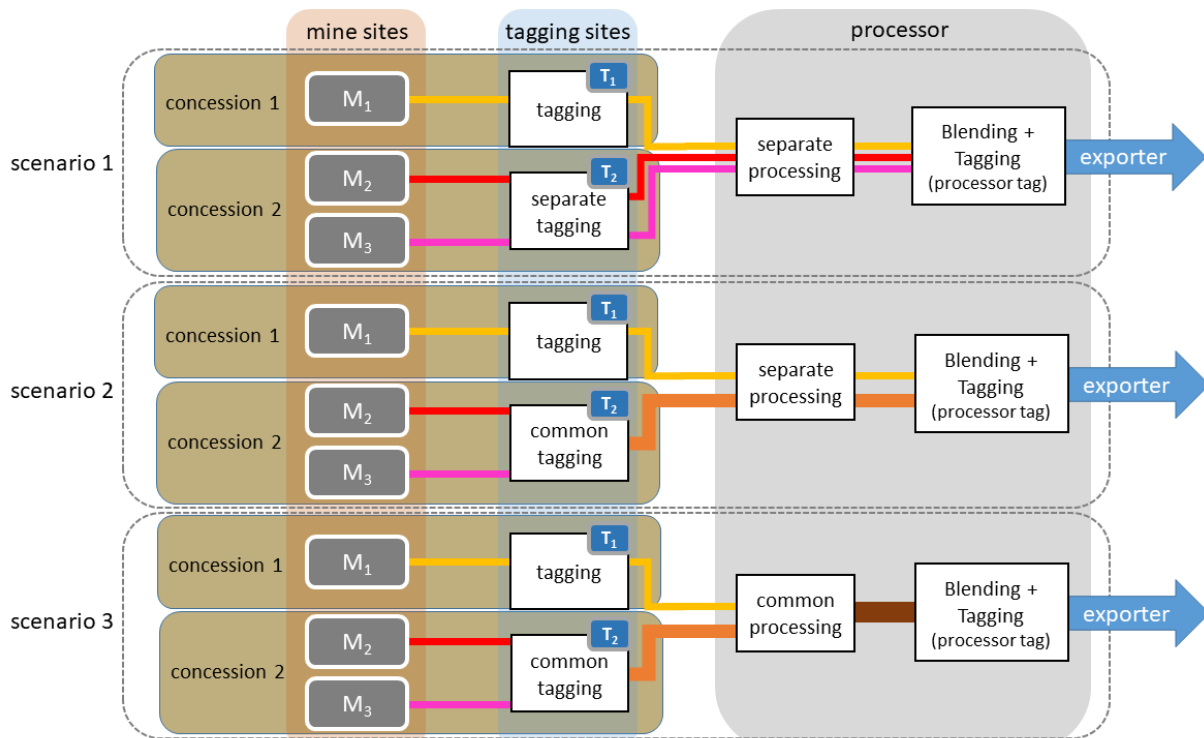


Figure 11: Exemplary mineral flow scenarios from mine sites via (mine) tagging sites to a processing plant where the grade of minerals is processed, blended and (processor-) tagged. The degree of mixing of concentrates with different origin increases from scenario 1 to 3 as more points of mixing appear in the supply chain.

The scenarios presented in figure 11 might serve as models to generalize existing entry level supply chains as most of the individual supply chains might be represented by one or some sections of one of those scenarios. In order to propose some AFP application scenarios, these general supply chain examples, or parts of it, will be used in order to further discuss AFP applicability throughout this document.

4. Differences between mineral supply chains in the region

As a result of the varying organization of mining activities, environment and mining policies, there are differences between mining sector in Burundi, DRC and Rwanda. Most relevant to the AFP implementation is the organization on concession and lower supply chain levels as described in the previous chapter.

Concession size

The usual size of a concession in DRC is normally by some factors larger than its Burundian and Rwandan equivalents and Congolese mining permits often cover more exploitable minerals. Concessions in DRC often cover more than 1000 ha and a range of substances like Au, Ag, Nb, Ta, Sn, W, Co, Cu and diamonds while e.g. about 80% of concessions in Rwanda are less or equal to 400 ha and mostly cover only up to three substances (Nb, Ta, W; rarely gold). Although concessions in DRC are larger and normally host several mine sites distributed all over the area the number of tagging sites per mine site is not higher than in Burundi and Rwanda. This is due to the infrastructure situation which doesn't allow that every mine site gets its own tagging site. In DRC, it has been agreed that one tagging site should cover the mine sites located on a radius of a diameter of 25 Km.

