Characterization and modelling of Acid Mine Drainage in a Highly acidic stream (Trimpancho mining complex, SW of Spain)

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Iberian Pyrite Belt

Extensive Mining Activity

Riotinto Mine (Spain)

Herrerías Mine (Spain)

Neves Corvo Mine (Portugal)

Aljustrel Mine (Portugal)

Environmental impact

Waste dumps

Acid mine drainage

Acidic pit lakes

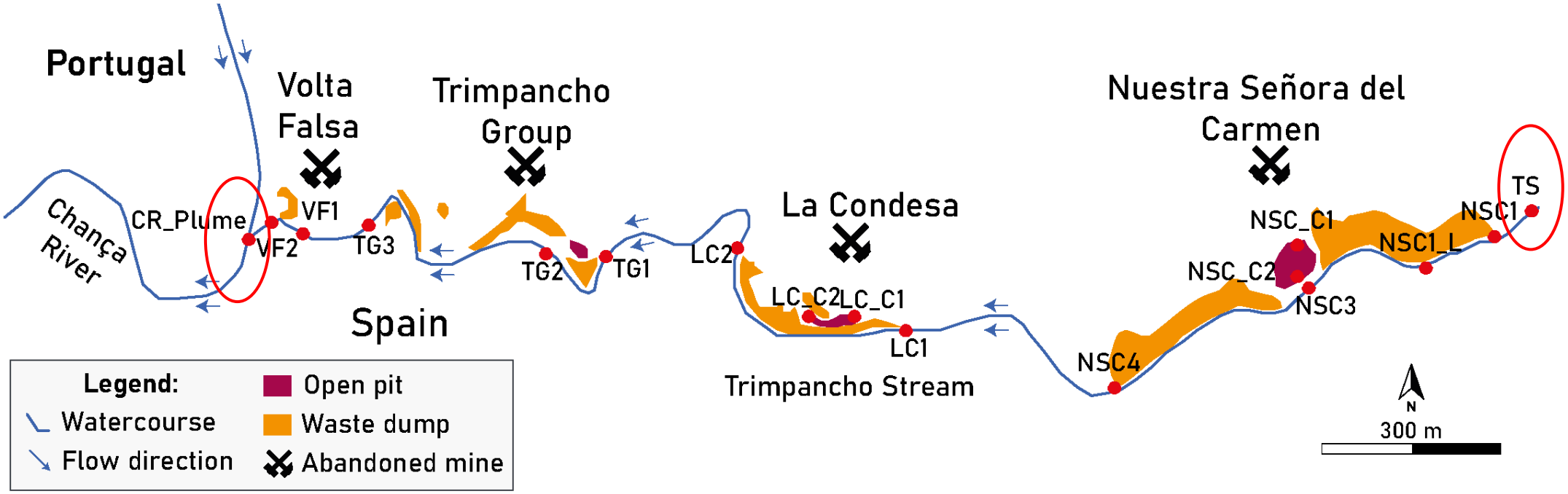
Water and soils contamination

Water Resource Management

Trimpancho Mining Complex

- Belongs to the Iberian Pyrite Belt (IPB)
- Massive sulfide ore deposits
- Hot-summer Mediterranean climate
- Closed in the end of XX century
- Without remediation

Sampling network



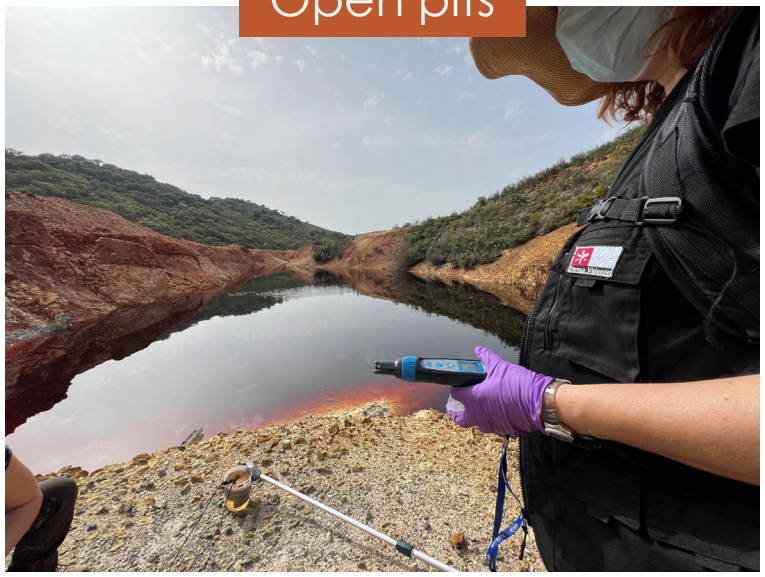
- February 2022 (dry period)
- Surface waters and secondary minerals
- 17 sampling sites

