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## **Interoperability / FAIR Data : building on Standards and Best Practices to achieve it**

Sylvain Grellet, H el ene Bressan, Kathi Schleidt, Abdelfettah Feliachi, Micka el  
Beaufils, Hylke van Der Schaaf, Peter Taylor

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**<https://brgm.hal.science/hal-04133108v2>**

Submitted on 13 Sep 2024

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FRANÇAISE

*Liberté  
Égalité  
Fraternité*



Géosciences pour une Terre durable

**brgm**

# SETTING THE SCENE

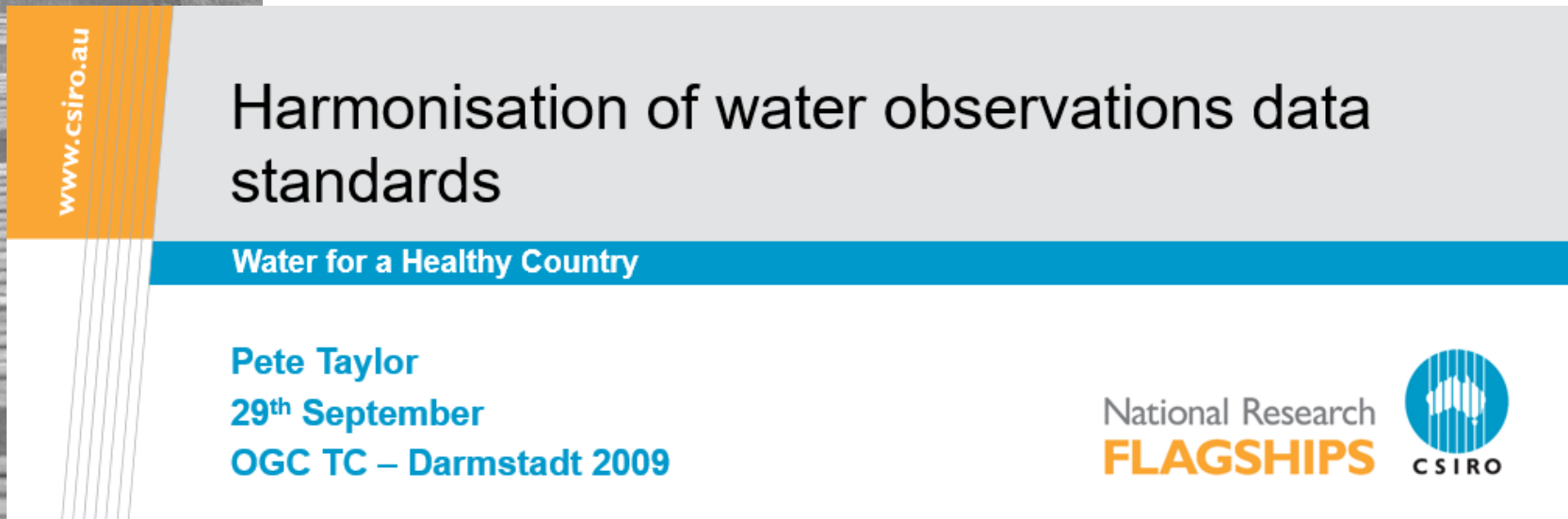


Sylvain Grellet – BRGM  
ENSG – mastère GDM – 2023-01-20



# Why do we need interoperability -> hydrology example

- Let's go there : [https://external.ogc.org/twiki\\_public/HydrologyDWG/DarmstadtTc2009](https://external.ogc.org/twiki_public/HydrologyDWG/DarmstadtTc2009)
- 2009\_Sept\_Darmstadt\_HarmonisationObservations\_PeterT.ppt



www.csiro.au

## Harmonisation of water observations data standards

Water for a Healthy Country

Pete Taylor  
29<sup>th</sup> September  
OGC TC – Darmstadt 2009

National Research  
**FLAGSHIPS** CSIRO



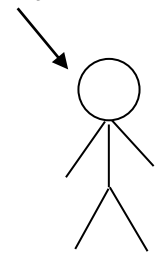
# Why do we need interoperability -> hydrology example

## The need for standards

- Sharing of hydrological data is somewhat ad-hoc, based largely on CSV files and FTP
- Leads to very inefficient (or non-existent) transfer and sharing of data
- Sharing requires a lot of transformation effort on the behalf of the data requestor
  - Parse different file formats
  - Understand the concepts
  - Metadata is often limited or non-existent, requiring follow up conversations

# Why do we need interoperability -> hydrology example

Hydro Jack



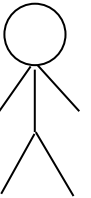
Need flow data!

Hmm maybe Don can help...

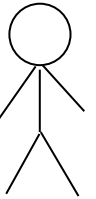
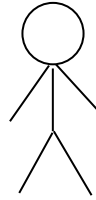
\*RING RING\*

Hi Don, I need some upper Derwent flow readings for my geochemical model. Any ideas?

Hmm, I've got one site. I'll send it through...

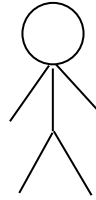


# Why do we need interoperability -> hydrology example



10 minutes...

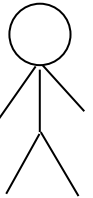
# Why do we need interoperability -> hydrology example



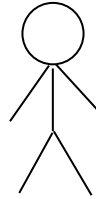
10 minutes...



**To: Jack**  
01/02/09, 3.2, 3, 1  
01/02/09, 3.1, 3, 1

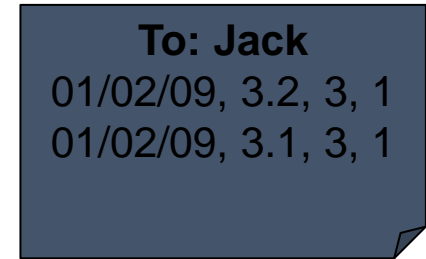


# Why do we need interoperability -> hydrology example



\*RING RING\*

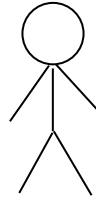
Ok. Got the data.  
Where is the site  
located?



Oh, it's at laughing jack bridge.



# Why do we need interoperability -> hydrology example

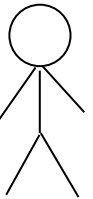


\*RING RING\*

Ok. Got the data.  
Where is the site  
located?  
Coordinates?



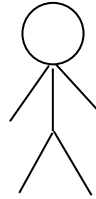
**To: Jack**  
01/02/09, 3.2, 3, 1  
01/02/09, 3.1, 3, 1



Oh, it's at laughing jack bridge.

Ummm. (papers shuffle)  
147.123 -41.588

# Why do we need interoperability -> hydrology example



\*RING RING\*

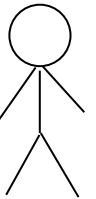
Ok. Got the data.  
Where is the site  
located?

Coordinates?

What reference  
system??



**To: Jack**  
01/02/09, 3.2, 3, 1  
01/02/09, 3.1, 3, 1

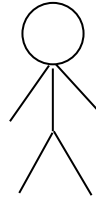


Oh, it's at laughing jack bridge.

Ummm. (papers shuffle)  
147.123 -41.588

I think it's GDA94

# Why do we need interoperability -> hydrology example



\*RING RING\*

Ok. Got the data.  
Where is the site  
located?

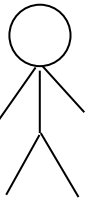
Coordinates?

What reference  
system??

Ok. What sensor is  
used?



**To: Jack**  
01/02/09, 3.2, 3, 1  
01/02/09, 3.1, 3, 1



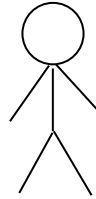
Oh, it's at laughing jack bridge.

Ummm. (papers shuffle)  
147.123 -41.588

I think it's GDA94

It's calculated from the stream  
gauge reading using a rating  
curve..

# Why do we need interoperability -> hydrology example



\*RING RING\*

Ok. Got the data.  
Where is the site  
located?

Coordinates?

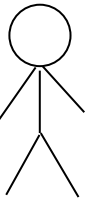
What reference  
system??

Ok. What sensor is  
used?

Oh...how accurate is  
that?



**To: Jack**  
01/02/09, 3.2, 3, 1  
01/02/09, 3.1, 3, 1



Oh, it's at laughing jack bridge.

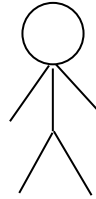
Ummm. (papers shuffle)  
147.123 -41.588

I think it's GDA94

It's calculated from the stream  
gauge reading using a rating  
curve..

Umm.....

# Why do we need interoperability -> hydrology example



\*RING RING\*

Ok. Got the data.  
Where is the site  
located?

Coordinates?

What reference  
system??

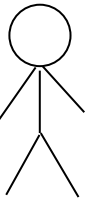
Ok. What sensor is  
used?

Oh...how accurate is  
that?

DON?



To: Jack  
01/02/09, 3.2, 3, 1  
01/02/09, 3.1, 3, 1



Oh, it's at laughing jack bridge.

Ummm. (papers shuffle)  
147.123 -41.588

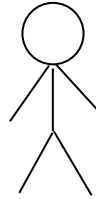
I think it's GDA94

It's calculated from the stream  
gauge reading using a rating  
curve..

Umm.....

\*CLICK\*

# Why do we need interoperability -> hydrology example



\*RING RING\*

Ok. Got the data.  
Where is the site  
located?

Coordinates?

What reference  
system??

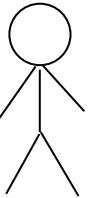
Ok. What sensor is  
used?

Oh...how accurate is  
that?

DON?



To: Jack  
01/02/09, 3.2, 3, 1  
01/02/09, 3.1, 3, 1



*How often have you been Hydro Jack  
(or Don) ?*

Oh, it's at laughing jack bridge.

Ummm. (papers shuffle)  
147.123 -41.588

I think it's GDA94

It's calculated from the stream  
gauge reading using a rating  
curve..

Umm.....

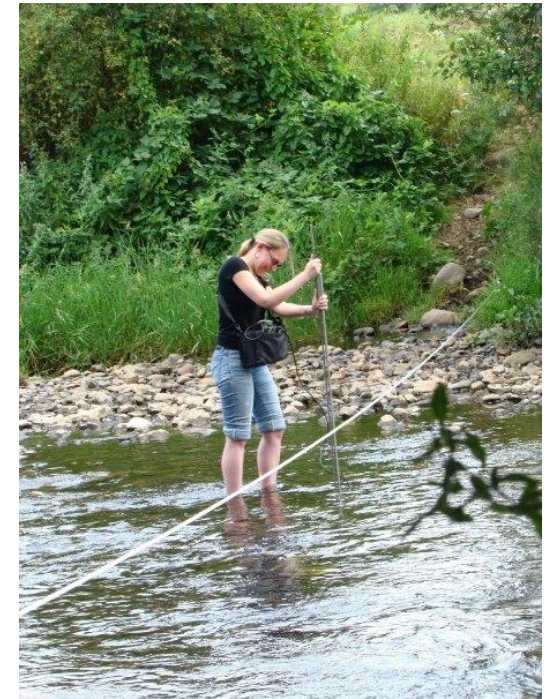
\*CLICK\*

# Why do we need interoperability -> geoscience example




Trad : *Linked data registries and vocabulaires*


*Data quality & interoperability thanks to semantics*




# Why do we need interoperability -> geoscience example



I observe on this outcrop the possibility of presence of **Mispickel (FeAsS)**, near **Beaulieu**



Let's analyze heavy metals in this sample sampled near **Beaulieu**:  
**As, Fe, Pb, ...**



