Panel 2 – Technology, Certification, and Traceability

Moderator – Frederico Bredan, OAB Brasília

I must state that the traceability of minerals is a reality. I just do not know if it will happen next year, in three years, or in eight years. Mineral traceability is, for me, one of the main agendas for the mineral sector.

In this respect, it is urgent to be speaking about gold, but there is also the entire discussion surrounding critical and strategic minerals, and traceability has three core aspects that I can mention.

1. Traceability is an excellent instrument for combating illegality, which is what we seek with gold.

2. At the same time, this element is, for me, the primary indicator of sustainable development (SD) for any sector. When we consider responsible mining, the ability to show that our mineral production indeed has a lower carbon footprint or that it uses natural resources more sustainably is what can provide the necessary label for mineral products.

3. The other point is when we consider traceability and stock control, the flow of the mineral market, and the whole discussion of supply and demand; traceability is one of the best instruments.

Recently, some operations conducted by the Polícia Federal exposed vulnerabilities in the sector, and in this light, this seminar becomes even more relevant. When we consider that a mineral project was licensed with some defect, where did that product go? Traceability can also provide this answer. Hence the importance of us discussing this, of bringing international inputs, and of showcasing Brazil as a model, as a protagonist in Latin America, and with its leading role in Africa and good relations with the South, we can indeed secure a representative and be an excellent model for implementing traceability worldwide. I was very pleased with the speech by Fernando, the Superintendent of the ANM, because he stated that state traceability must indeed be implemented. When we return to gold, there is no way to discuss traceability by considering only the profit. We must look at the entire sector, including gold.

Dr. Trevor Keel - World Gold Council

What I am going to do today is talk a little bit about the work of the World Gold Council and what we have been doing in this area over the last few years. We are calling this technology Origin Verification rather than traceability. What we have found over the last couple of years is that traceability means different things to different people, and sometimes some of the subtleties of what we are trying to achieve get lost in that very broad idea of traceability. So, what we have been looking at over the last few years is

largely new technologies that can help support the verification of the origin of gold material.

I think that is quite an important point to make, separating the broader theory of traceability a little bit. Obviously, there are many traceability technologies out there of all sorts. Some are technology-based, some are not. So, we are focusing very much on the technology side of origin verification. The second thing I would like to mention is, as David said earlier, and I would like to reiterate, that we as an organisation are fundamentally technology agnostic. So, I will be presenting one technology that we have been working on with a partner, a technology company, over the last few years. However, we know this is not the only method out there. We have already seen what is happening in Brazil. There are many other technologies around the world that are being developed to look at traceability and verification of materials. Therefore, we are interested in all those types of technology. I want to talk to everyone about what is happening, I want to look at the technologies, and talk about the technologies that are being developed. We fundamentally want to work together effectively to try and accelerate this process. So, we are technology agnostic. And the example I'm going to give is one of several technologies. We are very excited about it, but we still think there is a lot more to be done.

So, we got the background on origin verification from Erika. You know, there has been a lot of work already done in South Africa; there has been work happening in Brazil, as we know, the work of Barbara Beck and her team and the people at MetaLore. What I am going to talk about today is a similar technology, it has a lot of similarities, but we are trying to develop it in a slightly different way.

We have already heard a little bit about XRF, and this technology is obviously based on XRF and portable XRF. I will not go into that technical part, but I will give a brief introduction to it. So, XRF allows you to effectively create a chemical bulk without the need for an arbitrary laboratory. Basically, what the technology does is fire X-rays at a sample, any sample, and what you get back from that is effectively a fingerprint. So, it is a fingerprint made up of various different metals and the ratios of those metals. So, the example here is really taking this example from a rock face in a mine in East Africa. If you moved five kilometres to the east, the XRF, the fingerprint would be different, and that is the whole basis of the approach and the technology. If you take enough of those samples, you start building up a database, and using that database, you can run it through various algorithms, and that is what our friends in Switzerland do, they are a *software* company, they develop algorithms that either give you an origin verification or not, as the case may be. It is a really intriguing way of looking at this challenge. Obviously, Eric's team and the police and some of the work in Brazil go much deeper into the science. What we are interested in is speed and ensuring that the technology and the data you can develop can be rapid, reliable, and can build a very strong foundation of information data. Our focus in this is taking the analysis from the raw rock face through to the refinery. Of course, the point where gold is refined is the point where it loses that chemical connection; all the other materials are removed from the cycle.

So, why do we think this is going to work? Why do we think this is an intriguing technology to try and bring to the ASGM challenge?

The first thing to say is that this technology is being used on a large scale, not by ASGM, but by a large refinery in Switzerland. So, every bar that comes through their gate is effectively analysed and run through this algorithm, and that gives them a level of comfort in terms of verifying where that material is coming from, and it works. We have seen it working over the last few months. What happens is you have an effective flagging system, so you get a green 'check' if the analysis you have done is as expected, so it knows which mine this material is coming from, if it matches, then you get a green check. Occasionally, you get a flag. And that flag is an opportunity for the refinery to have a discussion with the model and try and figure out what is going on with that specific batch.