Sampling sites

Open pits

Watercourse

Mixing waters



Methodology

Water samples

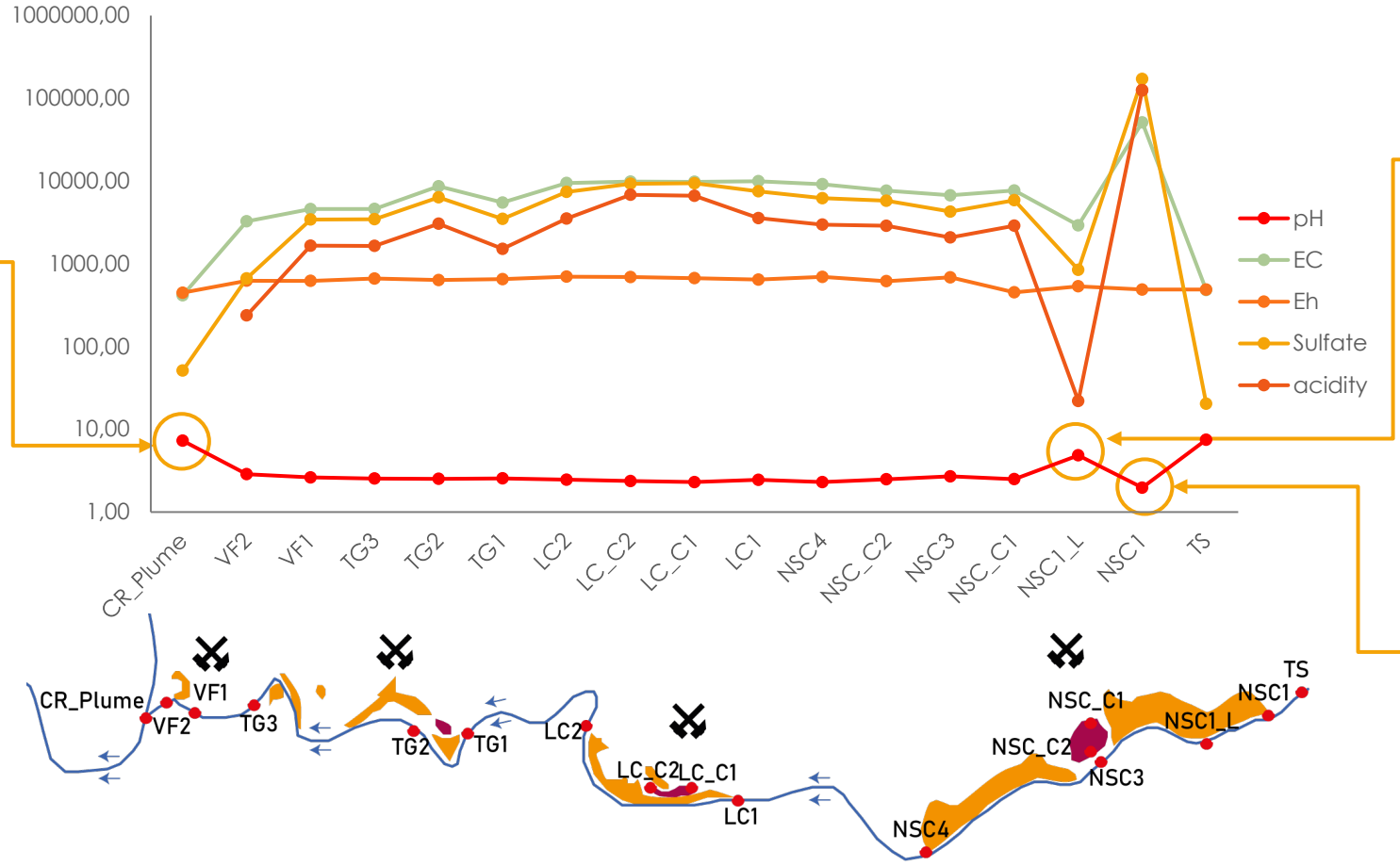
- pH, EC, and Eh - *in situ*
- Filtered samples (<0.45µm) for metals - **ICP-OES**
- Acidity and sulfate
  - volumetric titration
  - turbidimetry

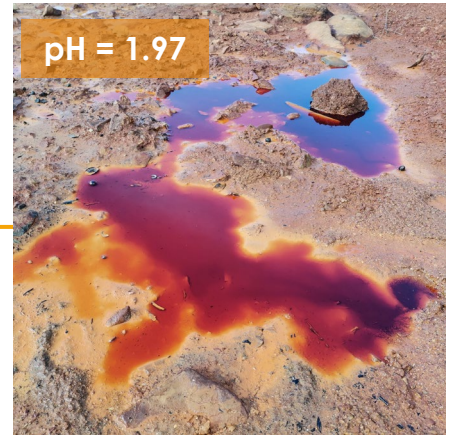
Mineral samples

- Air temperature and humidity measured *in situ*
- **XRD**, **FTIR**, and **SEM-EDS** for mineralogical and chemical characterization