Supply chain framework and the role of *négociants* tags

Due to differences e.g. in the local infrastructure and security situation, processing facilities for 3Ts of ASM production in DRC are overwhelmingly located in Goma or Bukavu. As a consequence, intermediate traders, or synonymously *négociants*, are by significant numbers involved in the mineral trade in DRC as transporters and traders. In contrast, processing facilities in Rwanda are scattered all over the country and *négociants* have lately been officially banned from the official supply chain framework (the related *négociant* tags still exist). Individuals who used to act as intermediate traders are still part of the Rwandan supply chain framework but now officially represent processors or exporters as sales buyers and sales agents.

A confusing element of the present CoC system is that actors who are buying from the tagging sites (intermediate traders) and those who are buying from these traders (processors/exporters) are both obliged to use *négociant* tags. It is therefore important to analyse the role of actors and the nature of the material they are handling:

The ***négociant*** is mostly an individual who is moving in a pick-up or small truck from one tagging station to another (also at different concessions) and buys mine-tagged minerals which he will then transport and sell to a processor.

The **processor** (who almost always is also exporting) is mostly a company with processing facilities which buys ore concentrates either directly from the mine owners, from *négociants* or the processor/exporter receives the concentrate from an own mine site. In Rwanda, processors also provide solely the processing service to customers without buying the concentrate.

Generally, a ***négociant* tag** has to be put on bags if these contain ore concentrates from more than one mine site. However, in DRC, *négociants* are obliged to use a *négociant* tag when moving ore concentrates beyond the concession, regardless whether the concentrate is mixed or unmixed.

A *négociant* tag may thus contain either

- i) processed ore concentrates from one or more concessions or
- ii) unprocessed, mine-tagged ore concentrate.

In Rwanda, it is assumed that more than 50% of all *négociant*-tagged concentrates are related to case i and might correspond to scenario 2 and 3 (see Fig. 10). In contrast, more than 50% of the *négociant* tags in DRC are declared to contain unprocessed, mine-tagged material (→ case ii) and correspond to scenario 1 and 2. In Burundi, only case ii is applied and the related scenario 1 is supposed to occur as required by the authorities.

5. Discussion of potential AFP application scenarios

Where along the supply chain does AFP sampling make sense?

AFP control samples should be taken from the lower upstream supply chain levels, preferably in concertation to a COC traceability scheme. The relevant technical considerations and AFP prerequisites point at unmixed 3T concentrates, i.e. 3T mineral concentrates from the stock of individual mine sites, unmixed mine-tagged shipments as well as those processed separately (see figure 12).