I observe on this outcrop the possibility of presence of **Arsenopyrite**



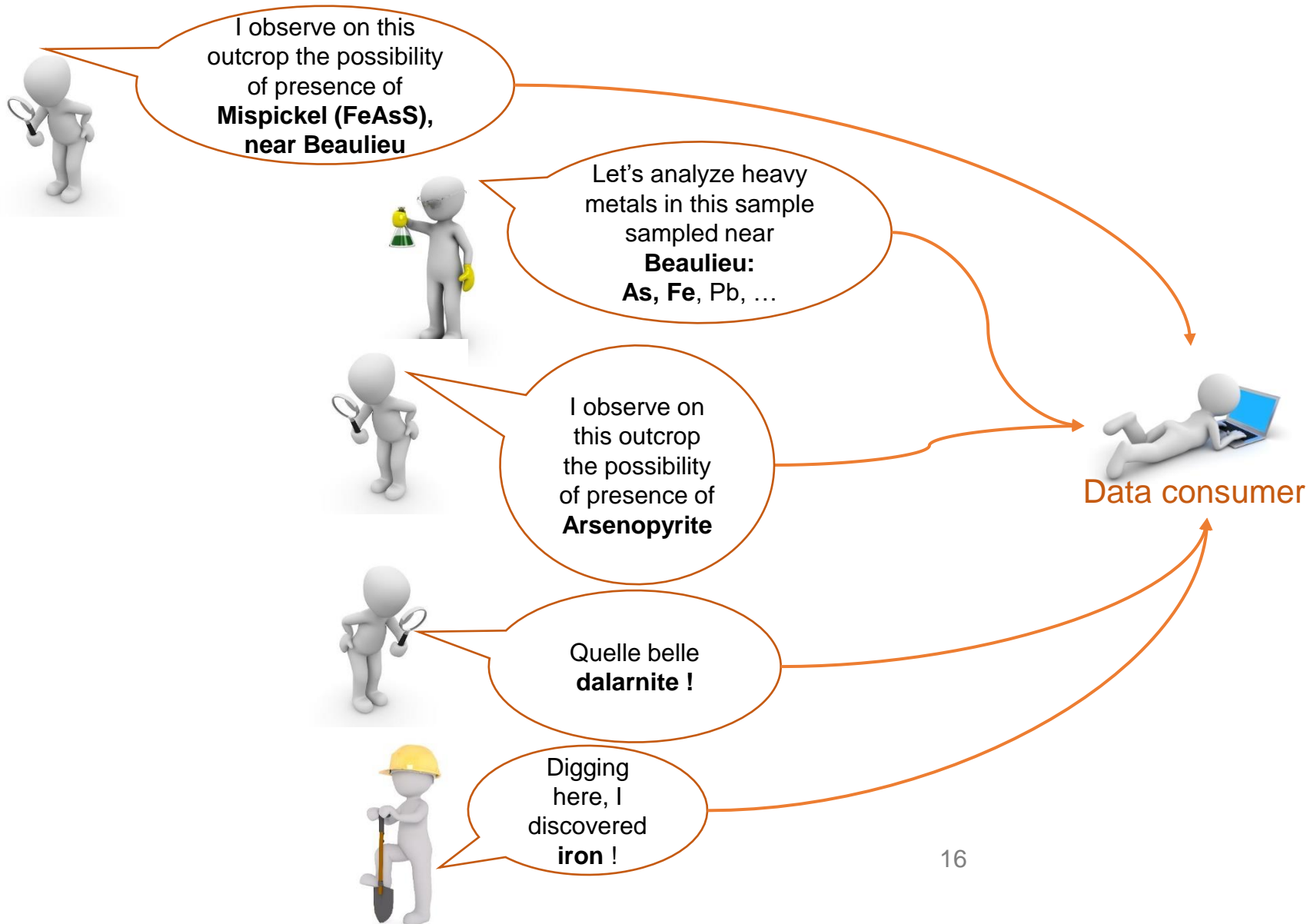
Quelle belle **dalarnite !**



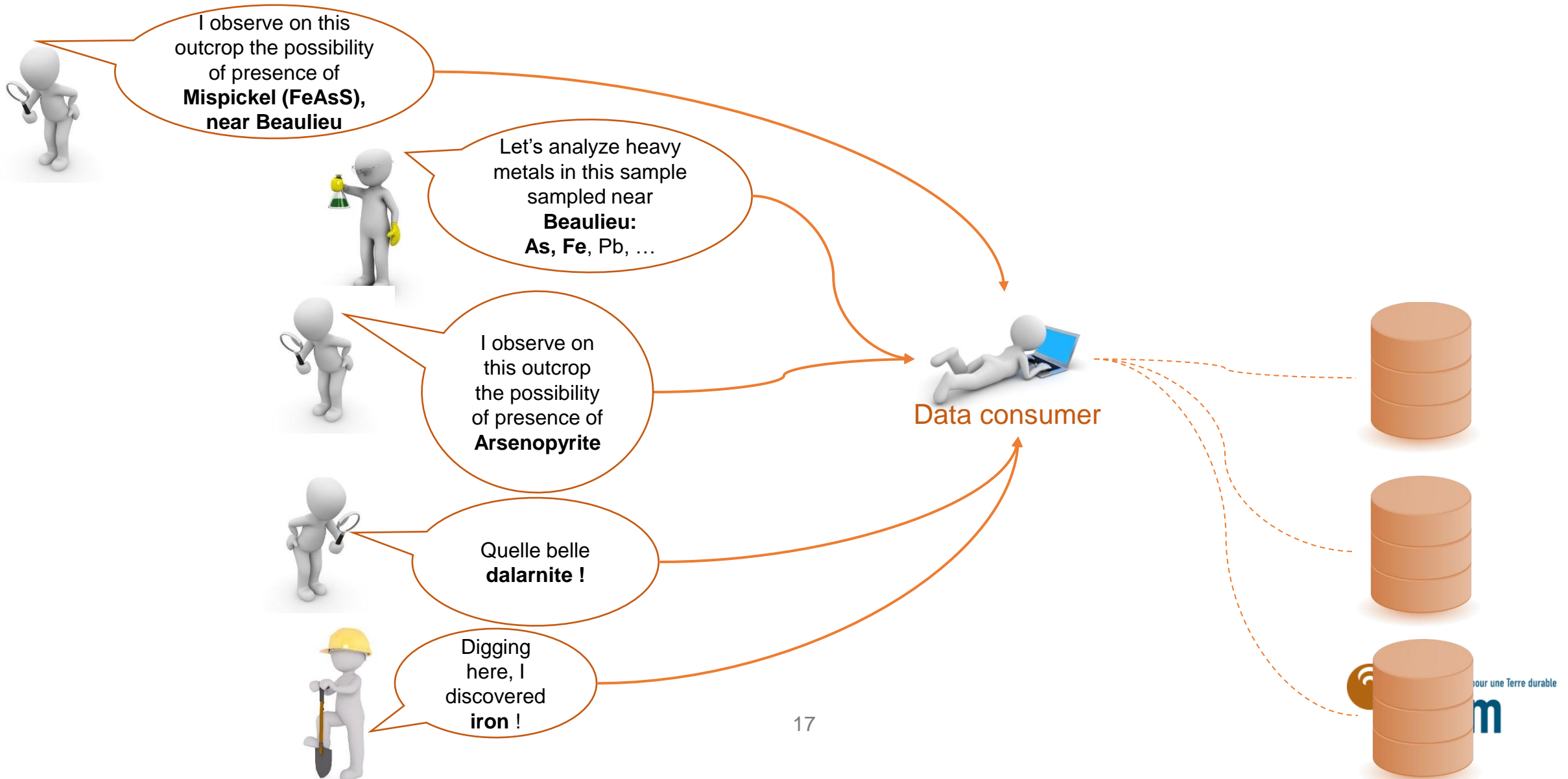
Digging here, I discovered **iron !**



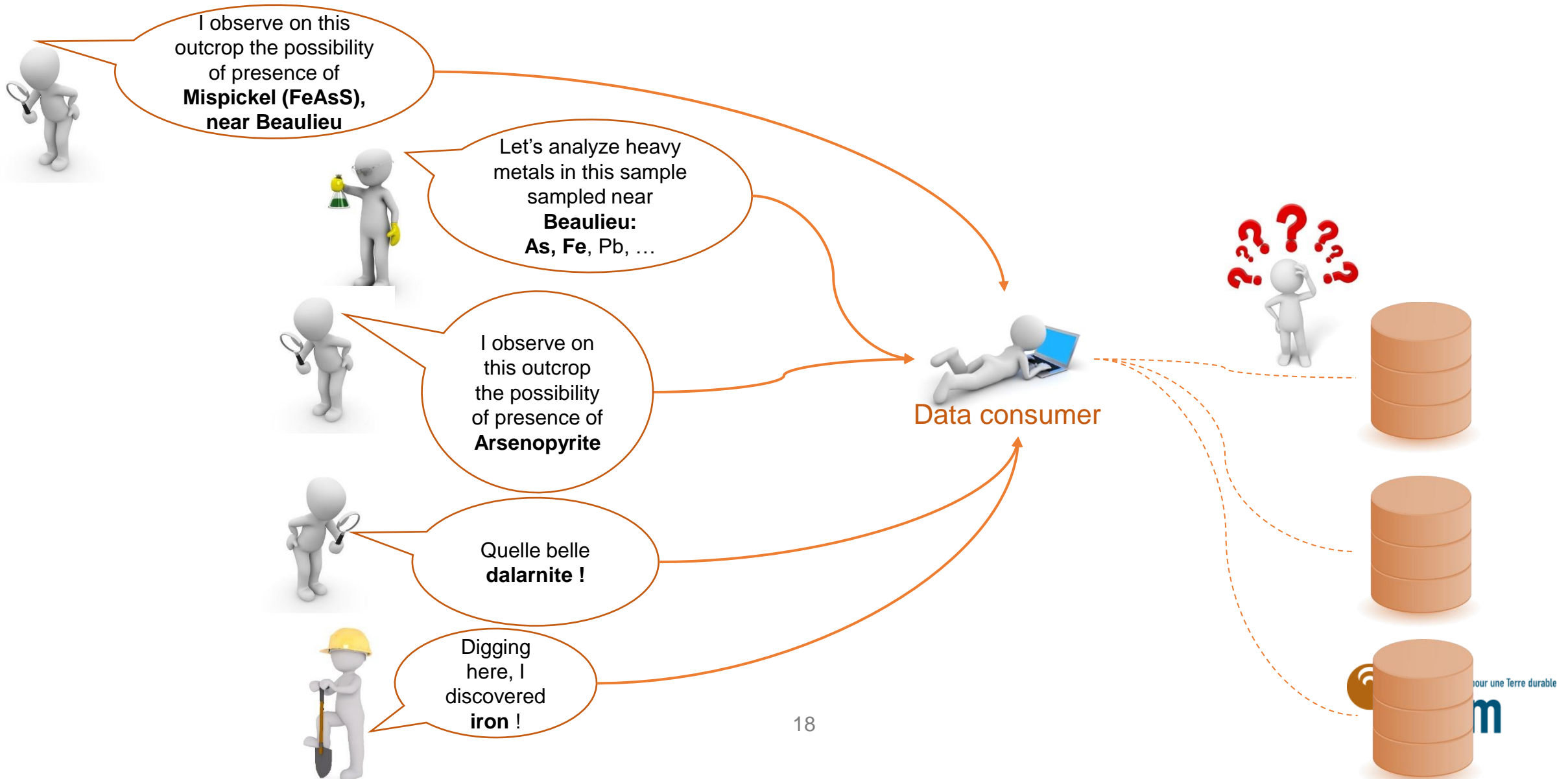
# Why do we need interoperability -> geoscience example