Results

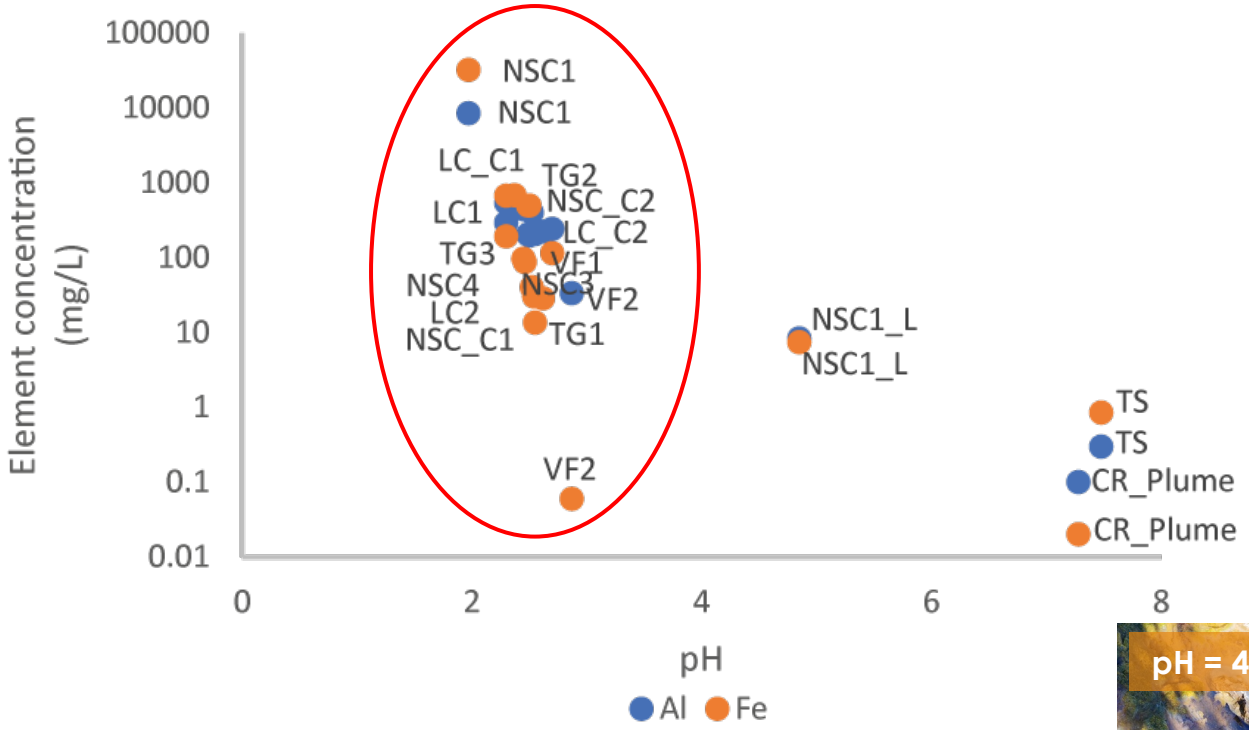
- Spatial evolution of physicochemical proprieties