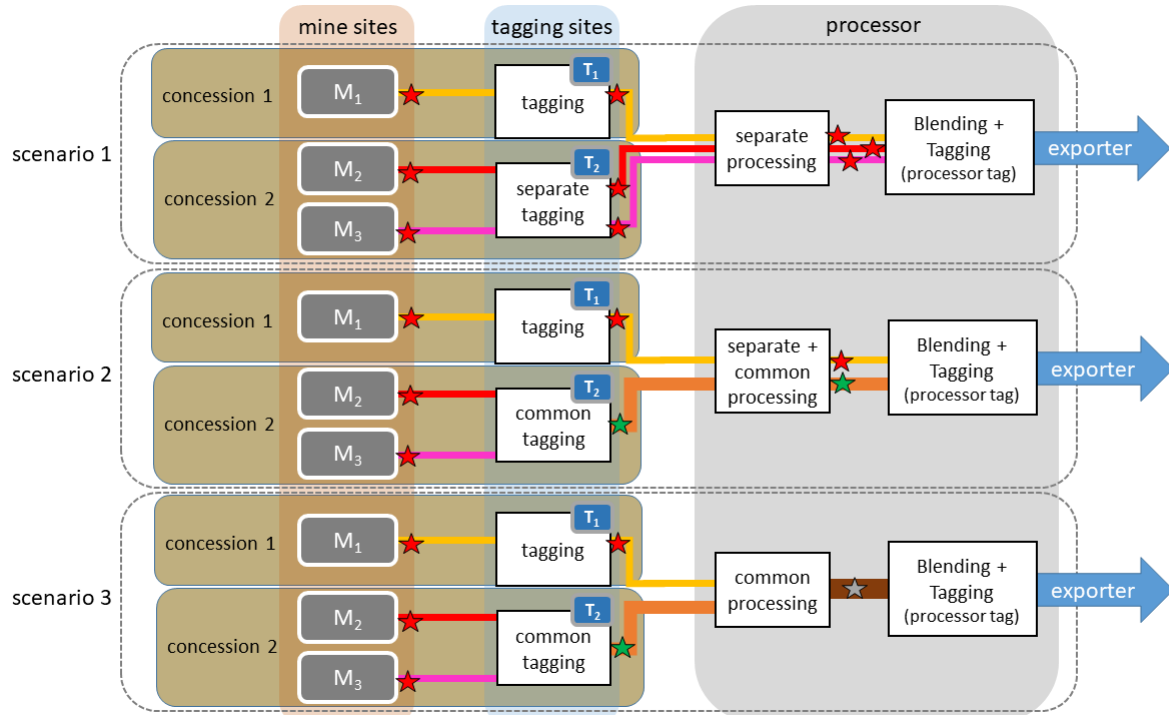


Figure 12: Exemplary mineral flow scenarios from mine sites to processors with possible AFP control sampling spots (red star). As the degree of mixing concentrates with different origin increases from scenario 1 to 3, the degree of AFP applicability is reduced accordingly. In some cases, geochemical variability might allow additional AFP application (green stars). Common processing of concentrates from different concessions as applied in scenario 3 does not allow AFP application (grey star).

Scenario 1 provides an example of AFP application for all included mine sites' material up to (but excluding) export material. In scenario 2, AFP can only be applied on the mine sites' stock as well as on the mineral flow related to mine site M₁ because M₂ and M₃ are tagged together as mixture. Scenario 3 is most restricting concerning any AFP application as control sampling may only target mine sites' stock and tagged shipments between M₁ and the processor.

However, when concentrates of different mine sites of the same concession are mixed this might also facilitate AFP application because it is likely to find geochemical similarities between them. If that is the case, AFP can be applied on mixed, mine-tagged concentrates of T₂ in all scenarios plus the common processed concentrates in scenario 2. The common processing of concentrates from different concessions as applied in scenario 3 does not allow AFP application as the geochemical variability is regarded as insufficient for AFP at this state.

Who should request AFP control sampling?

Two initial motivations for AFP control sampling have been defined previously which is:

- 1) proactive request by a mining company or their customers wishing to demonstrate a conflict-free origin of their minerals and
- 2) forensic tool in the frame of COC risk assessments, supply chain due diligence audits and special investigations.

OECD guidance, Dodd-Franc as well as the upcoming European law include the companies' responsibility to assure due diligence steps are taken in order to assure transparency in their respective mineral supply chains and minimize the risk of illicit actors taking part in the business. This responsibility is closely related to motivation 1 and depending on the companies' activities there are two specific reasons for AFP requests:

- Mining companies would want to assure potential buyers that the minerals they are selling are originating from their concession.
- Processors and exporters want to make sure that the minerals they are buying are provided by integer suppliers who declare the origin of their minerals correctly. This helps them to convince buyers of their processed product of its legitimacy.

Application of AFP thus increases the transparency and credibility even among upstream actors which will benefit to the mutual trust in the mining sector including the relationship between private companies and the national authorities. However, AFP should only be requested by actors handling unmixed concentrates to some extent as described in the previous chapter. Requests for AFP testing on concentrates from various concessions cannot be accepted at this state of AFP.

An increase of transparency and credibility can also be achieved for the RCM scheme, related with motivation 2. In case of doubt on the origin of minerals of a specific supply chain, special investigators (national or international) may request AFP in order to gather further information on the credibility of applied due diligence or traceability schemes. Hence, this will also improve the credibility of the engaged, legit actors from the private sector as well as the RCM scheme itself which would serve the goal of keeping market access of the Great Lakes region.

6. Proposed implementation strategy

According to AFP technical prerequisites, AFP should be applied at the mine sites and tagging sites as well as at the processor level on unmixed concentrates if the peculiarities of the individual supply chain does allow that. AFP control sampling should focus on stock material of the individual mine sites, mine-tagged bags of the former arriving at the processor and unmixed processed concentrates (including exporter level).

Implementation should be realised as a continuous process and begin at the lowest level of the supply chain, i.e. at the stock of unmixed concentrates of mine sites, where AMU and BGR have gained some experience in the past. Some control samples from the stock have been taken already previously during mine site visits. This could be extended in parallel to ongoing reference sampling campaigns that AMU and BGR would conduct anyways. Based on this, control sampling can be taken to tagging sites (also mixed) to gain further experience and then to processor's level.

The credibility of sampling is in general quite delicate and thus control sampling should be carried out exclusively by AMU and BGR, or in their presence respectively, during the implementation phase. At a later stage, other actors such as auditors might be legitimised to take control samples as soon as this does not affect the independence of the audit or investigation. The matter is related to the announcement of case of doubts which also is in the responsibility of the IMCA and auditors (third party auditors).

The extent of sampling (continuous reference and spot check control) cannot be generalised due to the heterogeneous production of the different actors. As a suggestion, AMU and BGR should work out a procedure that links the sampling frequency to the production.