So, what we are trying to do is effectively take that model and move it back into ASGM and the centralised processing model, which is again something David introduced earlier. What we are looking to work on and prove is that there is a model here where you can start to really get underlying comfort in the material that is arriving at a centralised processing plant from whatever mine it has come from. Obviously, decentralised processing plants are well-run. This particular plant has about 750 mines feeding into it. They have traceability in place. Not technical traceability, but people-based traceability systems. What we are trying to do here is prove up their technical traceability or origin verifications and enhance the situation that they are in. And we think this is an ideal situation to do that, it actually acts as a pinch point. The material arrives, this material has not been blended in any way. This material has just gone through a grinding process at the CPV. It has not been blended yet. It is only blended when it goes into the cyanidation area. There is an opportunity here, and this replicates a very significant amount of power.

We believe that XRF (X-ray Fluorescence) is going to be a very, very useful tool in really adding comfort to understanding the origin of that material. If there are any red flags, the materials have more alterations; it is an opportunity to really investigate using XRF. Of course, XRF has the advantage of being very rapid. It is actually very quick, it can take minutes per scan. And you get an immediate effect on the actual data, which is a limitation of laboratory-based technologies. Obviously, there are lots of benefits using laboratory-based technologies. There is a lot more detail involved in that type of analysis. We believe that if you can rapidly analyse and be confident and comfortable with the outcome of that, there is an opportunity to rectify problems quickly as they arise. That is really what we are aiming at. This is part of our focus.

Of course, there are challenges, huge challenges, we all know there are challenges in implementing new technologies. We also think there are significant opportunities in the world. Those challenges and opportunities are fairly obvious, probably from what I have already said. We have a rapid verification method; we have the opportunity to detect where order tapping has entered the process through a warning sign.

There are opportunities to reduce the risk of fraud and illegal activity. You can be able to help these processing plants improve their operations, improve their standards. And there are also a number of other opportunities around improving the operation as well with the *QuickTurn* and the WICOM data. And, of course, our ultimate goal is to try and improve and secure supply chains.

Now, the challenges that go with this are quite significant and obvious, and I think everyone working in this field is well aware of them. There are logistical complexities in working with some challenging parts of the world. Some of the bad actors that are determined to get their gold over the border or that are going to use mercury without any discussion of the matter, obviously that is not going to help this equation immediately. But our hope is to bring some of the actors who want to be part of the overall system into the formal system and give them opportunities to do so through technology, through the formalisation of the potentised process. We start to improve gold recovery, money talks, we all know that money talks, so you improve the gold recovery, that word starts to spread, and then you start to get more and more individuals, more and more miners thinking, well, maybe I will get it to process my material.

Another big challenge is, obviously, the essential oil processing plants. It works well in Peru, not all of them work well, but a good number of them operate very successfully in Peru for decades. There will be jurisdictions where there will be challenges in bringing these to the fore. Africa, for example, there will be challenges. Nevertheless, we think there are enough opportunities to bring those types as part of the system to improve the law. The miner is working in the area and, of course, the matters of that.

Professor Dr. Giorgio de Tomi - University of São Paulo

The small-scale gold mining sector is often isolated, and frequently, when there is a discussion about this sector, the institutions do not necessarily participate. We have everyone here. And we also have representation from the *garimpeiros* (artisanal miners), the cooperatives, through Gilson. And several institutions related to the sector. This is the moment for us to make a difference, everyone. It is excellent to discuss avenues. I liked what Trevor said; our approaches must be technology agnostic. We have the technology, but let us make it work.

We are at an important juncture; we are discussing the future of this sector. And the whole part about traceability and origin certification, which Trevor mentioned, is all fundamental for us to have market credibility and manage to change this narrative. We are in a war. We saw the first part of the event talking a lot about the difficulties we have in creating additional regulations, increasing the burden of responsibility on miners and chain actors to ensure all this *compliance*, and so on. But if we do not look after these people, we will push them towards illegality. We cannot let that happen; this is our battle; we cannot let it happen. Therefore, my optimism seeing this event is that there is a commitment from many institutions to make this a reality. So, let us continue and turn this discussion into results.

One thing I want to raise here for my colleagues at the Ministério de Minas e Energia (MME): I am with my colleagues who coordinated the National Action Plan for the Minamata Convention. Everyone, we have already delivered the diagnosis. We need your help; we need the articulation of everyone here to have the public consultation on the National Action Plan so we can move to action. Move away from discussion and now

move to action. I would like this event to also be a motivation for us to prompt this public consultation and make progress.

Returning now to Fred's question, everyone, it is as follows: we have done a great deal of work to try and introduce the traceability you are calling "documental" (paper-based). I think it is more of an intelligence traceability; I am using an intelligence traceability of the supply chain, but either way, it is a documentary approach. To apply it in practice, in reality. So, what we have been doing together with the IBGE, working over the last two or three years, is developing this approach to implement traceability now. Right?

What I think was interesting about the discussion we had is that this is complementary; it is not a substitute, and it provides another angle, an interesting angle for the market and for the miner. It is this diagram you are seeing here. We start at the beginning, where on the left side of the diagram, you see that we begin with an origin verification, which is the system that was developed. So here, we have the artisanal miner, the PLG (Permissão de Lavra Garimpeira), and you have a system, which Júlio has already mentioned, that verifies that mining right, right?

But that is not enough, which is why I say it is not just documentary; it is not enough to see that the area has complete documentation, is up to date with the CFEM, and genuinely operated within its polygon in that period, and so on. We must also have a verification loop, right? And that would be the *site out*. This generates a report and goes to a board that verifies this entire chain and approves it, and we are even using 'conforming' or 'non-conforming'. There is no certification; there is no certificate; it is a conformity. It is conforming or it is not conforming.