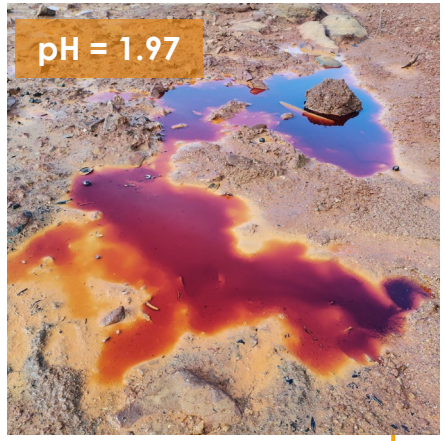


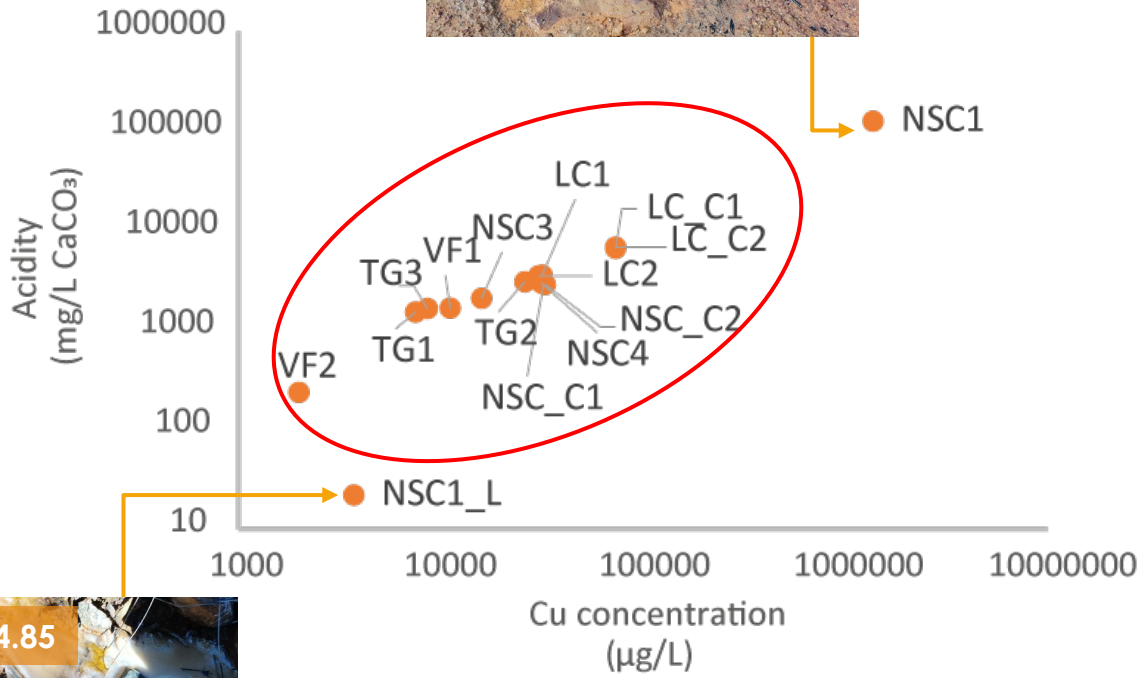


Results

- Hydrochemical relationships