To further AFP acceptance in the region, it might be good advice to differentiate between the motivations 1 and 2 (proactive request by company vs. supplement in an investigation case) concerning the explanatory power of any AFP test result. Motivation 1 is voluntarily (!) driven by the desire to demonstrate adherence to due diligence aiming at mineral origin verification. In contrast, motivation 2 is related to a non-voluntarily investigation of fraudulent behaviour by misrepresenting the mineral origin. In order to promote the acceptance of AFP and keep the power of AFP for investigators it is suggested to i) aim only at positive validation for motivation 1 requests and ii) aim at both positive and negative for motivation 2 requests.

Selection of proposed control sample locations for the AFP implementation

As of 2015, Rwanda had 101 certified mines of 3T minerals. 14 mines sites were of cassiterite, 15 mine sites were of Wolframite only, 15 mine sites were cassiterite as first mineral and coltan as second mineral with mixed cassiterite-coltan as third mineral, 55 mine sites were of mixed cassiterite and coltan and 2 were of coltan only. Out of 101 mine sites, 48 mines sites were exploration sites, which were also certified as mine sites under mineral certification scheme.

The next section make suggestion of proposed AFP implementation sampling sites in respect to each mine site, per mineral, in reference to AFP sampling map in Rwanda. AFP sampling map was superimposed on the mine sites locations and considering adequate AFP reference sampling influence zone, the implementation sampling sites are proposed.

Cassiterite

Table 1 shows the details of mine sites in this category. This table identifies 14 mine sites that were cassiterite only, of which 5 were under exploration. Based on AFP reference samples³, 8 mining sites were identified suitable for AFP implementation sampling under this implementation plan. However, five mine sites are suggested and preferred for control samples. This is based on the availability of nearby AFP reference samples. These five mine sites are highlighted in table 1 and listed in table 2 separately. They are (not in any order of preference):

- Nyagasagara,
- Rutongo Mines Concession,
- Rwinkwavu,
- Muntambara, Gitega, Batimba and Kidogo,
- Muhura-Nduba-Akabuga-Nyabisindu

Table1: Showing feasible mine sites for AFP Control samples; cassiterite.

Cassiterite										Feasible sampling site	Possible AFP reference sample number
Sl. No	Site ref	Mine Site No.	Mine Site (Perimeter)	ICGLR classification	Type of mineral license	Mineral 1	Mineral 2	Mineral 3	Mineral 4		
1	2	RW019/WP	Susa	Artisanal	Exploration	Cassiterite	N/A	N/A	N/A	Yes	1636
2	16	RW020/EP	Rugunga	Artisanal	Exploration	Cassiterite	N/A	N/A	N/A	No	No AFP Ref
3	20	RW015EP	Rukankama	Artisanal	Exploitation	Cassiterite	N/A	N/A	N/A	Yes	1418/1419
4	22	RW019/EP	Nyagasagara	Artisanal	Exploitation	Cassiterite	N/A	N/A	N/A	Yes	1124/1125/1144
5	24	RW023/EP	Muhanga	Artisanal	Exploration	Cassiterite	N/A	N/A	N/A	No	No AFP Ref
6	27	RW014/EP	Munini-Bujyujyu	Artisanal	Exploitation	Cassiterite	N/A	N/A	N/A	No	No AFP Ref
7	37	RW003/K	Kityazo	Artisanal	Exploitation	Cassiterite	N/A	N/A	N/A	No	No AFP Ref
8	57	RW001/NP	Rutongo Mines Concession	Small scale	Agreement (Exploitation)	Cassiterite	N/A	N/A	N/A	Yes	1179/1186/1187/1188/1189/1193/1194
9	72	RW055/EP	Rwinkwavu	Industrial	N/A	Cassiterite	N/A	N/A	N/A	Yes	1225/1227/1839
10	74	RW039/EP	Gakoma	Small scale	Exploration	Cassiterite	N/A	N/A	N/A	No	Not active
11	75	RW038/EP	Muntambara, Gitega, Batimba	Artisanal	Exploitation	Cassiterite	N/A	N/A	N/A	Yes	1397/1398
12	78	RW037/EP	Muhura-Nduba-Akabuga	Artisanal	Exploitation	Cassiterite	N/A	N/A	N/A	Yes	1458/1457/1494
13	79	RW036/EP	Rugarama	Artisanal	Exploitation	Cassiterite	N/A	N/A	N/A	Yes	1433
14	88	RW032/EP	Murwa-Jarama	Artisanal	Exploration	Cassiterite	N/A	N/A	N/A	No	No AFP Ref

³ The mine sites with no AFP reference sample, were not found suitable for AFP implementation sampling.