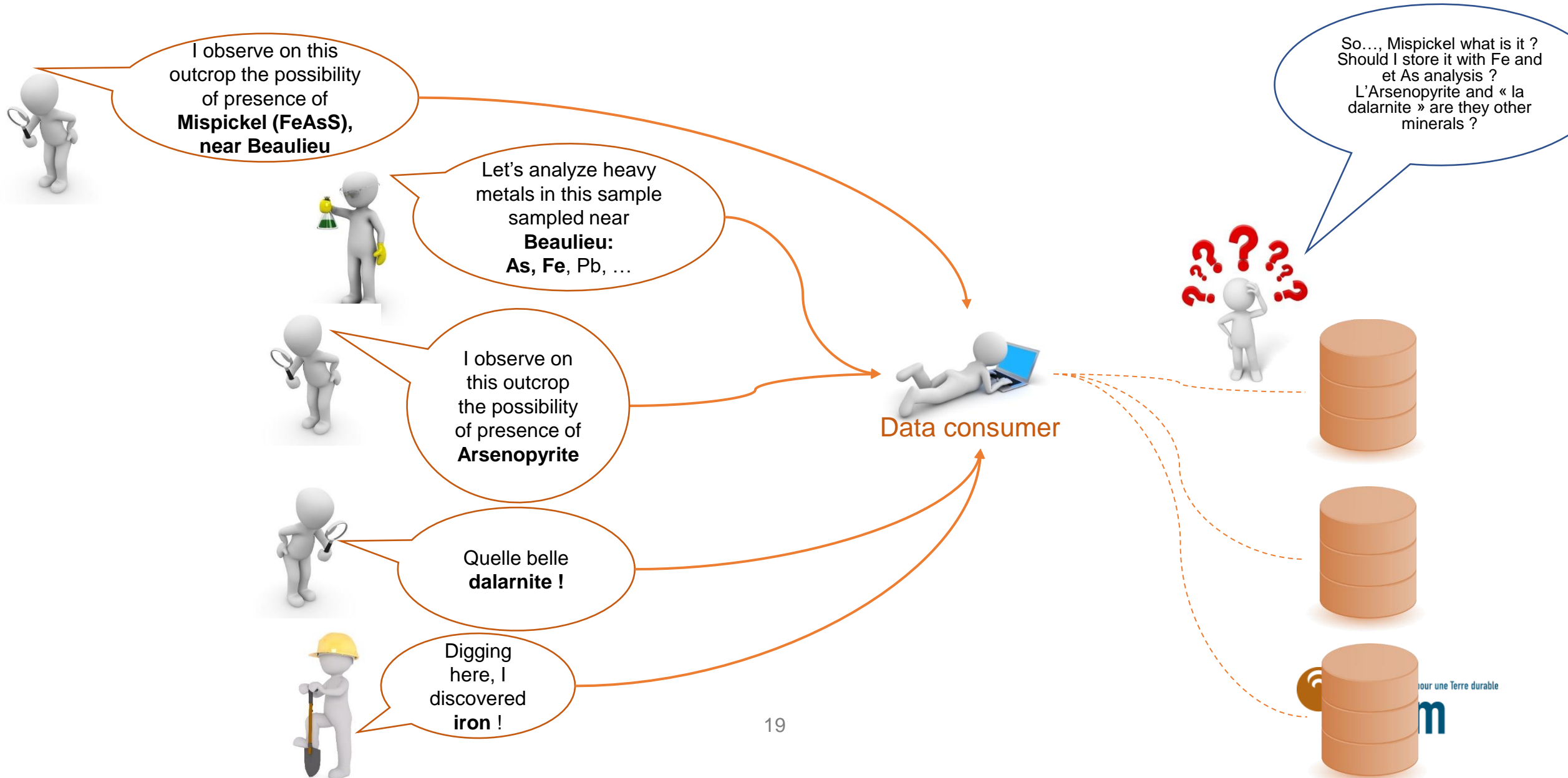
# Why do we need interoperability -> geoscience example



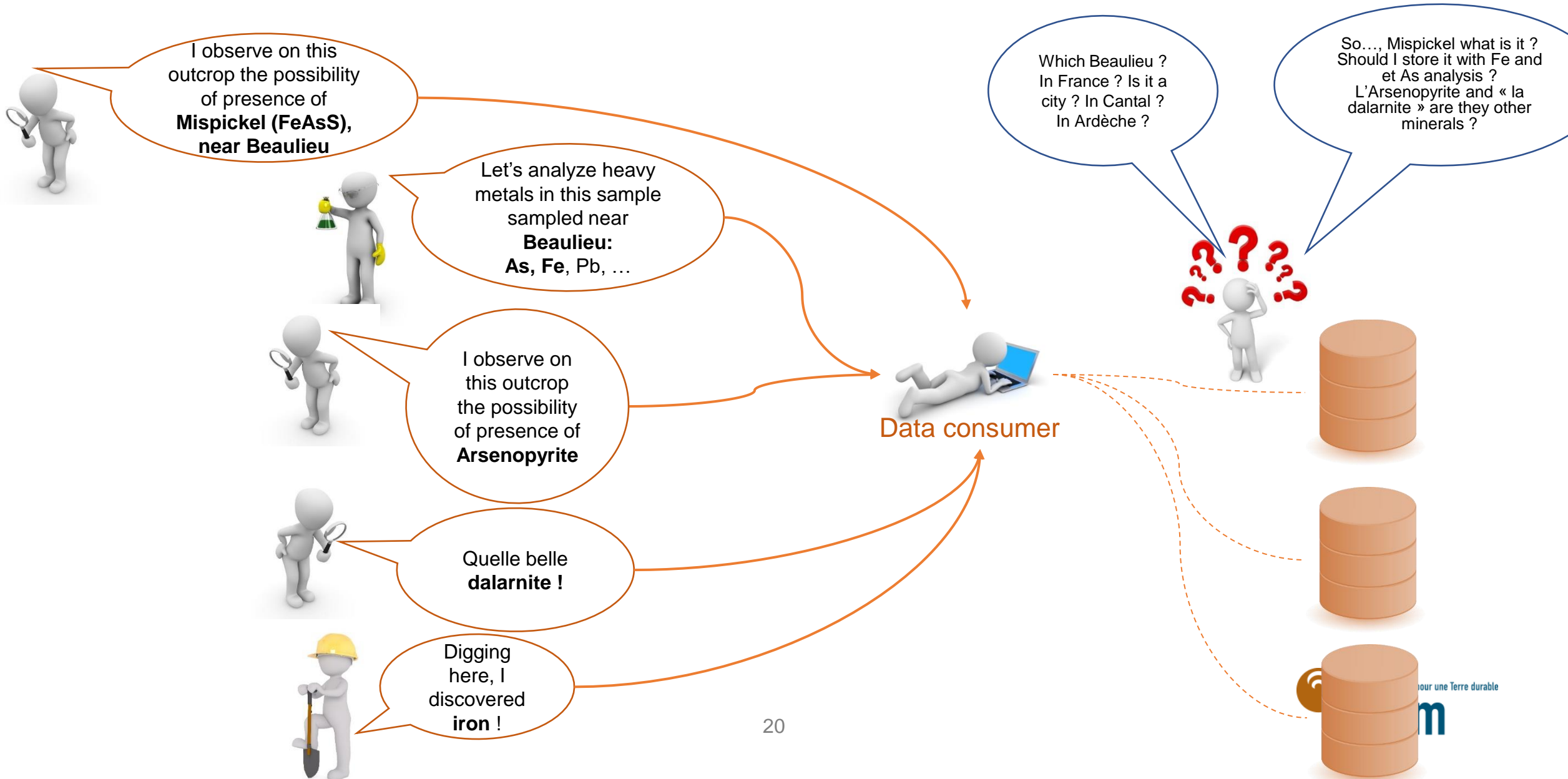
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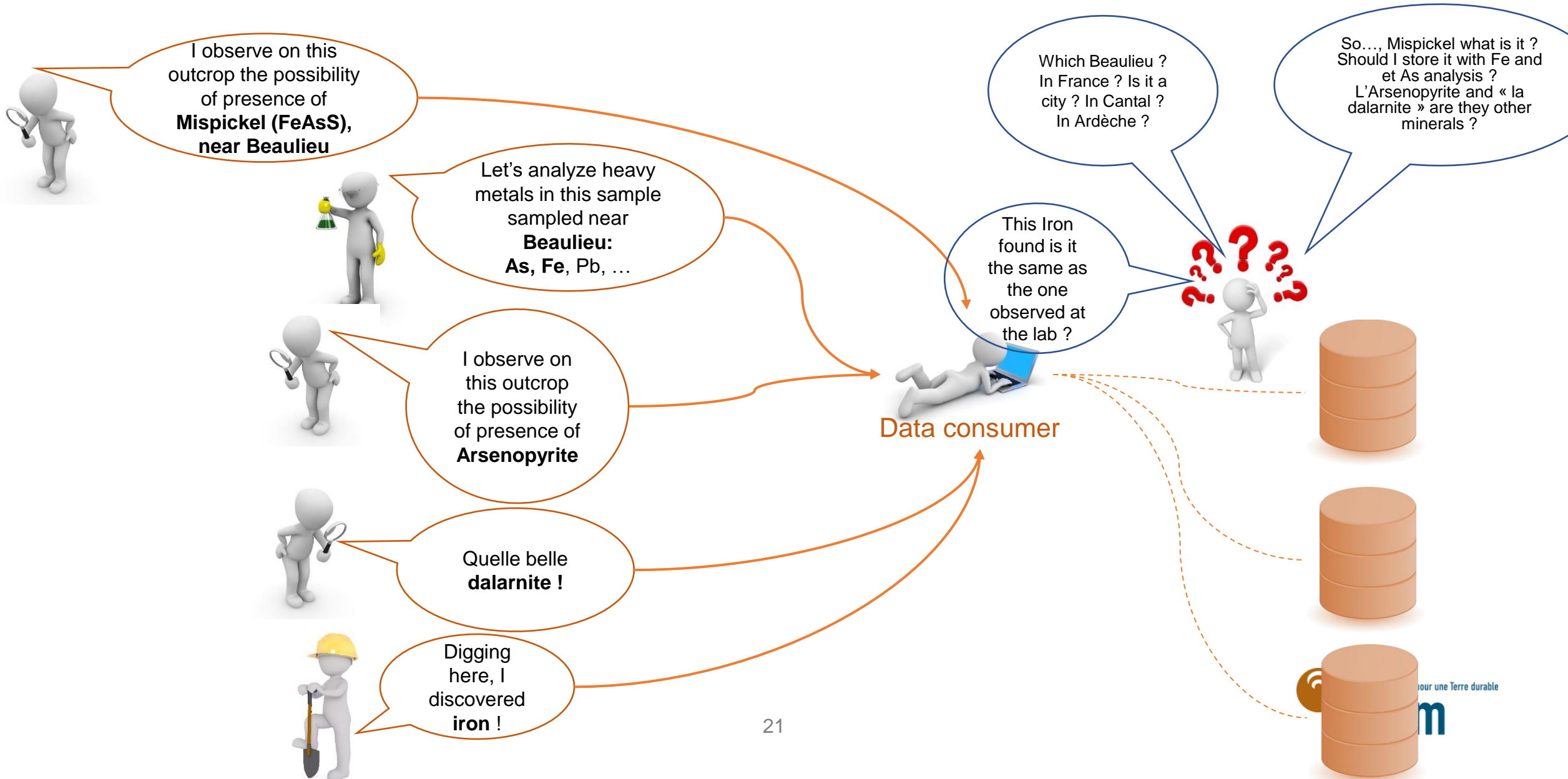
# Why do we need interoperability -> geoscience example