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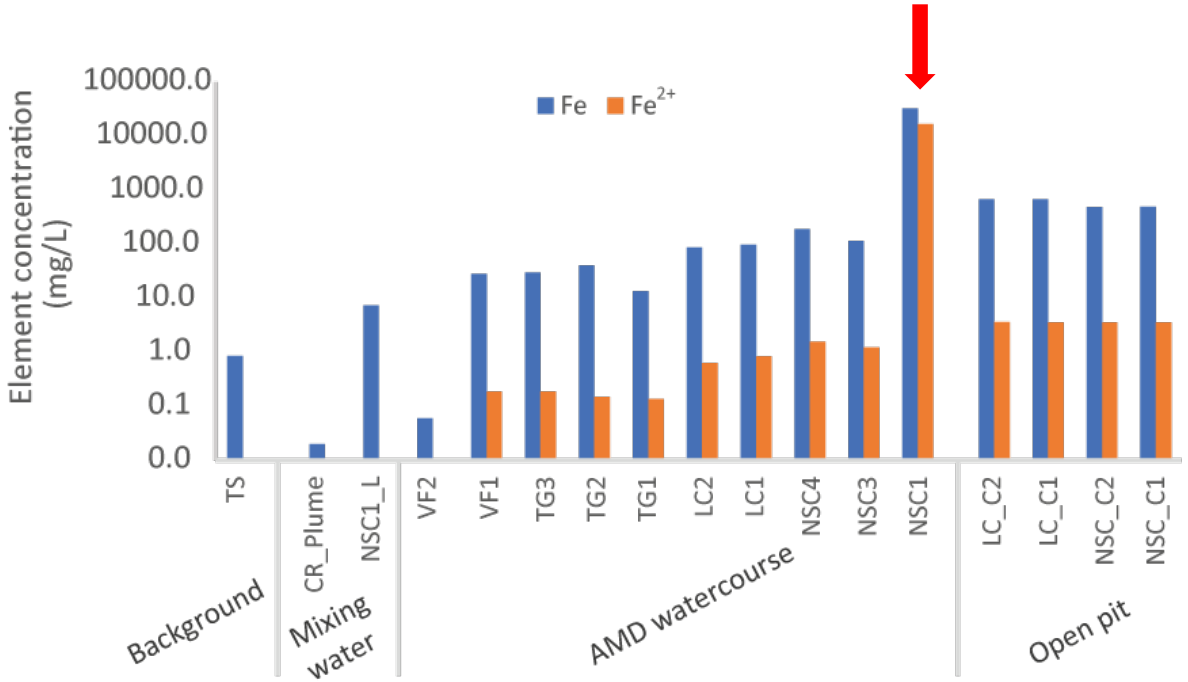
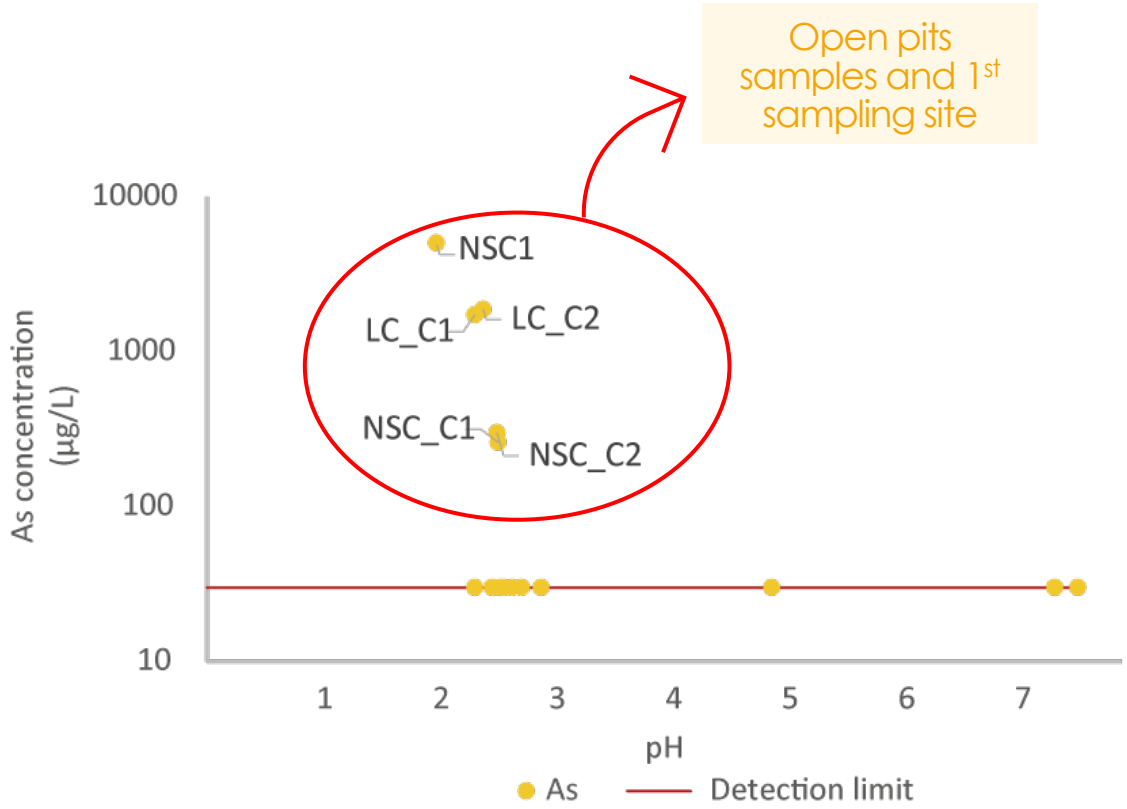