Table 2 showing the five suggested mine sites for collecting control samples (cassiterite)

Sl. No	Site ref	Mine Site No.	Mine Site (Perimeter)
1	22	RW019/EP	Nyagasagara
2	57	RW001/NP	Rutongo Mines Concession
3	72	RW055/EP	Rwinkwavu
4	75	RW038/EP	Muntambara, Gitega, Batimba and Kidogo
5	78	RW037/EP	Muhura-Nduba-Akabuga-Nyabisindu

Wolframite

Table 3 shows the details of mine sites in this category. As per this table, 15 mine sites were Wolframite only, of which 9 were under exploration. Based on AFP reference samples, 6 mining sites were identified suitable for AFP Control samples. However, three mine sites (exploitation ones) are suggested and preferred for control samples. This is based on the availability of nearby AFP reference samples. These three mine sites are highlighted in Table 3 and listed in Table 4. They are (not in any order of preference):

- Gifurwe
- Nyakabingo
- Bugarama Mining Concession

Table 3: Showing feasible mine sites for AFP Control samples; wolframite

Sl. No	Site ref	Mine Site No.	Mine Site (Perimeter)	Wolframite only						Feasible sampling site	Possible AFP reference sample number
				ICGLR classification	Type of mineral license	Mineral 1	Mineral 2	Mineral 3	Mineral 4		
1	10	RW023/WP	Ryabunani, Rutagara	Artisanal	Exploration	Wolframite	N/A	N/A	N/A	No	No AFP Ref
2	13	RW022/WP	Ngurugunzu	Artisanal	Exploration	Wolframite	N/A	N/A	N/A	Yes	1488/1501
3	17	RW026/EP	Kibaza/Dihiro	Artisanal	Exploration	Wolframite	N/A	N/A	N/A	No	No AFP Ref
4	28	RW015/NP	Runyempundu	Artisanal	Exploration	Wolframite	N/A	N/A	N/A	Yes	1483/1503
5	32	RW014/NP	Nkoma, Nyarurama	Artisanal	Exploitation	Wolframite	Gold	N/A	N/A		
6	39	RW002/KC	Buhiza, Nkusi	Small scale	Exploration	Wolframite	N/A	N/A	N/A	No	No AFP Ref
7	56	RW004/NP	Gifurwe	Small scale	contract for mining	Wolframite	N/A	N/A	N/A	Yes	1195/1201/1202/1203/1204/1205
8	58	RW002/NP	Nyakabingo	Industrial	Special	Wolframite	N/A	N/A	N/A	Yes	1025/1026/1028/1032/1033/1034
9	59	RW003/NP	Bugarama Mining Concession	Small scale	Exploitation	Wolframite	N/A	N/A	N/A	Yes	1211/1214/1215/1217/1219/1220
10	73	RW043/EP	Muhamba	Artisanal	Exploration	Wolframite	N/A	N/A	N/A	Yes	1354/1357
11	77	RW044/EP	Nyanga	Artisanal	Exploration	Wolframite	N/A	N/A	N/A	No	No AFP Ref
12	81	RW034/EP	Rwamashyongoshyo and Rweri	Artisanal	Exploration	Wolframite	N/A	N/A	N/A	No	No AFP Ref
13	85	RW031/EP	Kibabara	Artisanal	Exploration	Wolframite	N/A	N/A	N/A	No	No AFP Ref
14	87	RW039/EP	Ruramira-Bugambira	Artisanal and Small scale	Exploitation	Wolframite	N/A	N/A	N/A	No	No AFP Ref
15	94	RW001/SP	Rongi	Artisanal	Exploitation	Wolframite	N/A	N/A	N/A	Yes	1277

Table 4 showing the three suggested mine sites for collecting control samples (Wolframite).

Sl. No	Site ref	Mine Site No.	Mine Site (Perimeter)
1	56	RW004/NP	Gifurwe
2	58	RW002/NP	Nyakabingo
3	59	RW003/NP	Bugarama Mining Concession

Coltan

Two mining sites existed which mined coltan as first mineral. Both of them are suggested for AFP implementation sample. Table 5 shows the details.

Table5: Showing feasible mine sites for AFP Control samples; coltan

Sl. No	no	Mine Site No.	Mine Site (Perimeter)	Coltan first mineral						Feasible sampling site	Possible AFP reference sample number
				ICGLR classification	Type of mineral license	Mineral 1	Mineral 2	Mineral 3	Mineral 4		
1	7	RW042/WP	Kiguri	Artisanal	Exploration	Coltan	Cassiterite	N/A	N/A	Yes	1314/1319
2	48	RW010/SP	Gataba-Nyakirobane	Artisanal	Exploitation	Coltan	mixed concentrate (cassiterite-coltan)	N/A	N/A	yes	1291

Mixed minerals mine sites:

Category 1. cassiterite 1st mineral, coltan 2nd mineral, Wolframite and mixed concentrate

In this category 15 mine sites were identified. 8 mine sites were identified feasible for AFP control samples. The table 6 show the listing and other details. No preference AFP implementation sampling was selected in this category. Due to their small size of operation (artisanal), their preference will be determined by status of their operation during AFP sampling exercise.