So, at the beginning of the chain, if everything is conforming, we are using an approach that will track each of the transactions along the supply chain: the oversight of production at the mine itself, then the oversight of the transaction at the buying post, then the documentary and physical oversight of the transaction at the DTVM, then at the refinery, and finally at the end customer. In each of these events, we classify whether everything is OK or not OK. So, whether it is *compliant* or *non-compliant*. So, it is a simple system, a simple approach, but it is practical, and we are ready to start. We have already selected the location where we will do this; we are negotiating with the mines; we are working with the institutions to make this happen immediately, to move away from theory, away from discussion, and into action. That is what we are doing in this case.

And in this diagram specifically, everyone, I want to draw your attention to an element that I do not know if you noticed. For me, it is key for this type of approach to work. Let us assume we can track production from beginning to end, and everything is *compliant*. Great. How does that benefit the *garimpeiro* right at the start of the chain? And how will he be recognised for this? Our proposal is this red line. What is it? If everything went right, everything is *compliant*, the end consumer—remember David spoke at the start of the event, he said he foresees a day when all gold will be responsible. He said that. Let us work; we are here to work towards that. Where the entire origin of gold will always be responsible. Now, for us to get there, we have to recognise the person who is working properly at the beginning. Remember that concept of Just Transition? Moving away from

the 'Just Transition' *blah-blah-blah* and moving towards the true Just Transition. So, if everything was compliant and it really worked, I want to see a bonus for the miner at the beginning. Because then we ensure we create a virtuous cycle there. So, this is the approach we are using. In my opinion, it does not conflict with the other technologies, but it will be able to act immediately in the field and carry out all this monitoring from the beginning to the end of the chain. Right?

Júlio César da Silva Veras - CFEM Oversight Management, ANM

Today, I have come to discuss a little about traceability from the fiscal perspective. In the previous panel, the fiscal aspect of the CFEM (*Financial Compensation for Mineral Exploitation/Exploitation*) and its collection were discussed. It was also mentioned that there are only four inspectors—yes, there are only four inspectors, two of whom are here. We will discuss some of our difficulties while also presenting the reality of gold traceability and CFEM collection within our remit.

The difficulty in using the PLG (*Permissão de Lavra Garimpeira*), the legalisation of illegally extracted gold, and the issue of money laundering have already been thoroughly discussed here. I wanted to show you the challenges that the CFEM Oversight Management faces today in changing the CFEM inspection itself and in identifying and tracking this gold. And that the CFEM payment that is made must genuinely go to the title that was granted to the titleholder.

So, in a very simple way, we can see this in this small *slide*. In practice, the *garimpeiro* extracts his gold, and due to the high liquidity of this gold, it already functions as a medium of exchange within the mining area. Generally, he makes his payments there, buys his inputs, makes other payments, and the intermediary in this chain ends up taking this gold and trading it in a DTVM (*Securities and Exchange Distributor*). This entire journey from extraction in the *garimpo* to the DTVM is carried out through an Ordinance, Ordinance 361 of 2014. All this control is done by means of this declaration, all very manual.

Until 2023, the DTVM itself also issued an invoice for the gold for the acquisition of this financial asset gold. This invoice was also physical. So, you are faced with the acquisition by a DTVM, which, by force of legislation, is the one that has to make the CFEM payment. What happens in practice? We, four civil servants, were faced with thousands of fiscal documents. For the purposes of CFEM oversight, we had no way of carrying out this verification, practically it became impossible to do, not to mention that on the physical invoices issued, due to the presumption of good faith that was in force until 2023, gold was attributed to certain processes that did not even have licensing for extraction within the ANM. We were faced with the issue of tracking this fiscal gold based on physical documents, making an audit impossible in this regard, often attributed to processes that were either not yet in the habilitation phase or did not even exist.

In a recent audit carried out in 2025 by the Tribunal de Contas da União (TCU), it detected exactly what we are discussing here. This intermediation between extraction and the DTVM and the acquisition itself was an operational failure of the ANM. We had a blind spot there; we could not carry out any type of control over this, all done manually. The TCU has now determined that the ANM must act within 90 days to implement electronic control for the purpose of monitoring this gold.

Due to this issue of Good Faith that was in force, the TCU ruling also identified what it called "ghost mines." These are those mines where you declare, arrive at the DTVM to sell that gold, and declare production from a mine that did not even exist. So, there is a mine that only existed on paper, which the TCU calls a "ghost mine." And it also brought up the issue of "super-mines." These are mines that have an extraction capacity, an operational capacity of X, but when that gold was commercialised, a quantity 100 times greater than the mine's capacity was attributed. So that is what the TCU defined as "super-mines."

We have had some recent advancements. In 2022, so that we could at least have control over those first acquirers of gold, the ANM published Resolution 103 of 2022, which introduced the registration of the first acquirer. So, from Resolution 103 onwards, all first acquirers of gold had to be previously registered with the ANM. In 2023, there was the STF decision that ended the presumption of good faith on the part of the DTVMs.