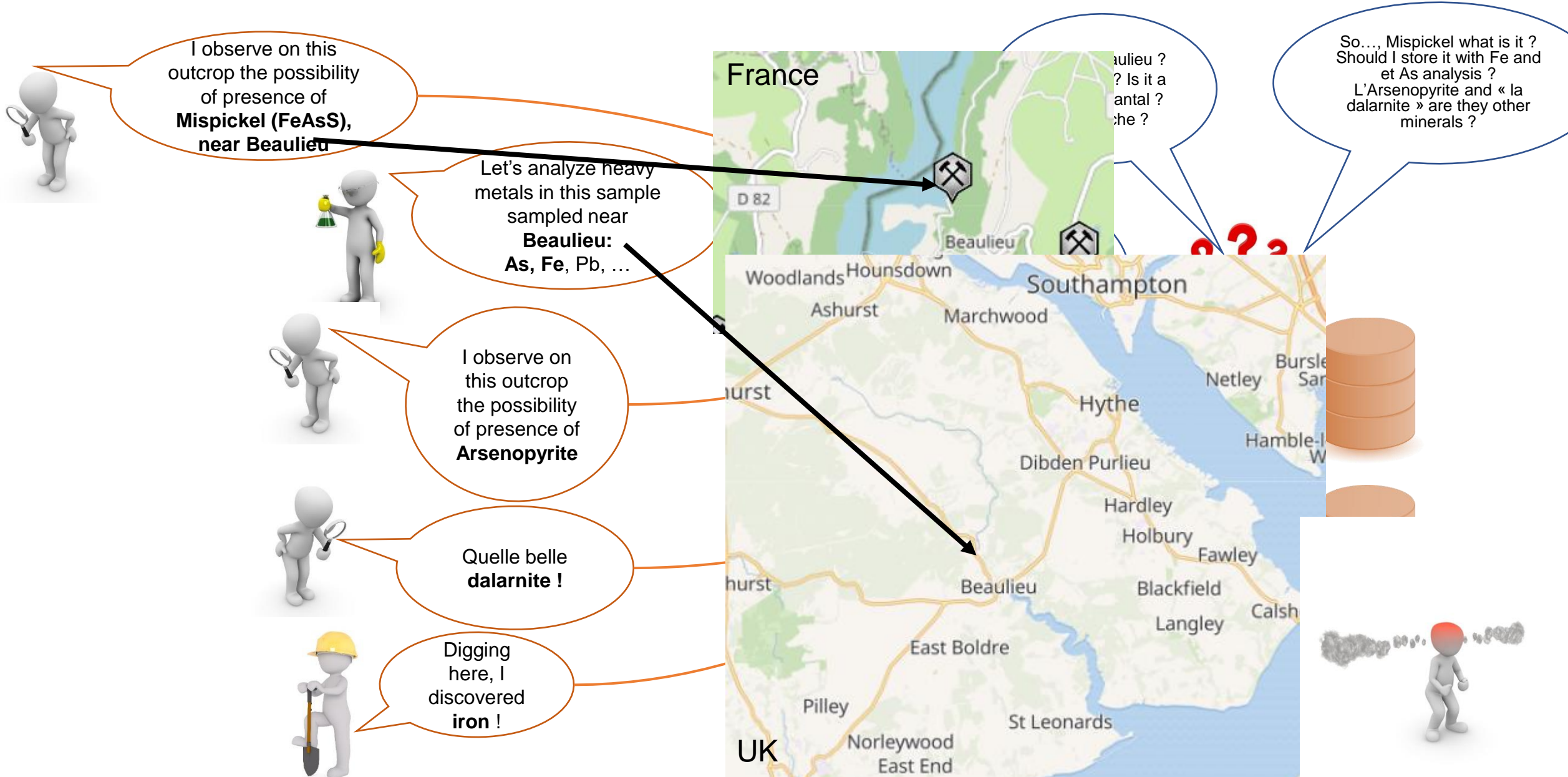
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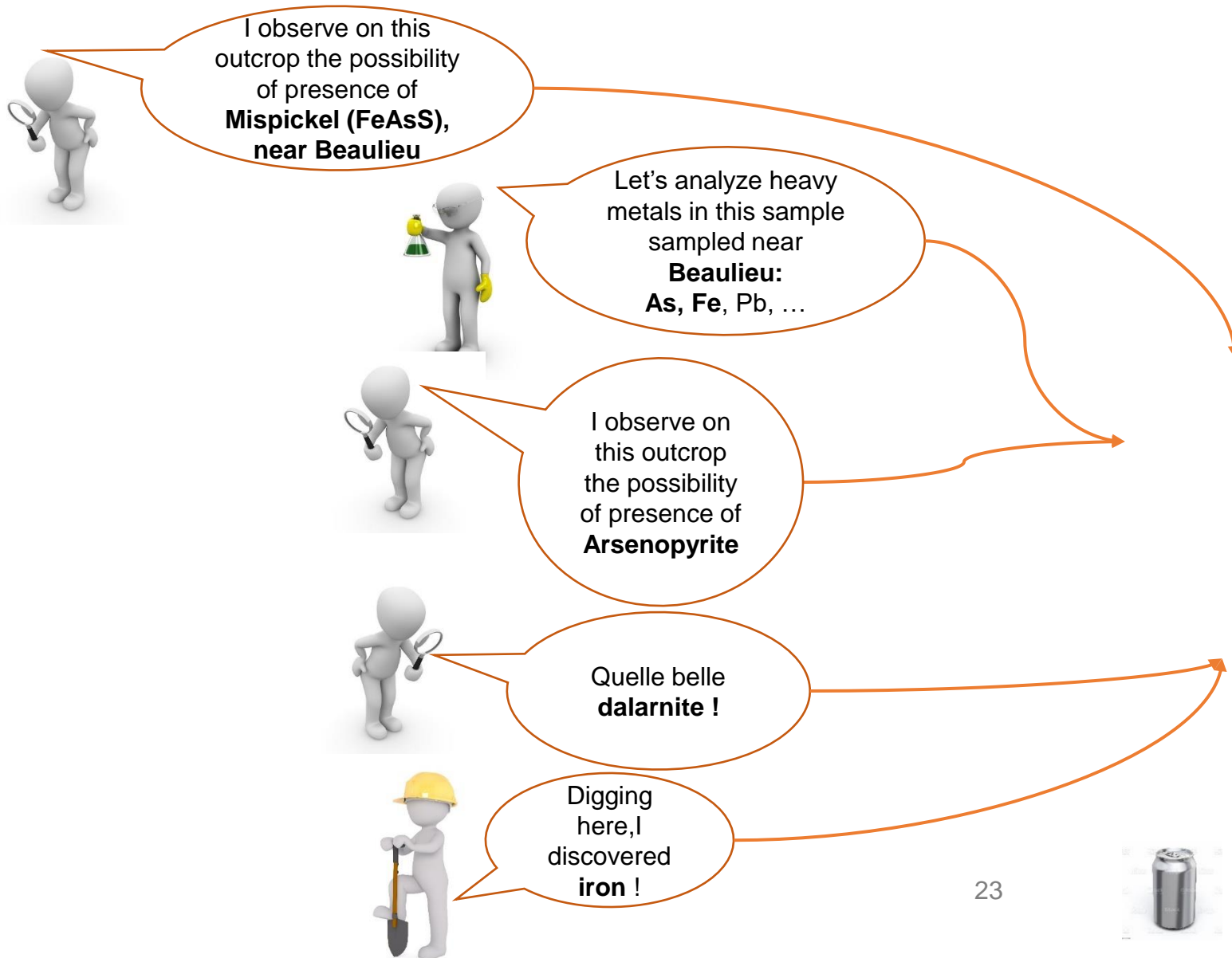
# Why do we need interoperability -> geoscience example