Table 6: Showing feasible mine sites for AFP Implementation Samples: Category 1

Cassiterite 1st mineral, Coltan 2nd mineral, Wolframite and mixed concentrate										Feasible sampling site	Possible AFP reference sample number
Sl. No	Site ref	Mine Site No.	Mine Site (Perimeter)	ICGLR classification	Type of mineral license	Mineral 1	Mineral 2	Mineral 3	Mineral 4		
1	25	RW017/EP	Mukarange-Gitoki	Artisanal	Exploitation	Cassiterite	Coltan	N/A	N/A	Yes	1442/1443/1446
2	26	RW022/EP	Gituza	Artisanal	Exploration	Cassiterite	mixed concentrate	N/A	N/A	No	No AFP Ref
3	30	RW013/NP	Bututsi, Kajwi	Artisanal	Exploitation	Cassiterite	Wolframite	N/A	N/A	No	No AFP Ref
4	36	RW005/KC	Nunga	Artisanal	Exploration	Cassiterite	mixed concentrate	N/A	N/A	No	No AFP Ref
5	38	RW004/KC	Bashyamba	Industrial and small scale	Exploitation	Cassiterite	Coltan	N/A	N/A	No	No AFP Ref
6	40	RW018/SP	Nyarubande	Artisanal	Exploitation	Cassiterite	Coltan	Wolframite	N/A	Yes	1495/1600/1613
7	46	RW021/SP	Nkoto	Artisanal	Exploration	Cassiterite	Coltan	mixed concentrate (cassiterite-coltan)	N/A	Yes	1468/1634
8	47	RW020/SP	Murambi-Cyatenga	Artisanal	Exploration	Cassiterite	Coltan	mixed concentrate	N/A	Yes	1637
9	49	RW019/SP	Kirwa	Artisanal	Exploitation	Cassiterite	mixed concentrate (cassiterite-coltan)	N/A	N/A	Yes	1342/1346/1348
10	50	RW018/SP	Nyamirama	Artisanal	Exploitation	Cassiterite	mixed concentrate (cassiterite-coltan)	N/A	N/A	Yes	1240/1241
11	55	RW022/SP	Kamuzi	Artisanal	Exploitation	Cassiterite	Coltan	mixed concentrate (cassiterite-coltan)	N/A	Yes	1518/1519
12	76	RW040/EP	Ngara	Small scale	Exploitation	Cassiterite	Coltan	N/A	N/A	No	No AFP Ref
13	80	RW035/EP	Bibare	Small scale	Exploitation	Cassiterite	Wolframite	N/A	N/A	Yes	1405/1406
14	84	RW078/EP	Kangamba	Small scale	Exploitation	Cassiterite	Coltan	N/A	N/A		766/767/769
15	89	RW042/EP	Isangano	Artisanal	Exploration	Cassiterite	mixed	Wolframite	N/A	No	No AFP Ref

Category2: Mixed concentrate of cassiterite and coltan

In this category 55 mine sites were identified. 32 mine sites were identified feasible for AFP control samples. The table 7 show the listing and other details. No preference AFP implementation sampling was selected in this category. Due to their small size (artisanal), their preference will be determined by their status of operation during the time of AFP sampling exercise.