At that time, there was already a discussion at the Receita Federal (Federal Revenue Service) about the change I mentioned earlier: until 2023, I was faced with the physical electronic invoice. In 2023, the Receita Federal, through Normative Instruction 2138 of 2023, instituted the electronic gold invoice. The ANM participated in the drafting of this gold invoice, and here I want to point out that even though the Agency participated in the gold invoice's *layout*, it does not have access to this information. So, that control that I had at the beginning of the chain, done manually, an electronic gold invoice would open doors for the ANM to have the minimum knowledge about the gold chain. Because in the gold invoice, I have information about the buyer, the transporter, and I have information about the acquirer of the quantity of gold that they passed on, which the DTVM acquired, and the ANM does not have access to these gold invoices, despite having participated in the drafting of this document. The Receita Federal rightly claims that the National Tax Code only allows the exchange of information among taxing authorities. And since the CFEM is not a tax, the ANM would not be entitled to this information.

I highlight that there is a Decree in force, from 2007, which institutes the public system of fiscal bookkeeping, the SPED, and the first module is the electronic invoice, but even with this decree, we do not have access to this information. So, at the minimum of the gold chain, which is the end, the acquisition, with operational data, gold data, buyer, transport, we cannot get access.

To circumvent the situation of not accessing these invoices, the ANM in 2024 instituted the Declaration of Economic-Fiscal Information (DIEF-CFEM) through Resolution 156 of 2024. Here I am talking about a declaration, an ancillary obligation, in which both the holder of that *permissão de lavra garimpeira* and the DTVM itself have to make this

declaration and provide it to us. So, from there, we would also have a control over the production of the titleholder and the destination of this gold that would be commercialised by the DTVM. We also have information from the DTVM itself informing from whom it bought that gold and the quantity, and this allowed the ANM to have a small control between the extraction and the acquisition of this gold.

To circumvent the lack of access to these invoices, this Resolution 156 has a provision in its Article 7 that determines—it obliges every holder of a mining right to include the ANM's CNPJ (National Registry of Legal Entities) on the fiscal document so that we would have access to this information, so that we could capture this information, this invoice, and there have control over the gold being acquired. The problem with this story is that the invoice *layout* was instituted based on the service invoice *layout*, and in the service invoice, there is no corner of the XML to place the CNPJ, meaning that despite this, the ANM still does not have access to the fiscal document.

What is being discussed within the oversight management? I want to highlight that Resolution 156 and the DIEF-CFEM were made in partnership with SERPRO; they helped us a lot with all the *expertise* they have there. What is being discussed today within the oversight management for the purpose of gold tracking, which I will once again call fiscal gold tracking. It is being considered today that to solve the problem identified by the TCU, which is precisely the lack of control over the intermediary in the chain, the institution of an Electronic Gold Transport Guide is being considered. But this guide would not be a simple guide, because we fear that with the institution of this guide, another market will be created, which was the illegal trade of the Gold Transport Guide itself.

So, we are considering instituting this guide; it is being discussed to institute this guide, having some safety locks as a prerequisite. So, the first lock is the operational lock, because we realised that until now there have been great advances in terms of legislation, but I think the main problem to be faced is precisely the interoperability of systems. I have Resolution 103 which institutes the registration of the first acquirer; the ANM allows the registration there, but there is no way to consult the Banco Central (Central Bank) to know if this institution, this DTVM, was, for example, duly authorised by the Central Bank. We do not have this verification. We have the Receita Federal that allows the issuance of an electronic invoice for the acquisition of gold, but it does not communicate with the ANM's system to see if the process to which the acquisition of gold was attributed is duly authorised in the agency.

So, what is the problem? The problem is not the creation of tools with fiscal terms, people, right? It is not the creation of one more tool, like a guide, for the purpose of control, but rather, perhaps, a mechanism for interoperability between systems: the ANM, the Receita Federal, the Banco Central. Why doesn't the ANM, for example, at the time of this registration, consult the environmental agencies to see if this PLG has a valid, active operating licence, right? So, everything leads us to believe that the lack, that the biggest problem, is the lack of interoperability between systems.

What is the idea? That this electronic transport guide has an operational lock in which we can identify the PLG holder, the transporter, the first acquirer, and that this guide

contains the bank account of this PLG holder. All this generating a unique key just like the key to the fiscal invoice is issued. The intermediary in the chain or even the PLG holder himself would go to a DTVM for this acquisition to be made. The DTVM, at the moment of issuing the invoice, would place this access key for validation purposes, in which, via API, the electronic invoice issuing system would come to the ANM, check if that guide is really a valid guide that has not been used yet. With this validation, the automatic payment would occur in the previously registered account of this PLG holder. With this, we imagine that it eliminates that issue, that malicious third party who ends up receiving the money there, in a possible transaction that occurred in bad faith.

And finally, a volumetric lock. In the study recently organised in a TCU audit, through the CFEM, it showed that the maximum capacity of a PLG is 82 kg, approximately 82 kg of gold, which is around 1,724 grams per hectare. So, I would also have a verification in this regard, by accumulating the transport guides that were issued to have an idea of the quantity of gold that has already been commercialised to see if that mine has or does not have capacity, with the aim of at least mitigating the problem of the super-mines. This is what is being discussed today in the agency in fiscal terms and what would be possible to implement more quickly.