# Why do we need interoperability -> geoscience example

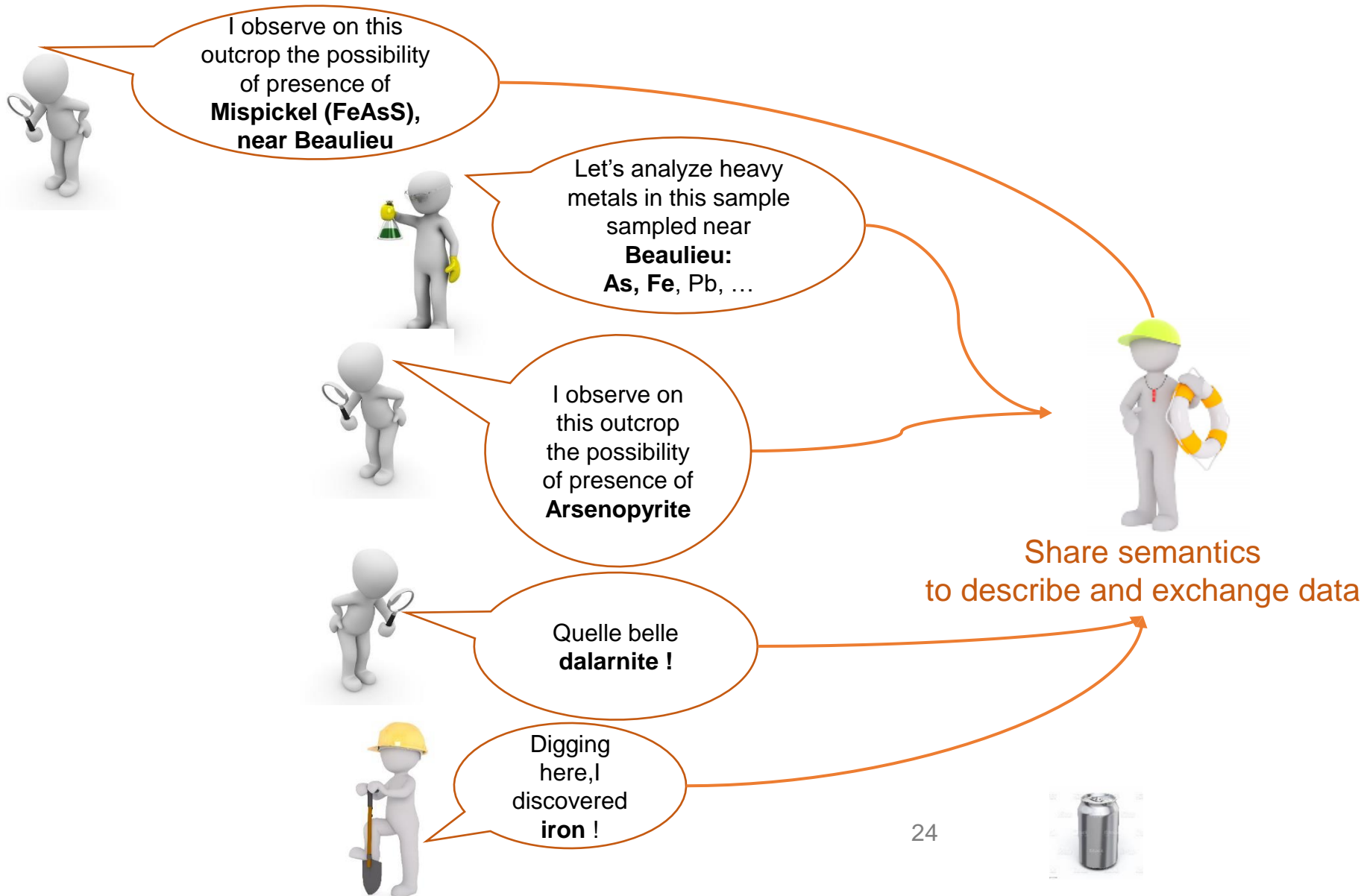


# Why do we need interoperability -> geoscience example

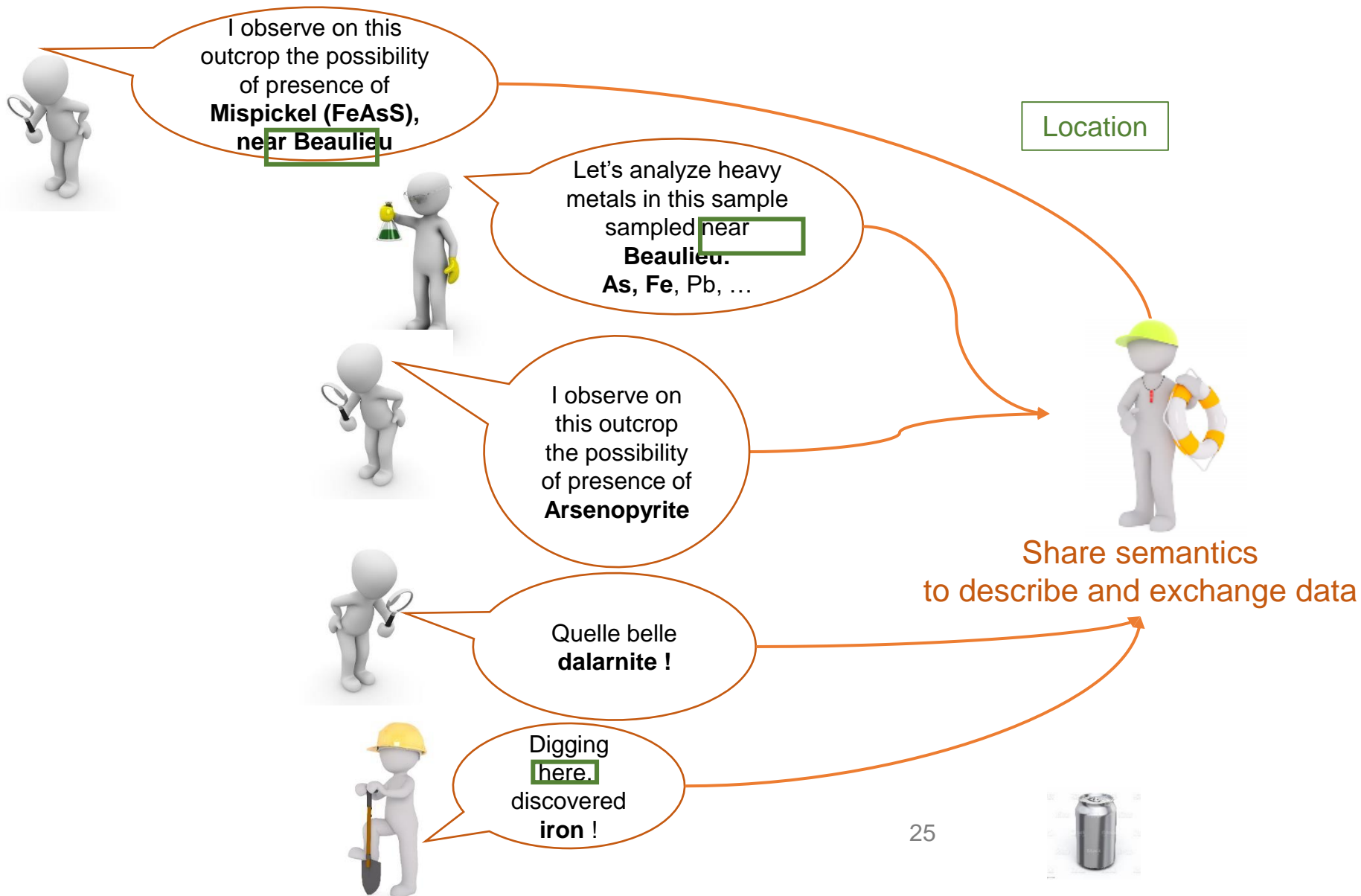




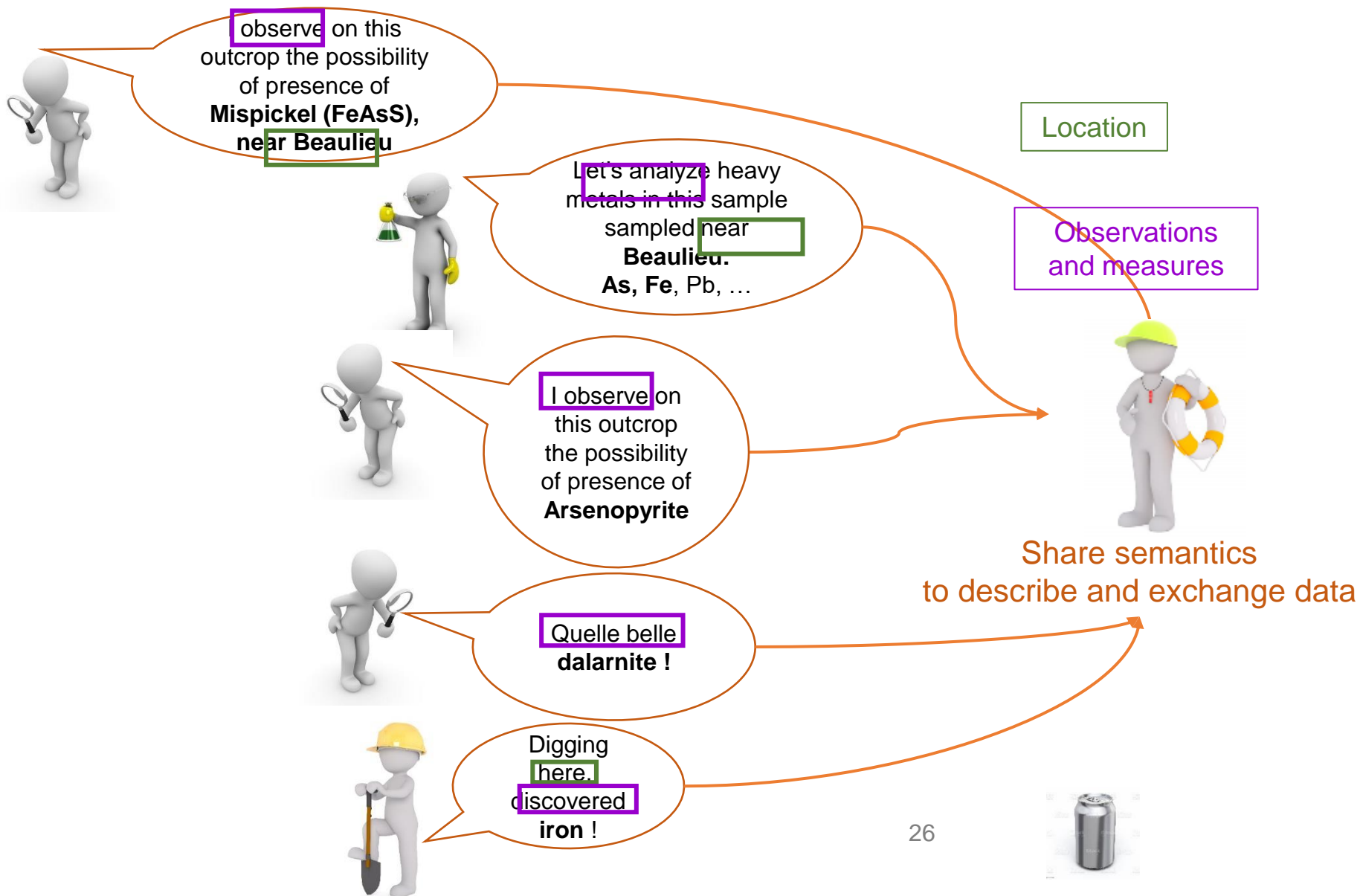
# Why do we need interoperability -> geoscience example



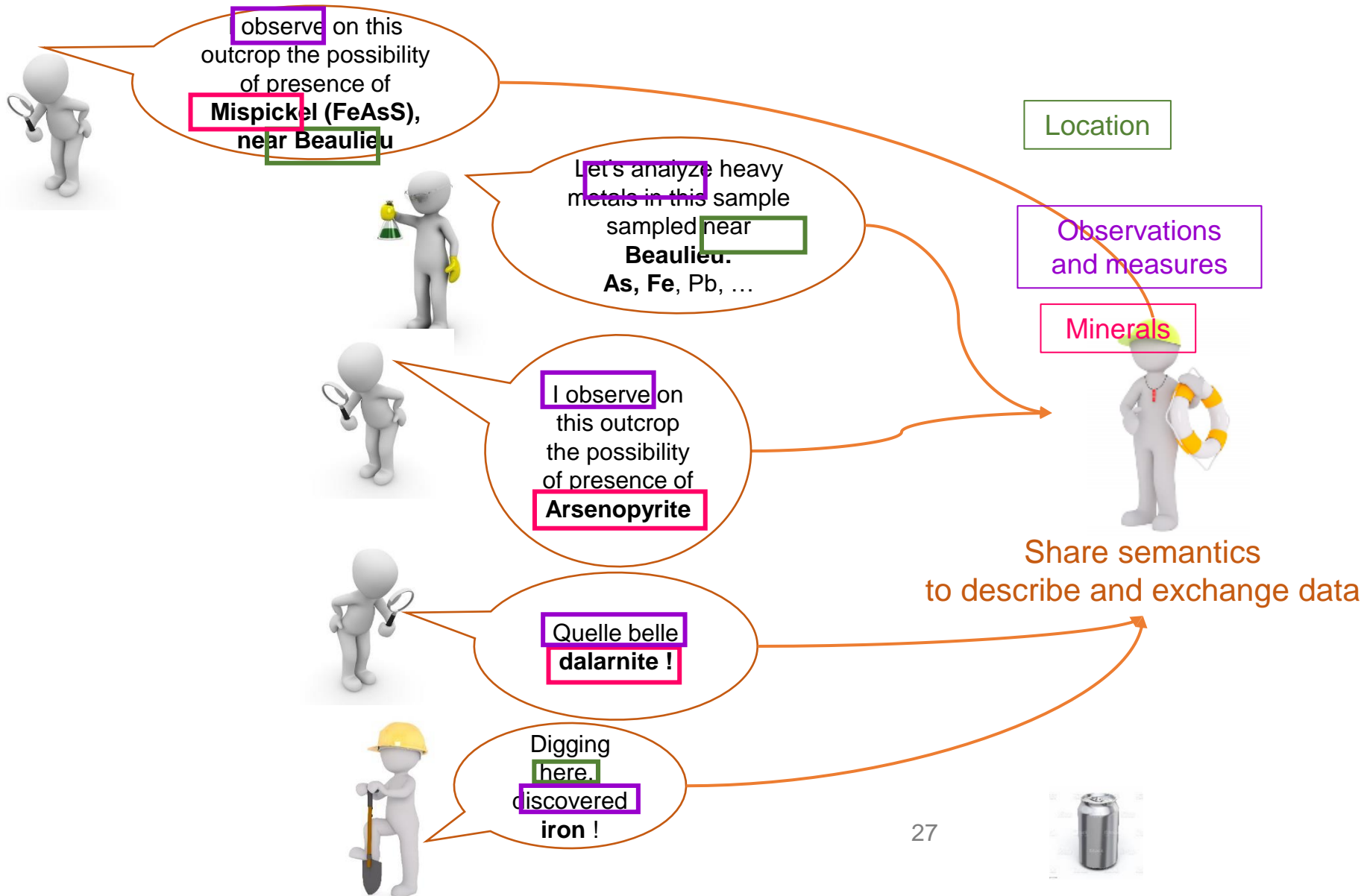
# Why do we need interoperability -> geoscience example



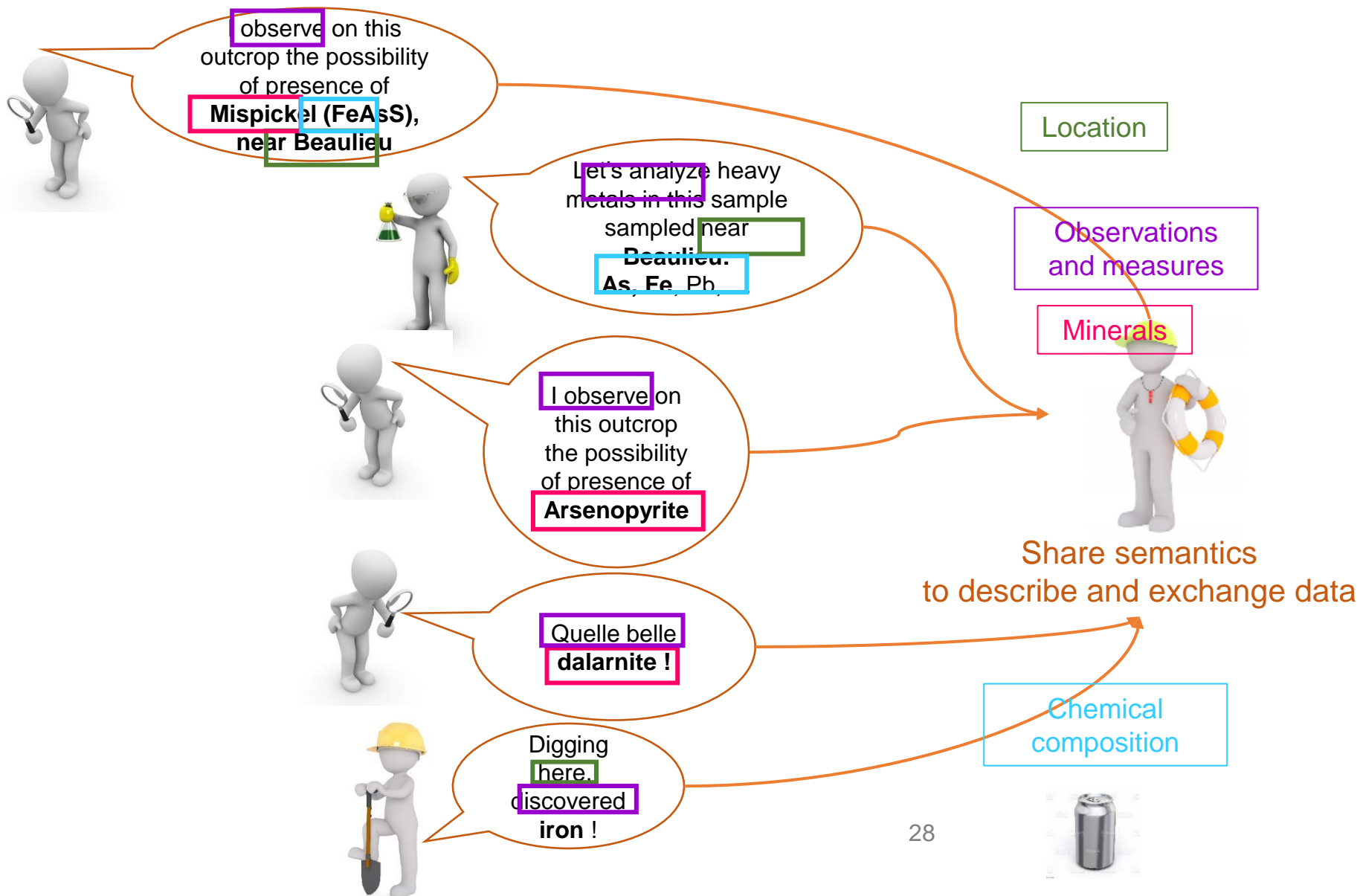
# Why do we need interoperability -> geoscience example