Results

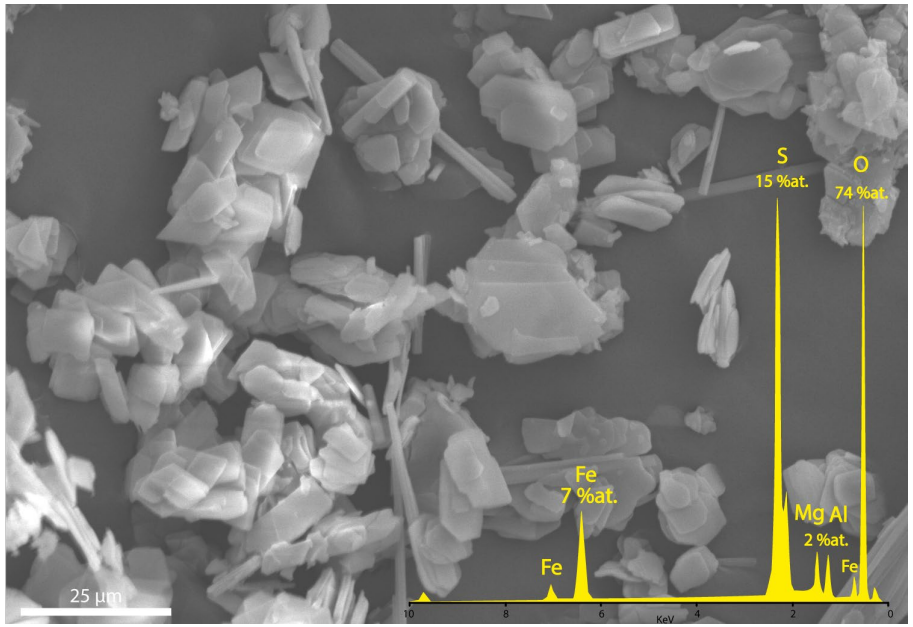
- Secondary minerals

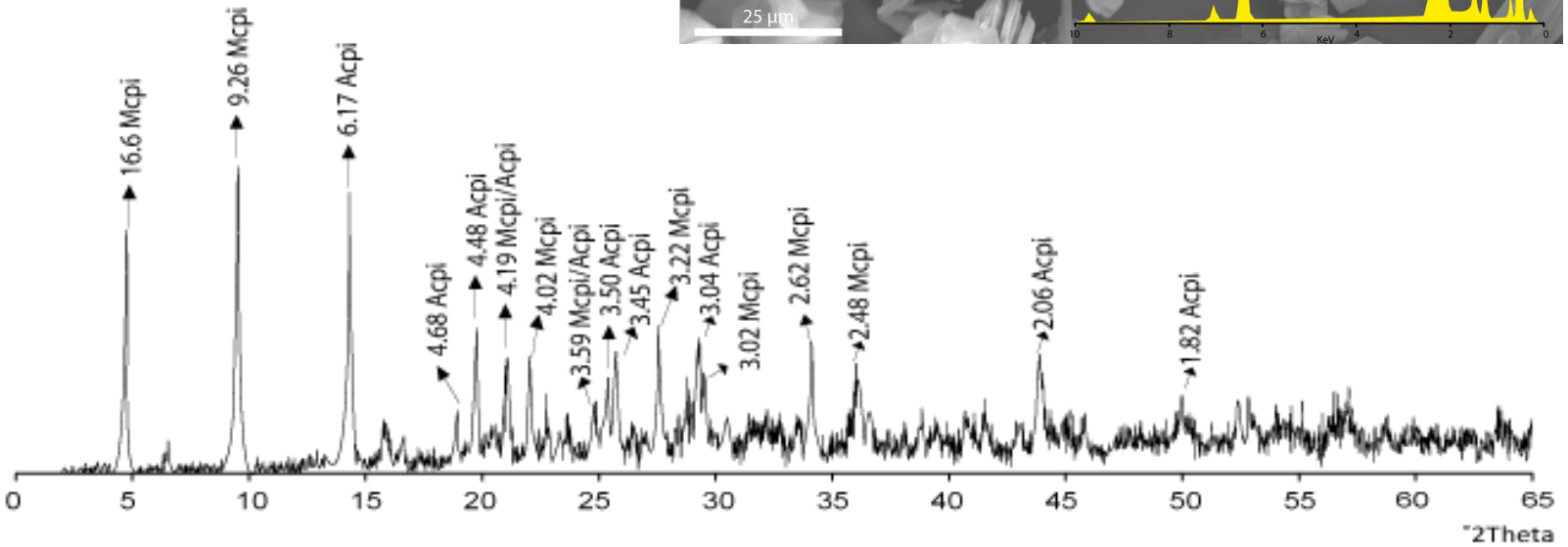
Mineral	Formula
Melanterite	$FeSO_4 \cdot 7H_2O$
Rozenite	$FeSO_4 \cdot 4H_2O$
Copiapite	$Fe^{2+}Fe^{3+}_4(SO_4)_6(OH)_2\ 20H_2O$
Magnesiocopiapite	$MgFe^{3+}_4(SO_4)_6(OH)_2 \cdot 20H_2O$
Aluminocopiapite	$Al_{2/3}Fe^{3+}_4(SO_4)_6(OH)_2\ 20H_2O$
Epsomite	$MgSO_4 \cdot 7H_2O$
Hexahydrite	$MgSO_4\ 6H_2O$
Halotrichite	$Fe^{2+}Al_2(SO_4)_4 \cdot 22H_2O$
Coquimbite	$AlFe_3(SO_4)_6(H_2O)_{12} \cdot 6H_2O$
Jarosite	$KFe^{3+}_3(SO_4)_2(OH)_6$

Results

- Copiapite Group

- **Mineral phase:** Magnesiocopiapite and Aluminocopiapite
- **Morphology:** tabular shape
- **Chemical composition:** O (74 at.%), Fe (7 at.%), S (15 at.%), Mg and Al (2 at.%).