What benefits do we imagine? We can block the issue of fraud, because through these safety locks, we prevent the commercialisation of electronic transport guides. We create an inviolable digital trail connecting the miner, transporter, and financial flow directly to the mining right. Both the ANM's partners and the Banco Central's partners are unanimous in stating that the first acquirer of gold must be a DTVM, so if this was legally conceived, the most correct thing would be for the payment to fall directly into the PLG holder's account. We would have this control over intermediaries, we would strengthen oversight, we would guarantee that the DTVM itself had legal certainty, because it is a mechanism for it to prove that that gold really came from that DTVM in which it is being presented. We would increase our compliance and transparency.

Would it solve all the problems? I do not believe so. Monitoring tools for gold tracking have already been shown here by colleagues, but we could improve even more through intelligent inspection mechanisms. We could cross-reference this information, start analysing patterns of issuance guides being issued at a frequent periodicity, with the same quantity. We could add satellite images to see the issue of the PLGs to see if they would or would not be active there. So, we could refine and move away from what we have today, which is basically nothing.

Moderator Frederico Bredan

The issue of 'laundering' gold for the DTVMs—is that settled? The issue of the 'super-mines'—is that settled? Everyone knows it is not. And there are other points.

The point that is clear, but perhaps not so clear to others, and here I link it to Tomi's comment that there must be a bonus for the *garimpeiro*. I think it is quite simple. What

happened over the last two years in Brazil, when the presumption of good faith began to fall, when the use of the electronic invoice began, and not just that, the Receita Federal (Federal Revenue Service) initiated a series of detentions at Guarulhos airport—this caused the chain as a whole to suffer an imbalance.

This imbalance is probably financial. Why did they stop buying gold? Because if you have a lot of gold detained at Guarulhos airport, your working capital becomes more complicated, because how are you going to maintain 100 kilos of gold seized? So, you buy less gold from the *garimpos*. By buying less gold, you have a higher freight cost, a higher security cost, which means your acquisition cost increases. How does the acquisition cost increase? It becomes more advantageous for the DTVMs to buy gold. That is how this happened.

And in this movement where the DTVMs no longer buy gold, the gold goes to the parallel market. It is no news to anyone here that gold in Brazil continues to be produced and delivered to the parallel market. No illegal extraction was suspended in the last few years. The machine was suspended and burned, but the rest continues. Gold at this price is extremely advantageous. And what happened? The DTVMs no longer buying meant that the CFEM was no longer registered, and that is why there was a drop in gold CFEM. Did gold stop being produced? No. Where is it? In the parallel market, with organised crime.

How do we bring this market back to the formal market, because it will continue to be produced? The moment a state traceability stamp is instituted, a strong one, where the government provides security for this market, which is the *garimpeiro* himself—the *garimpeiro* does not want to remain in the illegal mine; it is much better for him if he could have the gold legalised. But what happens? If he sells to a DTVM today, his discount is greater, so he goes to organised crime; he will sell to whoever pays more. Unfortunately, that is the scenario we have today.

We have to create, in addition to traceability, these benefits. And traceability ends up being a financial benefit. The gold buyer wants to return to the market. How does he return to the market? By having traceability. Why will he return to the market? Because that is all he knows how to do, he will not have detention at Guarulhos airport, his buying and selling flow will resume, and he can achieve a better margin. Hence the need for us to push this issue of traceability.

And here I would like to cite another example, that of the 'laundering' of the DTVMs and Ghana Gold, so to speak. The issue of recycled gold was mentioned. The PF (Federal Police) has already disclosed this several times, and seizures at Manaus airport involving invoices for recycled gold, but clearly in that case, XRF worked to show that it was mining gold and not recycled gold, so this managed to rule it out. Therefore, we have to look at the chain as a whole; we cannot look only at artisanal mining. We have to include recycled gold; we have to include the large mining companies for the entire chain. So that finally, when it reaches the jeweller's, even if I am buying a wedding ring, I know exactly the origin of my gold.

I find it very interesting that you monitor and institute government systems. I have already had some experiences with traceability in other sectors. And if there is someone in the Esplanada (Government district) who can look at these current systems that do not communicate with each other and bring about this integration between the various agencies, I think I know who it is. And if you can make some contributions to us, I would be grateful.

Marco Tulio da Silva Lima – Privacy Products Manager, Serpro

Serpro is keenly aware of the issue just raised by the ANM. We have practically all government databases within Serpro, but often due to legal issues, we cannot make use of these databases, even when they involve two entities of the same government. This is a genuinely complex matter.

One solution that I personally see for us to use in these data and integration issues is precisely blockchain, which was presented as a tracking solution. Serpro has been working with *blockchain* for some time, since 2017. We began doing proofs of concept, working mainly with private networks. We are now seeking the use of public networks as well, to be able to expand its utilisation to other markets, including international markets, making it possible to buy an asset from Brazil in another country. So, we are engaging in these forums. We are currently working with Cardano in this regard. And studying tracking solutions, I have seen that several genuinely use *blockchain*. For example, we have *Goldchain* and *MindSpider*, which is an open protocol for mining use with other assets too. So, there are truly avenues we could work on. Serpro already has a certain *expertise* working with this, especially in terms of the Receita Federal's (Federal Revenue Service) *B-cadastros*, *bConnect*, and *P-Compartilha*. So, we already use DLTs (*Distributed Ledger Technologies*), *blockchain* technology, for data sharing between government entities.