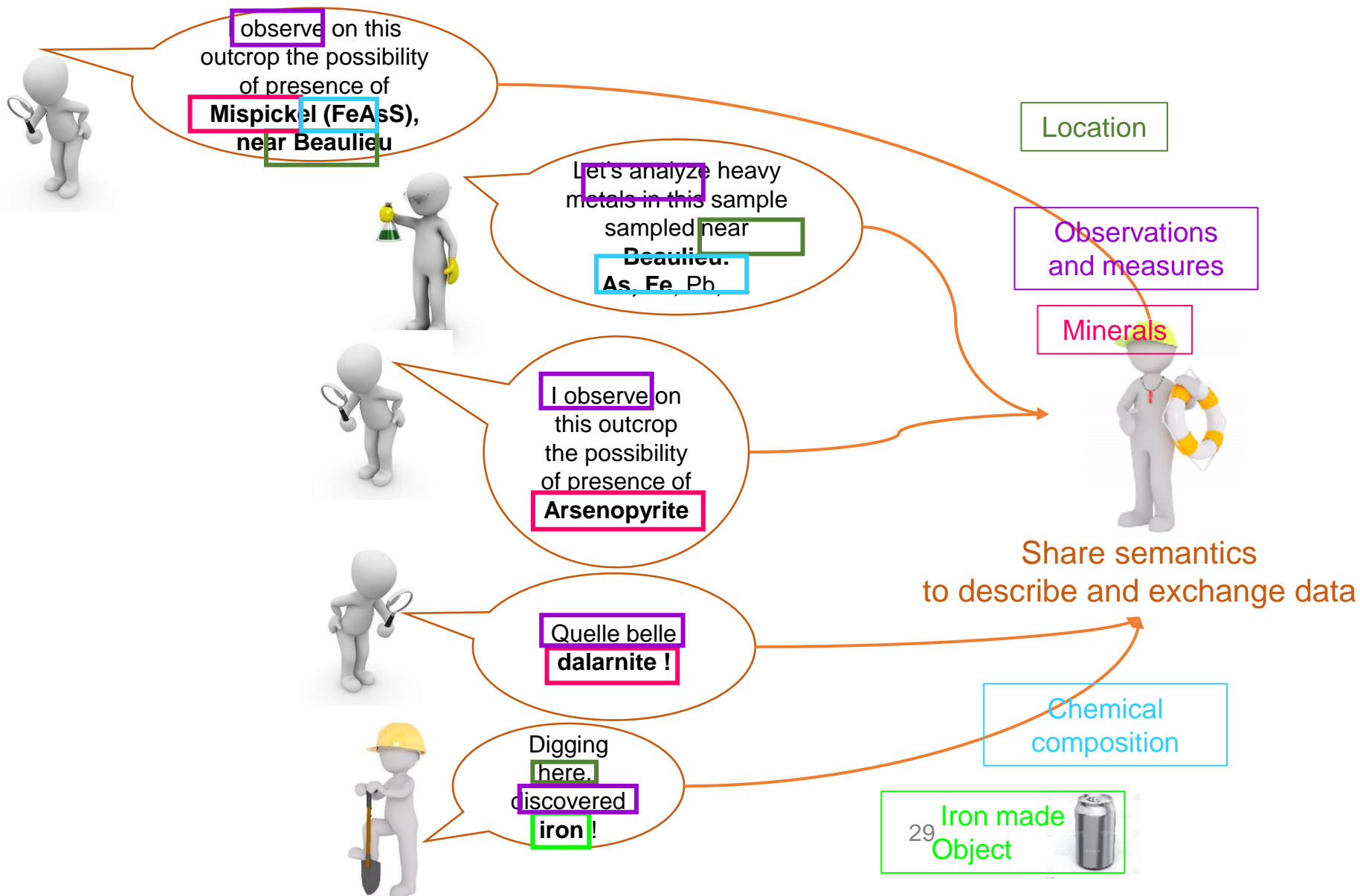
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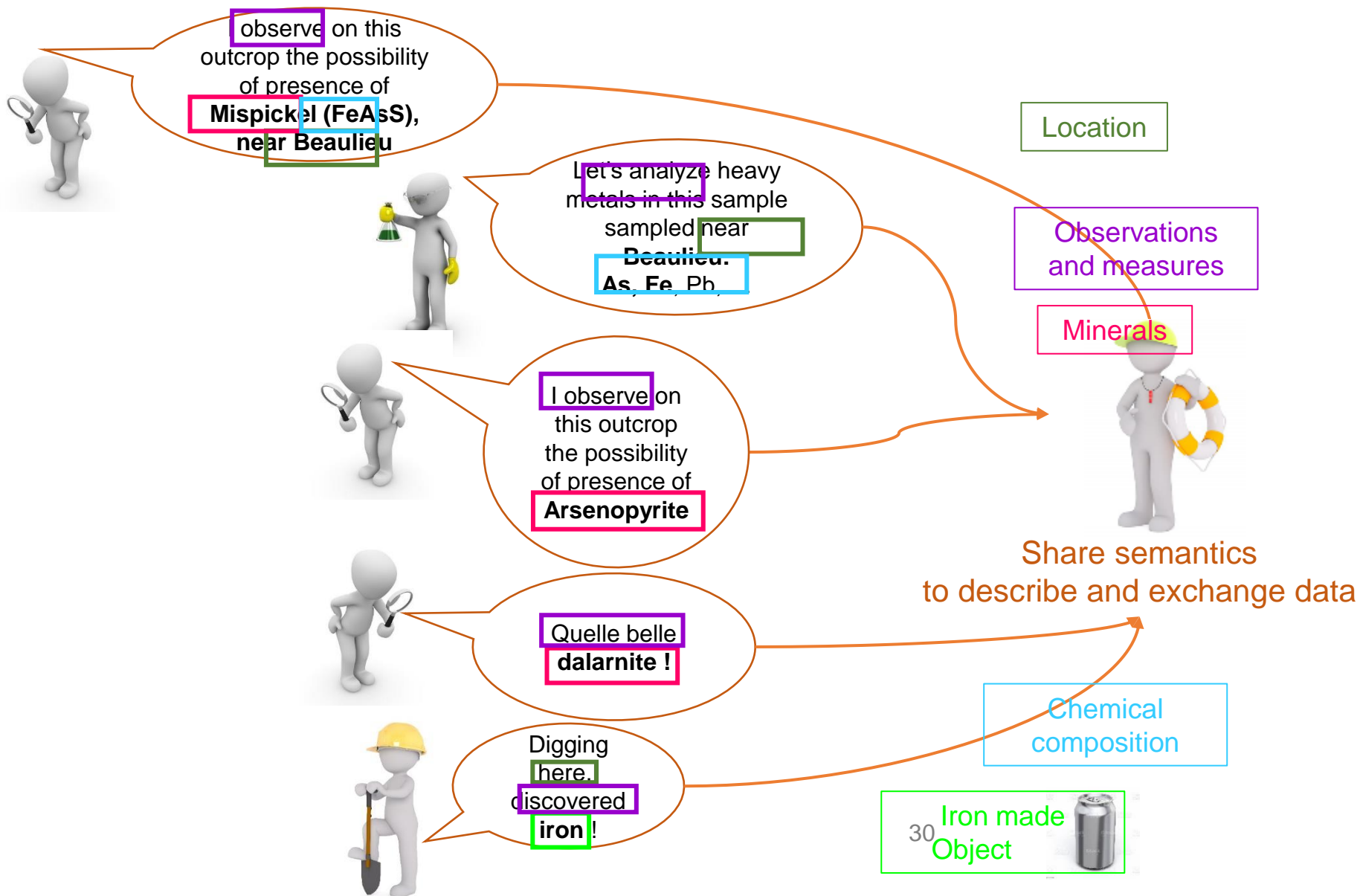
# Why do we need interoperability -> geoscience example



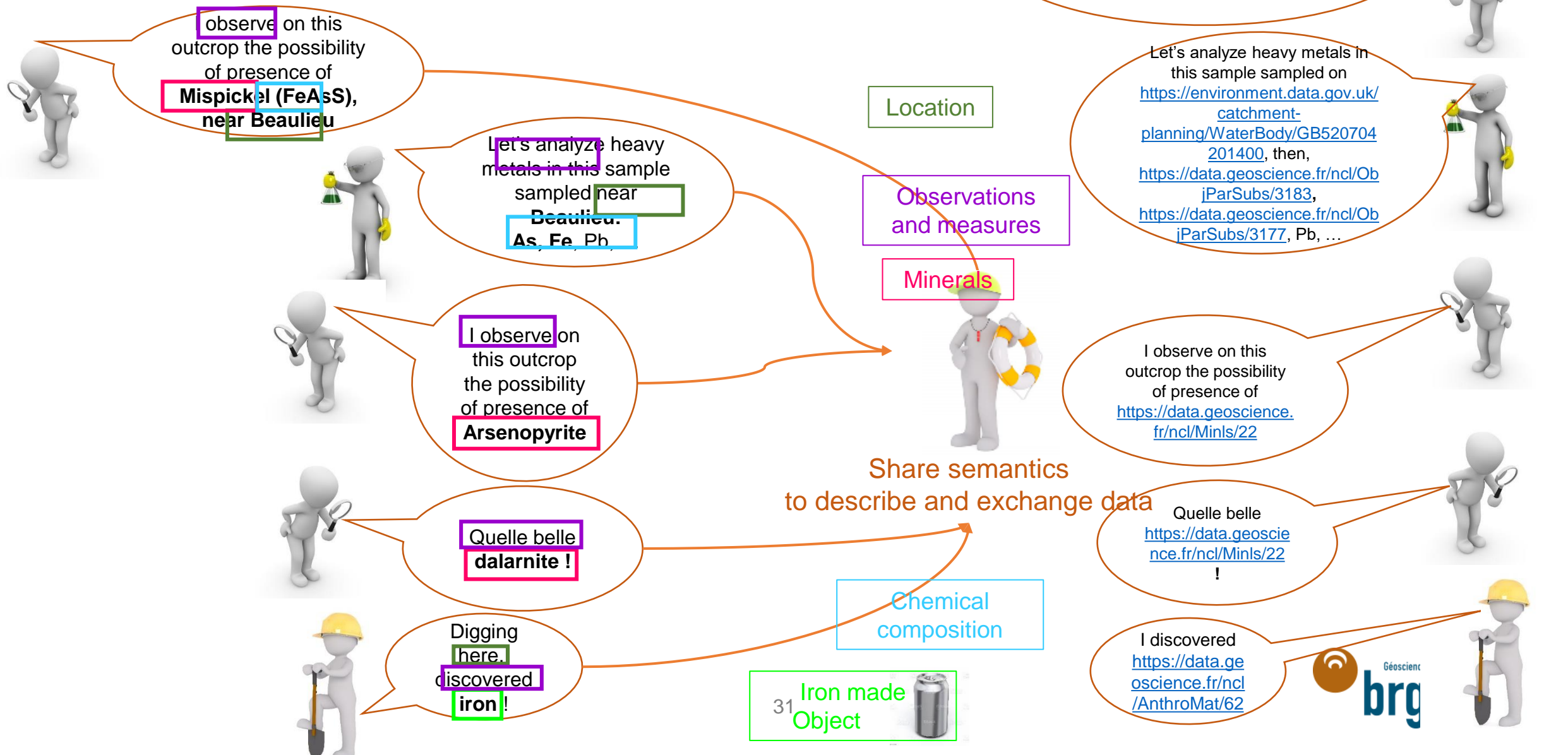
# Why do we need interoperability -> geoscience example



# Why do we need interoperability -> geoscience example



# Why do we need interoperability





# do we need interoperability -> geoscience example

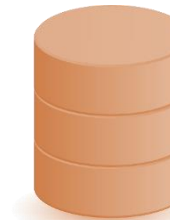
I observe on this outcrop the possibility of presence of <https://data.geoscience.fr/ncl/Minls/22> (FeAsS), near <http://id.insee.fr/geo/commune/15020>

Let's analyze heavy metals in this sample sampled on <https://environment.data.gov.uk/catchment-planning/WaterBody/GB520704201400>, then, <https://data.geoscience.fr/ncl/ObjParSubs/3183>, <https://data.geoscience.fr/ncl/ObjParSubs/3177>, Pb, ...