Table 7: Showing feasible mine sites for AFP Control samples: Category 2

Sl. No	no	Mine Site No.	Mine Site (Perimeter)	Mixed concentrate of Cassiterite and Coltan						Feasible sampling site	Possible AFP reference sample number
				ICGLR classification	Type of mineral license	Mineral 1	Mineral 2	Mineral 3	Mineral 4		
1	1	RW018/WP	Gaseke	Artisanal	Exploration	mixed concentrate	N/A	N/A	N/A	No	No AFP Ref
2	3	RW014/WP	Rukara-Kavumu	Artisanal	Exploration	mixed concentrate	N/A	N/A	N/A	No	No AFP Ref
3	4	RW017/WP	Mubuga	Artisanal	Exploration	mixed concentrate	Coltan	Wolframite	N/A	No	No AFP Ref
4	5	RW004/WP	Kiburungu	Artisanal	Exploitation	mixed concentrate	Coltan	Cassiterite	N/A	Yes	1314/1319
5	6	RW026/WP	Kavomo	Artisanal	Exploitation	mixed concentrate	Coltan	Cassiterite	N/A	Yes	1307
6	8	RW020/WP	Gakenke	Artisanal	Exploitation	mixed concentrate	Coltan	Cassiterite	Wolframite	Yes	1615
7	9	RW016/WP	Rukaragara, Biruyi	Artisanal	Exploration	mixed concentrate	Wolframite	N/A	N/A	No	No AFP Ref
8	11	RW015/WP	Busuku (Bwiza)	Artisanal	Exploration	mixed concentrate	Coltan	Cassiterite	N/A	Yes	1490/1498/1520/1521
9	12	RW033/WP	Nyabitunda	Artisanal	Exploration	mixed concentrate	N/A	N/A	N/A	Yes	1522
10	14	RW021/WP	Kanyana	Artisanal	Exploration	mixed concentrate	N/A	N/A	N/A	Yes	1463/1464
11	15	RW016/EP	Rebero	Artisanal	Exploration	mixed concentrate	Cassiterite	N/A	N/A	Yes	1607/1608
12	18	RW027/EP	Rubona	Artisanal	Exploration	mixed concentrate	N/A	N/A	N/A	No	No AFP Ref
13	19	RW024EP	Rubona	Artisanal	Exploration	mixed concentrate	Cassiterite	N/A	N/A	No	No AFP Ref
14	21	RW018/EP	Kabayezi-Karambo	Artisanal	Exploitation	mixed concentrate	N/A	N/A	N/A	No	No AFP Ref
15	23	RW021/EP	Murara	Artisanal	Exploitation	mixed concentrate	N/A	N/A	N/A	No	No AFP Ref
16	29	RW021/NP	Murehe	Artisanal	Exploration	mixed concentrate	N/A	N/A	N/A	Yes	1454/1534/1599
17	31	RW022/NP	Rukore	Artisanal	Exploration	mixed concentrate	N/A	N/A	N/A		
18	33	RW018/NP	Kamubanga-Rushari	Artisanal	Exploration	mixed concentrate	N/A	N/A	N/A	No	No AFP Ref
19	34	RW017/NP	Ruli	Artisanal	Exploitation	mixed concentrate	N/A	N/A	N/A		
20	35	RW016/NP	Gitwa	Artisanal	Exploitation	mixed concentrate	N/A	N/A	N/A	Yes	1460/1472
21	41	RW016/SP	Nteko	Artisanal	Exploration	mixed concentrate	N/A	N/A	N/A	No	No AFP Ref
22	42	RW017/SP	Mutobo	Artisanal	Exploration	mixed concentrate	Wolframite	N/A	N/A	No	No AFP Ref
23	43	RW035/SP	Bukokora-Rwimigozi	Artisanal	Exploitation	mixed concentrate	Coltan	N/A	N/A	Yes	1518/1819
24	44	RW009/SP	Gatebe, Kagihima, Akanyamwishyura, Mumukira, Cabengeri	Artisanal	Exploitation	mixed concentrate	N/A	N/A	N/A	Yes	1437/1473
25	45	RW23/SP	Murehe-Gihara	Artisanal	Exploration	mixed concentrate	N/A	N/A	N/A	Yes	1518/1519
26	51	RW016/SP	Kayonza	Artisanal	Exploitation	mixed concentrate	N/A	N/A	N/A	Yes	1342/1347/1348
27	52	RW017/SP	Bugarama	Artisanal	Exploitation	mixed concentrate	N/A	N/A	N/A	Yes	1437/1473
28	53	RW024/SP	Binyeri-Gisoro- Rwisha	Artisanal	Exploration	mixed concentrate	N/A	N/A	N/A	No	No AFP Ref
29	54	RW013/SP	Gahungeli	Artisanal	Exploitation	mixed concentrate	N/A	N/A	N/A	Yes	1437/1473
30	60	RW012/WP	Nyamumure	Artisanal	Exploitation	mixed concentrate	N/A	N/A	N/A	Yes	1487
31	61	RW011/WP	Nyagatama	Artisanal	Exploitation	mixed concentrate	Coltan	N/A	N/A	Yes	1627
32	62	RW031/WP	Rwambogo	Artisanal	Exploitation	mixed concentrate	N/A	N/A	N/A		
33	63	RW027/WP	Mukura-Mwendo-Kagombwa	Artisanal	Exploitation	mixed concentrate	Coltan	N/A	N/A		
34	64	RW033/WP	Kivumu, Nyabirasi	Artisanal	Exploitation	mixed concentrate	N/A	N/A	N/A	Yes	1522
35	65	RW028/WP	Gitarama	Artisanal	Exploration	mixed concentrate	Wolframite	N/A	N/A	Yes	1430/1480/1629
36	66	RW025/WP	Kabera and Gitwa	Artisanal	Exploration	mixed concentrate	N/A	N/A	N/A	No	No AFP Ref
37	67	RW029/WP	Runombe	Artisanal	Exploration	mixed concentrate	Wolframite	N/A	N/A	Yes	1629/1430/1480
38	68	RW009/WP	Giseke, Gihinga	Artisanal	Exploitation	mixed concentrate	Coltan	N/A	N/A	Yes	1623/1624
39	69	RW010/WP	Kamusheshe-Kamajyambere	Artisanal	Exploitation	mixed concentrate	N/A	N/A	N/A	Yes	
40	70	RW032/WP	Rwamatete	Artisanal	Exploration	mixed concentrate	N/A	N/A	N/A	Yes	1612