I see one network in particular as having great potential for us to use here: the Blockchain Brasil network. It emerged from an agreement between the TCU (a public auditing body) and the BNDES (a development agency), and it has various participants, such as Serpro itself, Dataprev, and some municipalities. I see possibilities to advance with either a public or a private network, with these entities in the supply chain.

Another interesting possibility: we also participated in ENCLA discussions, where *blockchain* was presented in the 2020 session as a potential tool for combating corruption and money laundering. So, we really see these possibilities.

Speaking a little about the solutions from *Responsible Gold*, *Mindspider*, and *Golden Chain*, the majority truly work with this idea of end-to-end tracking across the entire chain, using what some will call a *Cryptosteel*, a seal, and sometimes it is a physical seal itself. Some work with the idea of genuinely using a kind of container, where the bars are placed, you really put a physical seal on it, and you program the route it will take, who it

will pass through, and if it deviates from the route, if someone breaks the seal, it generates an event, an alert.

Of course, we are not relying only on *blockchain*; we can rely on XRF, we can rely on predictive AI to capture precisely those issues of anomalous production in a mine, we can work with IoT (*Internet of Things*) for geolocation, movement, and so on, and truly reach the final buyer so that no one fails to buy their wedding ring because they lack assurance of origin. So, these are truly interesting possibilities that we can work with. As I said, Serpro already has some experience with these technologies, and we are available to contribute in this regard.

The tax reform itself is also a very interesting moment, I believe, because the idea is genuinely to automate and facilitate many processes. Today, these electronic invoices are already with Serpro, so some of the solutions I have seen work precisely with the tokenisation of gold. We could implement this tracked tokenisation precisely on the invoice, right from the issuance, sale, and resale. This *token* can be a fungible *token* that will be broken down; it starts with a gold bar of so many kilos and so many grams, goes to one person, goes to another, and at the end, you can genuinely trace this path and understand where it came from, and whether this gold complies with legal frameworks and specific market standards, such as the European market.

We have been looking closely at this, for example, in the agribusiness sector. In agribusiness, we already have pressure from countries, mainly the European community, regarding legal frameworks for deforestation, slave labour issues, and so on. And again, we have databases in the government today at the Ministry of Labour concerning employers who subject their workers to conditions akin to slavery. So, I think a lack of information is genuinely not the problem, which is the issue that was raised.

So, these are formative issues; they are issues of integrating these systems, but we see that it is indeed possible to use the technologies that are already available to the government to work in this direction. And we truly have a network with the PF, with the COAF, with the ANM, and so on, with all the links, including the mining companies, the refineries, and all the way to the jeweller's, whether here in Brazil or in another country, and we can provide this transparency. Serpro is working today precisely on a tokenisation system, where we will be making several registrations on *blockchain*, registrations of seals to carry out verification via QR code, also working on *tokens*, fungible *tokens*, non-fungible *tokens*. So, this is a possibility of using this technology to help. Of course, we know that the issue is not so simple. We know that fraudsters are creative and will always look for a way, but through what has already been discussed here—XRF, Predictive AI, and other means—we can also pursue them to improve this scenario, which is fundamentally about responsible gold. Thank you.

Moderator Frederico Bredan

It is important for us to mention that there is a bill currently in Brazil, under an urgency regime, for the implementation of gold traceability in the country. The rapporteur introduced this text proposing that the Casa da Moeda (Brazilian Mint) would be the body responsible for this traceability. There is also an official Supreme Court ruling for the agencies that highlighted this previously, for them to complement this traceability. So, Leonardo, if you could share with us what you have been doing.

Leonardo Alves da Silva – Superintendent, Commercial Department, Casa da Moeda do Brasil (Brazilian Mint)

Whenever we have the opportunity to represent the Casa da Moeda, we like to show what the Casa da Moeda is: a company with over 300 years of history, which has acted as the Brazilian State's security arm, providing security solutions for the Brazilian State.

So, please allow me to show a short institutional video, so that you can get to know the Casa da Moeda, and immediately after, I will talk a little about what we have been thinking about and what we have been working on concerning the traceability of gold specifically.

Institutional Video Audio

The Casa da Moeda has been operating for over 300 years, offering products and developing highly strategic solutions for Brazilian society. A state-owned industry that possesses the largest graphic and metallurgical security industrial complex in Latin America and one of the largest in the world. Located in Rio de Janeiro, the company has modern facilities and rigorous security standards to meet innovative demands and complex projects in the areas of circulating medium, payment, identification, traceability, authenticity, and fiscal and postal control, with highly qualified and trained professionals, state-of-the-art equipment, and differentiated infrastructure.

The CMB (Casa da Moeda do Brasil) produces banknotes, coins, passports, and since 1973 has assisted the government in combating tax evasion through the production of federal fiscal stamps. Always aligned with technological advancements, the CMB adopts high-standard security levels in its premises, with highly evolved digital cameras, with a 360-degree range and full monitoring of the production process. Access control features automated physical barriers such as turnstiles and motorised doors controlled by an intelligent system. Furthermore, it has restricted airspace, granted by the Air Force, with a peripheral intrusion detection and alarm system, with thermal cameras operating in daytime and night-time modes.