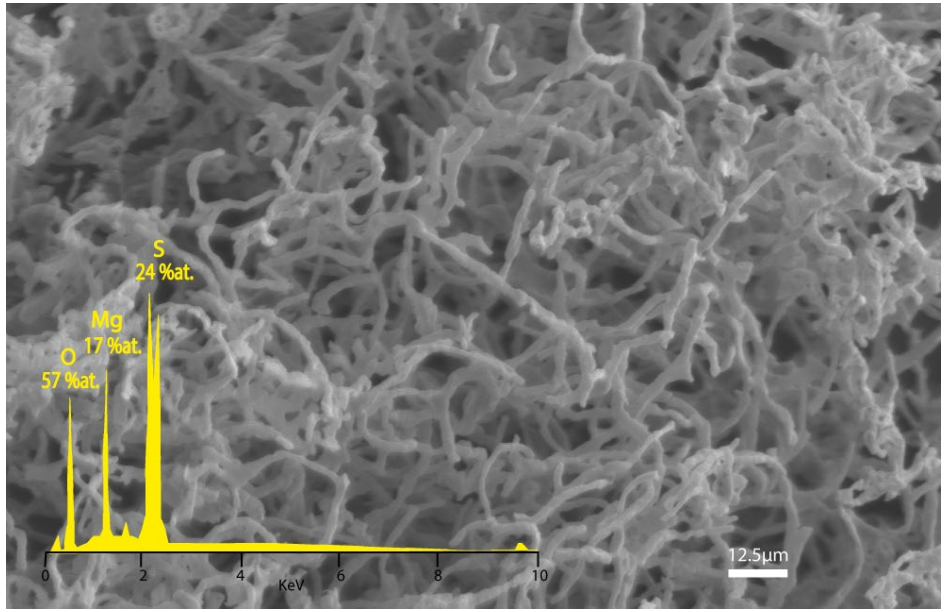


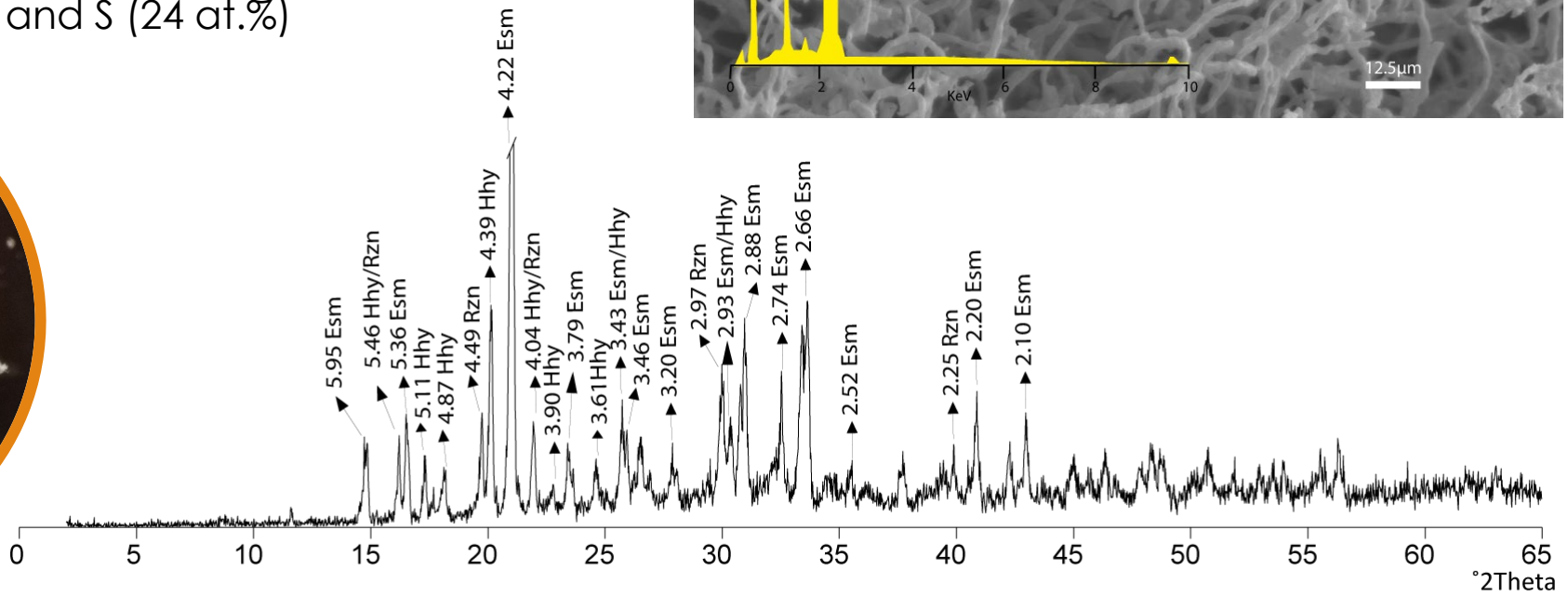


Results

- Mineralogical assemblage

- **Mineral phase:** Epsomite (Esm), Rozenite (Rzn) and Hexahydrite (Hhy)
- **Morphology:** fibers
- **Chemical composition:** O (57 at.%), Mg (17 at.%) and S (24 at.%)