I observe on this outcrop the possibility of presence of <https://data.geoscience.fr/ncl/Minls/22>

Quelle belle <https://data.geoscience.fr/ncl/Minls/22> !

I discovered <https://data.geoscience.fr/ncl/AnthroMat/62>



Share semantics to describe and exchange data

# do we need interoperability -> geoscience example

I observe on this outcrop the possibility of presence of <https://data.geoscience.fr/ncl/Minls/22> (FeAsS), near <http://id.insee.fr/geo/commune/15020>

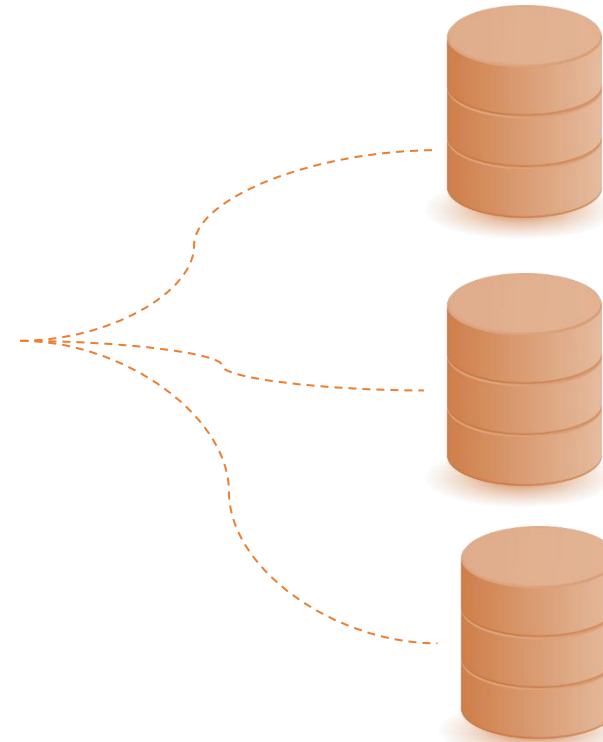
Let's analyze heavy metals in this sample sampled on <https://environment.data.gov.uk/catchment-planning/WaterBody/GB520704201400>, then, <https://data.geoscience.fr/ncl/ObjParSubs/3183>, <https://data.geoscience.fr/ncl/ObjParSubs/3177>, Pb, ...

I observe on this outcrop the possibility of presence of <https://data.geoscience.fr/ncl/Minls/22>

Quelle belle <https://data.geoscience.fr/ncl/Minls/22> !

I discovered <https://data.geoscience.fr/ncl/AnthroMat/62>

Interoperable data



Share semantics to describe and exchange data

# do we need interoperability -> geoscience example

I observe on this outcrop the possibility of presence of <https://data.geoscience.fr/ncl/Minls/22> (FeAsS), near <http://id.insee.fr/geo/commune/15020>

Let's analyze heavy metals in this sample sampled on <https://environment.data.gov.uk/catchment-planning/WaterBody/GB520704201400>, then, <https://data.geoscience.fr/ncl/ObjParSubs/3183>, <https://data.geoscience.fr/ncl/ObjParSubs/3177>, Pb, ...

I observe on this outcrop the possibility of presence of <https://data.geoscience.fr/ncl/Minls/22>

Quelle belle <https://data.geoscience.fr/ncl/Minls/22> !

I discovered <https://data.geoscience.fr/ncl/AnthroMat/62>

**Interoperable data**

No more siloed data

Share semantics to describe and exchange data

# do we need interoperability -> geoscience example



I observe on this outcrop the possibility of presence of <https://data.geoscience.fr/ncl/Minls/22> (FeAsS), near <http://id.insee.fr/geo/commune/15020>



Let's analyze heavy metals in this sample sampled on <https://environment.data.gov.uk/catchment-planning/WaterBody/GB520704201400>, then, <https://data.geoscience.fr/ncl/ObjParSubs/3183>, <https://data.geoscience.fr/ncl/ObjParSubs/3177>, Pb, ...



I observe on this outcrop the possibility of presence of <https://data.geoscience.fr/ncl/Minls/22>



**Interoperable data**

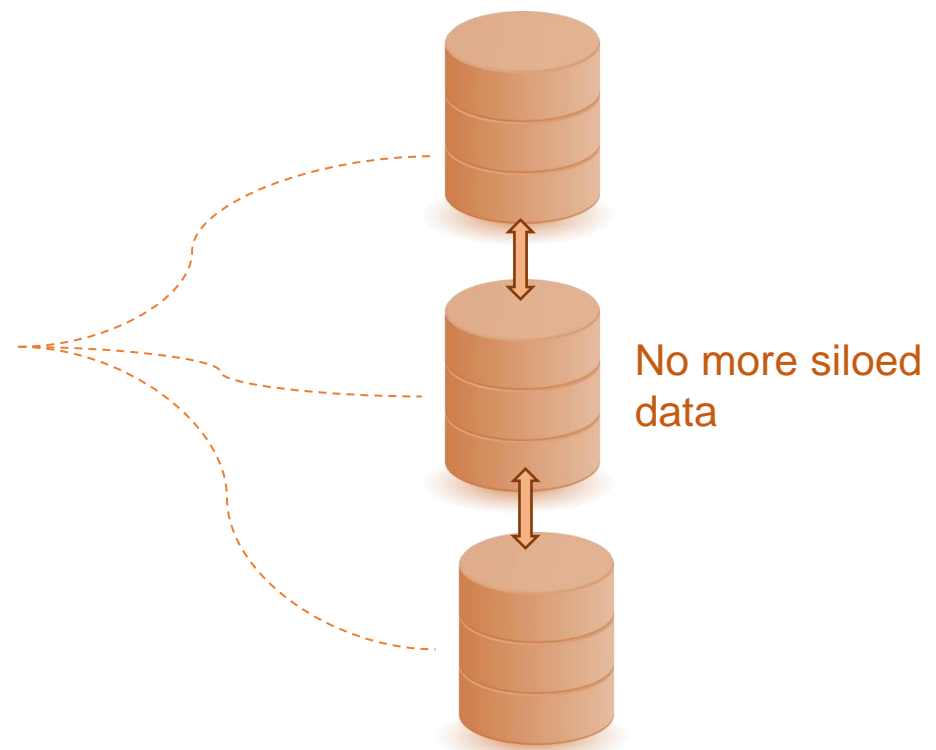
Quelle belle <https://data.geoscience.fr/ncl/Minls/22> !



I discovered <https://data.geoscience.fr/ncl/AnthroMat/62>



Share semantics to describe and exchange data



# Why do we need interoperability -> space example

- Lead to the creation of OGC SWE – Sensor Web Enablement standards

## Sensor Metadata!

WIREID Nov. 10, 1999: Metric Math Mistake Muffed Mars Meteorology Mission

LISA GROSSMAN 11-10-99 07:00 AM

### NOV. 10, 1999: METRIC MATH MISTAKE MUFFED MARS METEOROLOGY MISSION



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[Sport](#)

[Entertainment](#)

[Talking Point](#)

[In Depth](#)

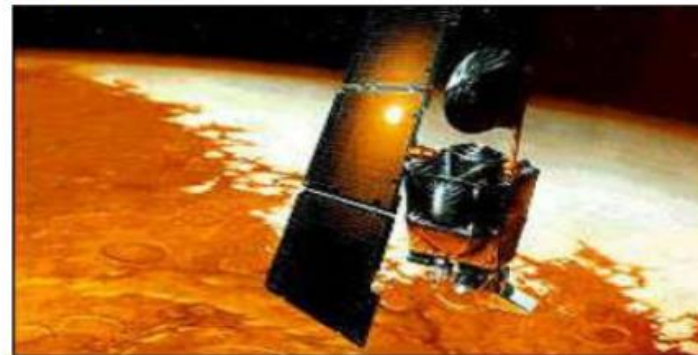
[On Air](#)

[Archive](#)

Thursday, September 30, 1999 Published at 18:53 GMT 19:53 UK

## Sci/Tech

### Confusion leads to Mars failure



The Mars Climate Orbiter: Now in pieces on the planet's surface

The Mars Climate Orbiter Spacecraft was lost because one Nasa team used imperial units while another used metric units for a key spacecraft operation.

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Sci/Tech Contents

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[What the loss of Mars Climate Orbiter means](#)

17 Jul 99 | Sci/Tech  
[Astronauts call for Mars mission](#)

#### Internet Links

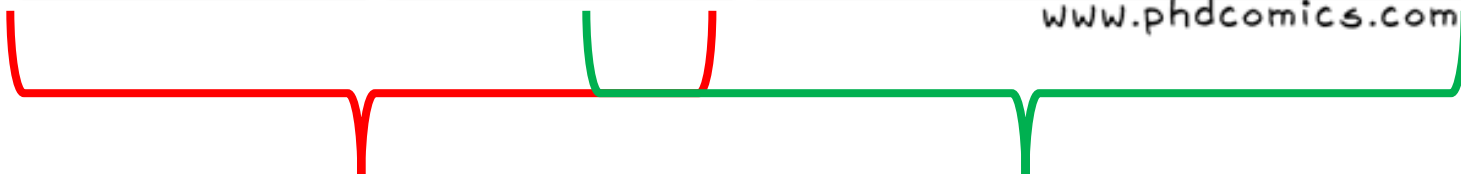
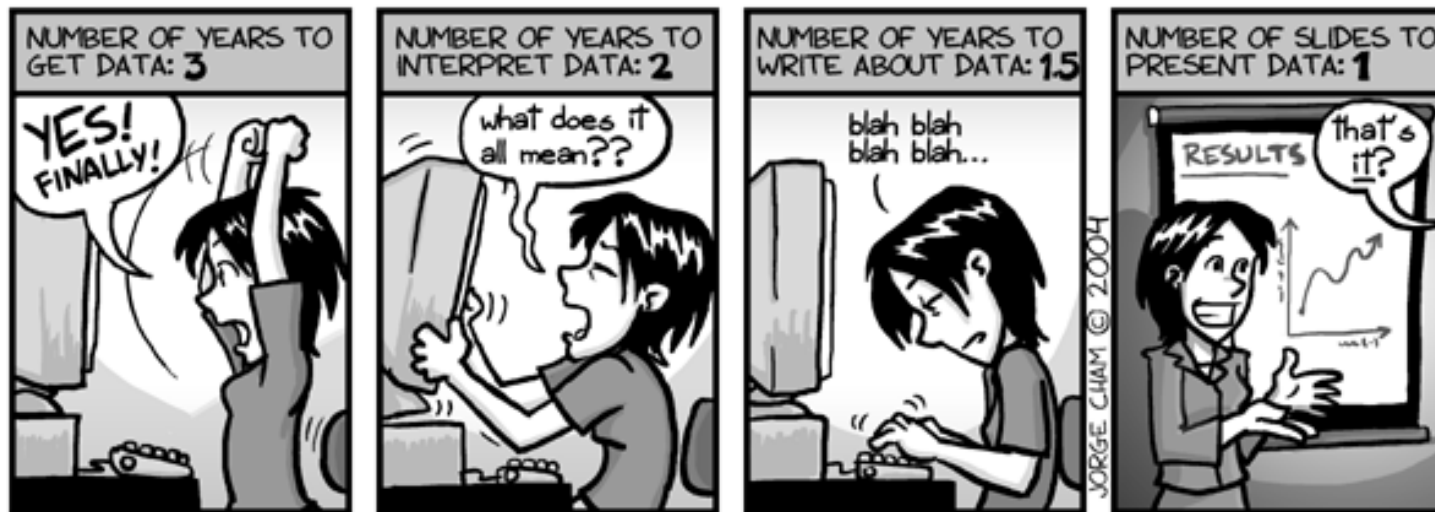
[Mars Climate Orbiter](#)

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# Why do we need interoperability -> Research example



## DATA: BY THE NUMBERS



Interoperability / FAIR data

for our domain colleagues do to their real work

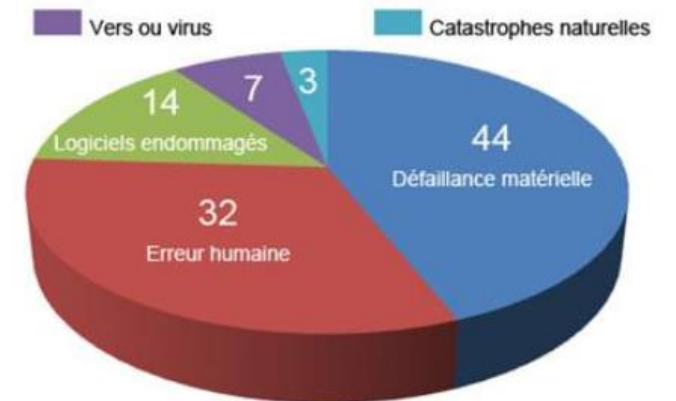
# Why do we need interoperability -> Research example

20 years after publication, 80% of scientific data is lost

## — III. Données de la recherche : pourquoi les gérer ?

20 ans après publication, 80 % des données scientifiques sont perdues...