Committed to modernity and ensuring self-sufficiency in its productions, the CMB has three manufacturing units: the Banknote Department, responsible for printing national

and international circulating banknotes; the Coin and Medal Department, which is involved in minting circulating coins and also commemorative coins and medals, as well as making commendations and decorations; and the Graphic Products and Cards Department, responsible for printing the company's graphic products, such as its postal and fiscal stamps, certificates, cards, among others. The department is also responsible for the production of Brazilian passports, serving the Federal Police and the Ministry of Foreign Affairs. In addition to these manufacturing units, the CMB has the area for making dies and artistic designs, both for the metallurgy and graphic parts, with the design of its fiscal stamps, passports, and banknotes, developing modern and innovative solutions that guarantee protection, control, and traceability.

To improve its self-sustaining resources, contributing to cost reduction and environmental preservation, the CMB has been investing in initiatives. The company has a photovoltaic solar plant, with the capacity to supply energy to various facilities in the industrial park. Furthermore, the company has a water reuse system, which contributes to the conscious consumption of the resource. The Casa da Moeda is synonymous with modernisation and innovation. The unique and innovative "Transforma" project, conceived by the Casa da Moeda, is a Brazilian circular economy solution capable of transforming discarded papers or banknotes that have already left circulation into furniture—a pioneering solution for the global problem of disposing of circulating medium. Holder of ISO and NBR certifications, the CMB is recognised for its competitive potential and commitment to quality, the environment, and security.

We always like to present this because we understand that it is an institution that every Brazilian needs to know. That is why it is important for us to present everything the Casa da Moeda does, in addition to other initiatives that are not in the video but that we can talk a little about now.

This issue of gold traceability has been discussed by society and the bodies represented here for some time. We started discussing and working on this in 2023 when we signed a protocol of intent with the ANM, and soon after, a cooperation agreement, aiming to provide a solution that could combat these problems that have already been discussed here. I will not dwell on these problems, we will not delve into the macro problems involved in the gold supply chain, but we understand that a secure traceability platform needs to adhere to some pillars, right? And this is what we have been mapping and discussing for some time.

First, this platform must deliver information, and what we have heard a lot here is exactly this: the fragmentation of registration data and the lack of integration between this information. The idea of this platform, which we have been presenting, is a platform that presents the information and integrates all government initiatives, so that the entities involved and the system can have secure information.

What we also understand should not be waived is the physical marking of the product. This is something indispensable for efficient and effective traceability. Also ensuring that this system functions technical assistance is a basic premise. The legal basis, the issue of Bill PL 3025 and other government initiatives discussing this issue were mentioned,

and it needs to provide the legal foundation for this traceability to be mandatory and for it to work, so that everyone can participate and must participate in this systematic approach. And what we understand is the State's role: we understand that the State needs to be the entity that acts as the main provider of this traceability system.

What are the main objectives we have identified here? First, to identify the origin of gold, everyone here is discussing this, and we have been discussing it for some time. Also, to provide information to authorities. We talked here about artificial intelligence, some initiatives in that line. The platform therefore intends to generate information and data processing for more assertive oversight. Our colleagues from the ANM spoke about the effort required to have an inspection, to exercise their oversight role, and the idea is for the platform to generate secure information and alerts so that this oversight is more targeted.

To differentiate the gold along the chain—so, from its extraction to the final consumer, we can track this gold and facilitate an unquestionable inspection process. One of the things we always think about is the role of the inspector in the field. When he needs to certify, he needs to ensure that that gold comes from a legal origin or not; he cannot have doubts, right? He cannot be afraid to state that that gold is of legal origin or not. So, we understand that this systematic approach provides the tools for this to happen in an unquestionable manner.

One important thing to mention is that the Casa da Moeda does not intend to be, and this solution does not uniquely intend to be, the solution to resolve the problem. We are talking about integration of efforts. We are talking about a platform that integrates government initiatives that exist. We saw the COAF speaking here, we saw the ANM oversight personnel, the World Gold Council talking about its experience regarding what is happening in the world. So, bringing good practices into this platform is what we understand to be very important.

One of the things we consider is registration. We need to have the registration of everyone involved, right? We perceive that there is an overlap of registrations and separate registrations. So, bringing the registration of everyone involved into a single system, a single platform: all those who are working, from the person operating the machine there in the *garimpo* or working in the mine, in the mining companies, to those who will transport the gold, those who will commercialise the gold—to have visibility of all of them within a platform.

Also, registering all the information. So, the activity of this gold needs to be registered as if it were a ledger. The issue of blockchain was mentioned here, which indeed guarantees the immutability of this information, the record of this information, the certifications. So, generating certifications through this platform in reports, making reports available. Everyone knows how difficult it is to gather information. I saw the study by the Escolha Institute and the work it must have taken to gather all this information, seek information from different sources, and cross-reference this data. And traceability—the traceability system that the Casa da Moeda has offered to the Brazilian Mining Agency is a platform that generates data that can be cross-referenced so that some information that is

extracted there, and even alerts, can be extracted from these activities once they are identified as suspicious.

How do we do this then? We do it by being present at all times, everywhere that gold will pass, from the *garimpo* to the mining company. So, we are not just talking about small-scale activity; we are also talking about the mining company, the registration of each batch of product that is extracted. Each one of them will have a unique number, a unique record, and that number will accompany it throughout the chain of custody. I repeat, not only in *garimpo* activities, cooperatives, we are also talking about the mining company, and physical verification points. We understand that the presence of the State needs to exist. When this gold is transformed into a bar, an ingot, it needs to be physically marked, aggregating all the previous information, bringing with it the entire history of that gold, where it was extracted, and if its origin is legal. Logically, it will receive this marking.