41	71	RW030/WP	Ngoma	Artisanal	Exploration	mixed concentrate	N/A	N/A	N/A	No	No AFP Ref
42	82	RW030/EP	Rutungu	Artisanal	Exploration	mixed concentrate	N/A	N/A	N/A	No	No AFP Ref
43	83	RW041/EP	Karambi	Artisanal	Exploration	mixed concentrate	N/A	N/A	N/A	No	No AFP Ref
44	86	RW033/EP	Rwamuhimbura	Artisanal	Exploitation	mixed concentrate	N/A	N/A	N/A	No	No AFP Ref
45	90	RW031/SP	Nyaruvumu and Gituntu	Artisanal	Exploration	mixed concentrate	N/A	N/A	N/A	Yes	1620
46	91	RW030/SP	Gitwa	Artisanal	Exploration	mixed concentrate	N/A	N/A	N/A	No	No AFP Ref
47	92	RW028/SP	Kagote	Artisanal	Exploration	mixed concentrate	N/A	N/A	N/A	No	No AFP Ref
48	93	RW025/SP	Bahozi	Artisanal	Exploitation	mixed concentrate	Wolframite	N/A	N/A	No	No AFP Ref
49	95	RW026/SP	Muhanga	Artisanal	Exploitation	mixed concentrate	N/A	N/A	N/A		
50	96	RW027/SP	Sholi	Artisanal	Exploitation	mixed concentrate	N/A	N/A	N/A	Yes	1618
51	97	RW012/SP	Mubuga-Gashorera	Small scale	Exploitation	mixed concentrate	N/A	N/A	N/A	Yes	125/1296
52	98	RW005/SP	Nyamyase	Artisanal	Exploitation	mixed concentrate	Coltan	N/A	N/A	Yes	1246/1470
53	99	RW004/SP	Rutobwe	Artisanal	Exploitation	mixed concentrate	N/A	N/A	N/A	No	No AFP Ref
54	100	RW029/SP	Kyato	Artisanal	Exploitation	mixed concentrate	N/A	N/A	N/A	No	No AFP Ref
55	101	RW020/NP	Shyunga	Artisanal	Exploration	mixed concentrate	N/A	N/A	N/A	Yes	1257

Signed on 14 May 2018

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Ajay K. Garg (Consultant)

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Dr. Rudolf Mauer (BGR)

7. Appendix

Appendix 1 – definitions related to AFP

In alphabetical order

AFP reference sample data base

The AFP reference sample data base contains information on 3T ore concentrate samples taken during AFP reference sampling activities. The data comprise general information like mine site name, concession, type of 3T commodity present, GPS coordinates, etc as well as mineralogical, geochronological and geochemical data. In case that the documented origin of an ore concentrate sample is in doubt, these data are used to confirm or dispel this doubt.

Mine site and sub-mine site

In context with AFP, a mine site is defined as a location of mineral extraction of limited spatial extent. For large or more complex mine sites with several separated spots of ore extraction and apparent and reasonable spatial relation to each other (which allows to assign them to originate from a mutual ore body) sub-mine sites are defined which refer to individual tunnels or small open pits (in the dimension of a few meters) from which ore is extracted.

Mineral pre-concentrates and mineral concentrates

Mineral pre-concentrate is defined as ore that has been subject to an initial non-standardized upgrading process (usually washing done by artisanal miners: panning, ground sluicing). Mineral concentrate is defined as ore or mineral pre-concentrate that has been subject to a standardized ore dressing/beneficiation process (usually done at a mechanized processing plant) in order to obtain a mineral product of export quality (i.e., of a pre-defined homogenous grade).

Reference sample

A reference sample is a 3T ore concentrate sample which was taken on the mine site by qualified AMU/BGR personnel or by trained and accredited samplers according to the AFP sampling protocol. To be categorized as reference sample, several prerequisites have to be fulfilled in order to facilitate their analytical results to be included into the AFP reference data base. Once AFP is implemented, reference samples shall then serve as the reference for comparisons with other samples (which e.g. have been taken from the supply chain).

Sample in question

A sample in question is any ore concentrate sample whose origin is doubted or has to be verified by comparison with a reference sample (see “Reference sample data base”). As a prerequisite for AFP testing, a reference sample from the mine site where the sample in question is supposed to come from has to be already integrated in the AFP reference sample data base or must be provided.