- Pour les auteurs
- Pour les équipes, organismes, institutions
- Pour la recherche mondiale
- **Causes :**
  - Destruction des supports
  - Problème de version, obsolescence matérielle ou logicielle
  - Lieu de stockage indéfini
- **Conséquences :**
  - Perte de temps, d'argent (fonds publics...)
  - Pas de vérification des résultats possible
  - Pas de comparaison des résultats dans le temps ou l'espace
  - Pas de réutilisations (différentes)



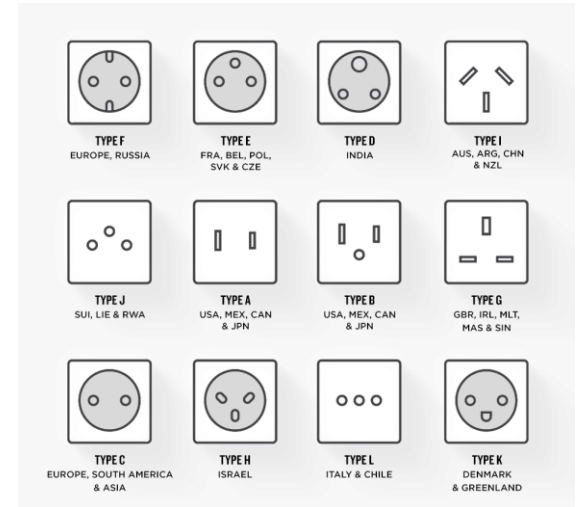
# Why do we need interoperability

It's everywhere in our daily life

- Simple thing done everyday



Simple because normalized, we can easily plug our kettle at home or at the office



Adaptators exist when need be

- Shared driving signs\*



With local specificities



\* let's not discuss who is driving on the good(right) side of the road please ☺



# Dream goal

Let's see what we could do if everyone played the interoperability game

- QGIS

EnvironmentalMonitoringFacility (representativePoint) - Attributs d'entités

Element	Value
gml:TimePeriod	
@gml:id	ObservingCapability.TimePeriod.14636
gml:beginPosition	1977-10-06T13:00:00Z
gml:endPosition	2018-03-30T02:00:00Z
ef:processType	
@xlink:href	http://inspire.ec.europa.eu/codelist/ProcessType/Value/process/
@xlink:title	Process
ef:resultNature	
@xlink:href	http://inspire.ec.europa.eu/codelist/ResultNature/Value/primary/
@xlink:title	primary
ef:procedure	
@xlink:href	http://resource.brgm-rec.fr/data/EntiteHydroGeol/507AC00
@xlink:title	Entite hydrogeologique 507AC00
ef:observedProperty	
@xlink:href	http://resource.brgm-rec.fr/data/somePath
@xlink:title	GroundWater.Level
ef:broader	
ef:supersedes	
ef:supersededBy	
ef:reportedTo	
@nilReason	http://inspire.ec.europa.eu/codelist/VoidReason/Value/Unpopulated
@xsi:nil	true
ef:hasObservation	
@xlink:href	http://resource.brgm-rec.fr/obs/RawOfferingPiezo/06512X0037/STREMY.2&responseFormat=http://www.opengis.net/waterml/2.0&temporalFilter=om%3AphenomenonTime%2Clatest
@xlink:title	Latest value (WaterML 2.0 format): Raw groundwater level measurement from piezometer 06512X0037/STREMY.2
ef:hasObservation	
@xlink:href	http://resource.brgm-rec.fr/obs/RawOfferingPiezo/06512X0037/STREMY.2&responseFormat=application/json&temporalFilter=om%3AphenomenonTime%2Clatest
@xlink:title	Latest value (JSON format): Raw groundwater level measurement from piezometer 06512X0037/STREMY.2
ef:hasObservedProperty	
@xlink:href	http://resource.brgm-rec.fr/obs/RawOfferingPiezo/06512X0037/STREMY.2&responseFormat=http://www.opengis.net/waterml/2.0
@xlink:title	Latest value (WaterML 2.0 format): Raw groundwater level measurement from piezometer 06512X0037/STREMY.2
ef:hasObservedProperty	
@xlink:href	http://resource.brgm-rec.fr/obs/RawOfferingPiezo/06512X0037/STREMY.2&MergeObservationsIntoDataArray=true
@xlink:title	Latest value (JSON format): Raw groundwater level measurement from piezometer 06512X0037/STREMY.2
ef:involvedIn	
ef:representativePoint	
gml:Point	
@srsDimension	

Dereferencing related raw ground water level timeseries URI

See :

[https://github.com/BRGM/gml\\_application\\_schema\\_toolbox/tree/master/docs/presentations/2018\\_INSPIRE\\_conference](https://github.com/BRGM/gml_application_schema_toolbox/tree/master/docs/presentations/2018_INSPIRE_conference)



# Dream goal

Let's see what we could do if everyone played the interoperability game

- Linked data aware web client

Enter BRGM linked data resource URI here... OR

```
{}
"@id": "https://opengeospatial.github.io/ELFIE/FR/HY-WaterBody/sgwIEE-009-",
"@type": "HY_WaterBody",
"name": "La Somme Canalisée",
"gsmp:hasGeometry": {
  "@type": "gsmp:Geometry",
  "gsmp:asWKT": "MULTILINESTRING((3 13347982042203 49 7409931557826 3 133170628680 49 7409863061587 3 13214210011018 49 7410646964317 3 1252874658722 49 7415840788399 3 1246553611381 49 74163055031 3 12161265730084 49 741860943894)(3 12161265730084 49 741860943894 3 12122729092244 49 741890079681)(3 06976861191596 49 7425710354124 3 06893673695930 49 7425768998422)(3 15918689153231 49 7427682536191 3 1586460279536 49 7422442393435 3 15275264729804 49 7419408914488 3 14587342803432 49 7415872285919 3 13899429797443 49 7412304817264 3 13556933117711 49 7410537433805 3 13490236704776 49 7410194423897 3 13347982042203 49 7409931557826)(3 12122729092244 49 741890079681 3 11843407483668 49 7421012769724 3 1115791627624
```

https://opengeospatial.github.io/ELFIE/FR/HY-WaterBody/sgwIEE-009-

http://opengeospatial/ontology/gsm2#GW\_HydrogeoUnit  http://www.opengis.net/standards/geosparql/Geometry  name  http://opengeospatial/ontology/hy/HY\_WaterBody  Stabilize

River network traversed to its mouth

[https://opengeospatial.github.io/ELFIE/demo/surface\\_groundwater\\_network\\_interaction](https://opengeospatial.github.io/ELFIE/demo/surface_groundwater_network_interaction)

# Interoperability

## Benefits

- 2 folds aspects
  - Either we have legal constraints (Re INSPIRE and FAIR presentation)
  - But when no constraints exist, how to set up a Data Sharing culture?
  
- Creating the necessary organizational context to opening / sharing data is already quite an endeavor
  - So, when this point is reached, the technical aspects should be straightforward.

# Interoperability

## Context

- More and more external pressure on organisations
  - Climate change
  - Health crisis
  - Reduced (public) fundings

=> Organizations cannot afford to reinvent their own wheel locally when it comes down to sharing data
  
- Even more when we have 90% of the solutions at hand
  - Experience shows that it's not a matter of IT issues (those can always be fixed)
  - It's a matter of organizing communities & changing behaviours

=> Let's explore how to do so

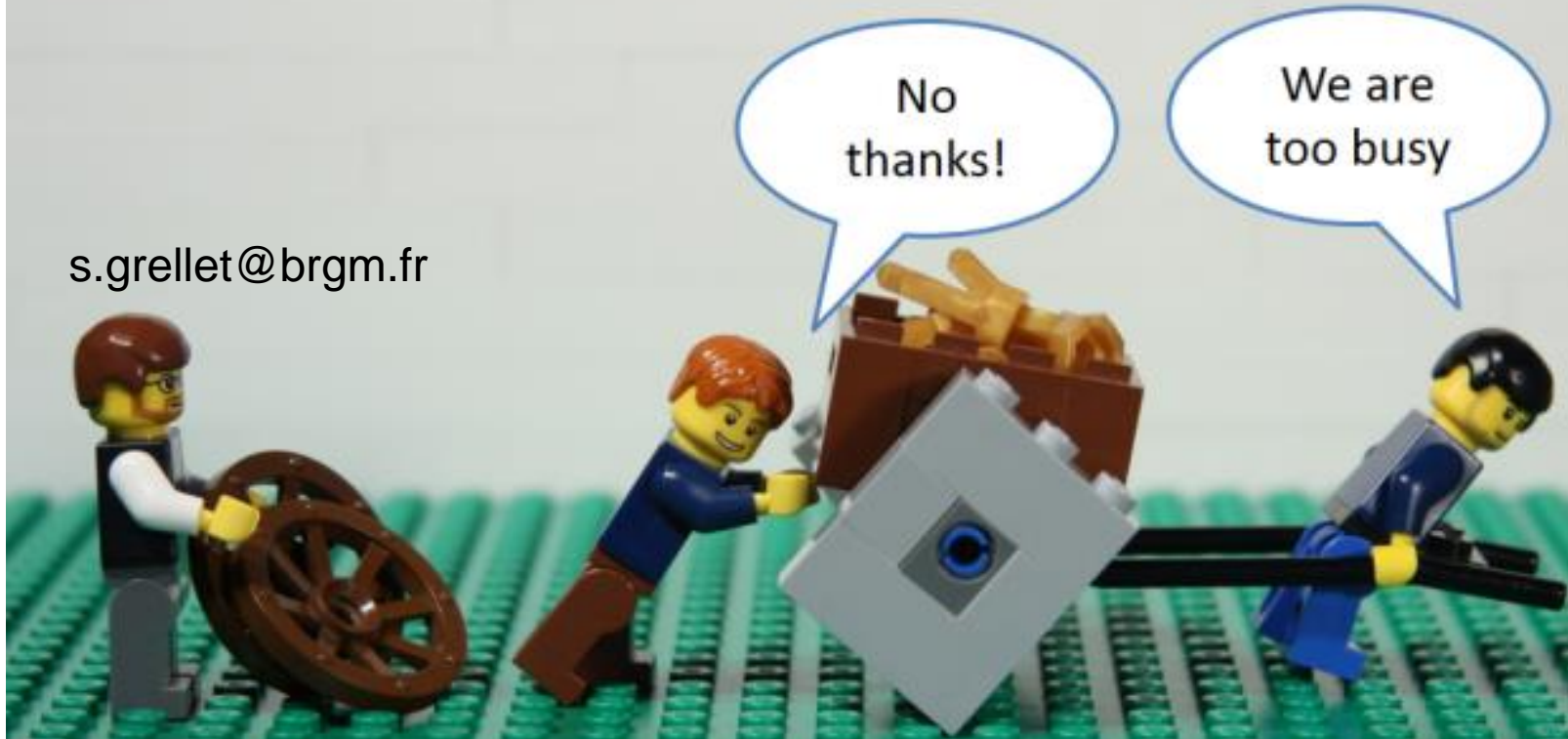
With local specificities

Thank you



Are you too busy to improve?

s.grellet@brgm.fr



Håkan Forss @hakanforss <http://hakanforss.wordpress.com>

This illustration is inspired by and in part derived from the work by Scott Simmerman, "The Square Wheels Guy" <http://www.performancecompany.com/>

# Thanks to

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