Here, illustrating some screens related to the platform: registration of the certificates, you will be able to separate and register each profile that operates in this mining ecosystem. Geolocation is important to generate alerts when registrations are made outside the polygons of the PLGs, or in locations very close to environmental protection areas, with indigenous lands that do not have permission for gold extraction. So, generating alerts that also point to suspicious behaviour, suspicious movement of gold, different from what was technically declared as the potential of that PLG. When there is a suspicious movement, a movement above the normal, this can also generate a *red flag* and bring alerts to oversight.

One interesting thing is that it is also possible to register the equipment that will be used in the gold extraction task. So, registration of the working front, remote monitoring of the extraction, records of the partners involved in the gold extraction operation, registration and exchange of custody between PLGs involved in the monitoring, secure gold transport guides—and I was happy to see that the ANM also already works thinking about an electronic transport guide, perhaps here we already have a convergence of efforts—registration of the exchange of gold custody between the *garimpeiro* and the PCO (Central Processing Plant), all this being registered by the platform. Registration of the working front, so machinery registration can also be done, bringing this information into the platform, registration of the extracted gold. So, as I said, each batch will be registered; each batch will receive a numbering associated with that PLG, and this will generate data so that we can observe the behaviour and movement of gold from the insertion of this data into the platform.

Custody exchange: so, registering every time this gold leaves someone's hand and passes to another person's hand, you need to register, you need to transfer the seal and also the physical product. So, you transfer the product and transfer the custody of that product; this seal is monitored, and this numbering is monitored. Not only is the physical product marked, but there is also a digital marking.

This screen talks about receipt. It is possible for the person receiving it to verify if that gold comes from a legal origin or not. It is also possible to aggregate gold from different PLGs into one bar, one ingot. So, through a physical seal, at that moment of physical

marking, you can aggregate the entire quantity and the origin of that gold from its source. So, when commercialising this bar, it is possible to identify the entire history of where it came from, where it passed through, through this physical seal.

A screen about the activation, the application of the physical marking. It is interesting to note that we advocate that this physical marking be done by a State agent and not by the industry itself and not by the manufacturer itself. The State agent needs to be there attesting to what this gold is, if it has a legal origin or not, and from there he will do the marking; he will stamp that product.

Here is a public app; that is, the platform also intends to give the citizen the possibility of verifying the origin of the gold, seja através da leitura de uma barra ou através da leitura de um lingote, até mesmo da indústria de joias quando esse ouro passa a receber um certificado de origem. So, the person buying will know where they are buying from, and the certainty is that this gold comes from a legal source.

Here is just a screen for us to present what the platform intends to deliver. So, we are not just talking about a traceability solution, but about the generation of intelligence data so that this can be worked on by the acting agencies, such as the ANM, the COAF, the Federal Police, IBAMA, various agencies that are involved here in this ecosystem. It is possible to identify then abnormal behaviours, such as negative stock, jolts, all this through these transactions. We can point this out with intelligence work and artificial intelligence cross-referencing data between gold commercialisation, gold extraction, declaration of mining potential of that land, and so on. All this is possible for us to identify.

Some benefits identified here: monitoring the quantity of gold extracted and stored by *garimpeiros*, PCOs, DTVMs, and mining companies. All commercial transactions will be registered in the same database, protected by *blockchain*, accessible to oversight bodies. Physical verification points at all points of transformation of gold into bars and ingots. Application of physical marking on the bars and ingots resulting from transformation carried out with gold in compliance with Brazilian regulation. The physical marking brings traceability information, tells the story of that gold, the possibility of integrating with other governmental initiatives, the strengthening of the ANM with resources for the optimisation of inspections based on the intelligence generated by the platform, and certification of origin and sustainability for Brazilian gold.

It is also possible to facilitate the task of authorising mining processes as well. How important this is, too—by having this unity, by having all this information registered, it is possible to generate a more assertive utilisation and facilitate the release of this gold. And the premium in the sales price, the valorisation of gold in the market. We have talked a lot about this here; we have heard a lot about this here. It is natural that this happens when this gold goes through a platform and thus guarantees its origin; it is natural that it is valued by the international market, access to new buyers, access to new markets as well. And we understand that producers will be valued from their entry into this traceability system. Assertiveness of oversight, control of individual production, detailed monitoring, facilitated origin checking for buyers, simplification of origin verification for

buyers, transparency and compliance, and also improvement in reputation and attraction of investments. And we understand that responsible companies will attract more investments for the market as a whole.

Moderator Frederico Bredan

I believe the convergence among all the institutions is clear. We have academia stating that it is possible to do what needs to be done; we have the oversight body saying that it has already been contemplating doing it, and that it is a necessity; we have the two public companies demonstrating that they possess the technical and operational capacity to execute this; and we have the international body, the World Gold Council, outlining and bringing forward certain pathways that can also be followed. Therefore, I think we possess all the necessary tools for this traceability to be duly implemented. The question remains as to where this convergence of institutions will take place. And here, placing myself as a representative of the OAB (Brazilian Bar Association) and of civil society, we can exert some pressure, and not merely wait for necessary judicial decisions and bills.