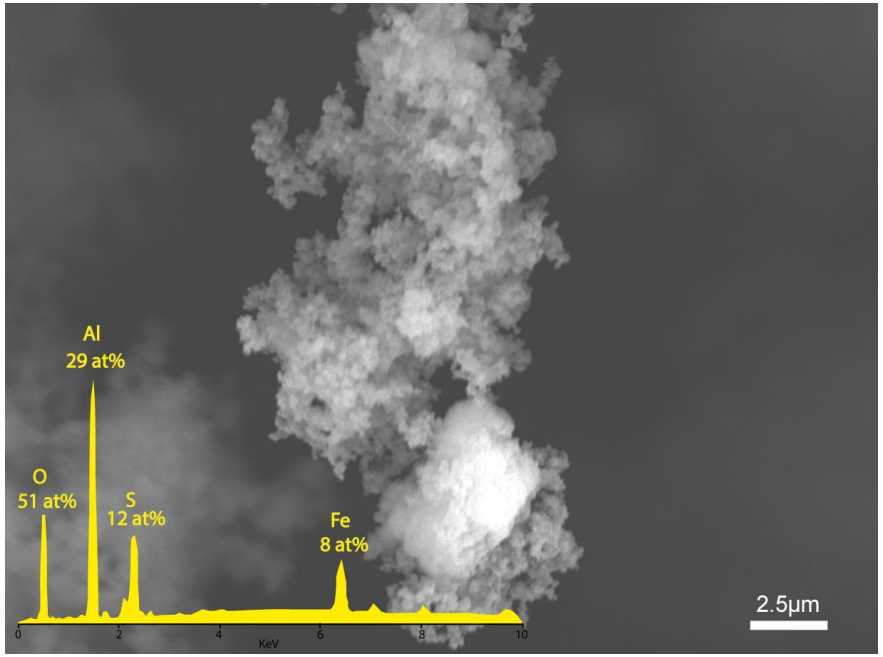


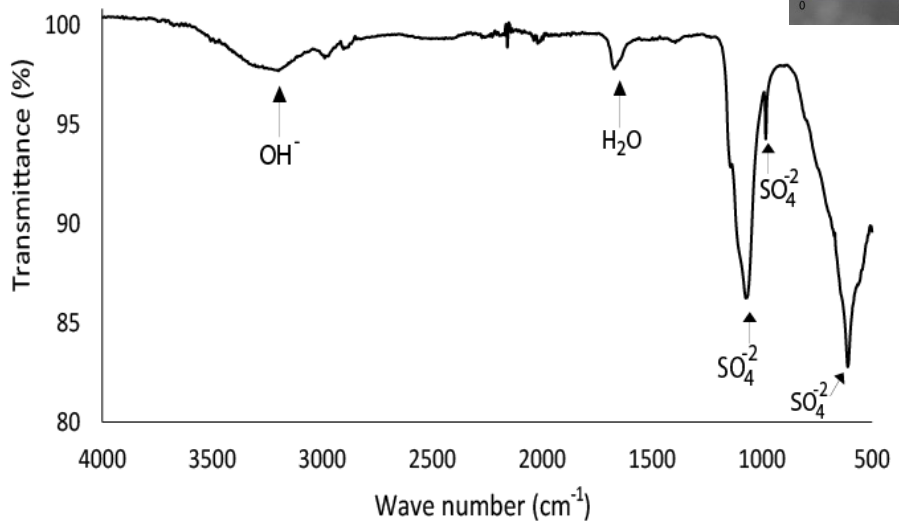


Results

- Aluminum hidroxysulfate mineral

- **Mineral phase:** Basaluminite (?)
- **Morphology:** tiny irregular particles
- **Chemical composition:** O (51 at.%), Al (29 at.%), S (12 at.%) and Fe (8 at.%)

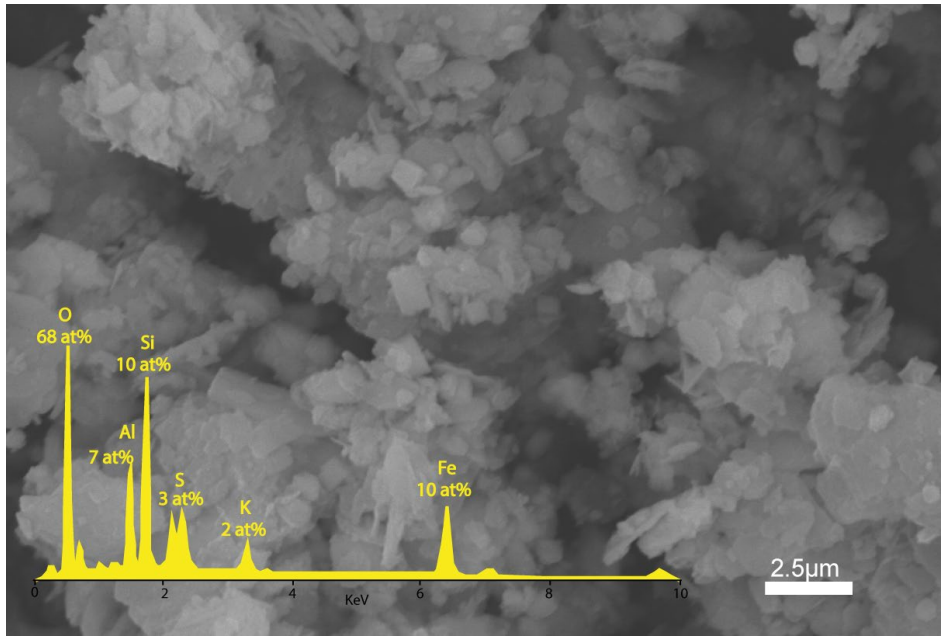


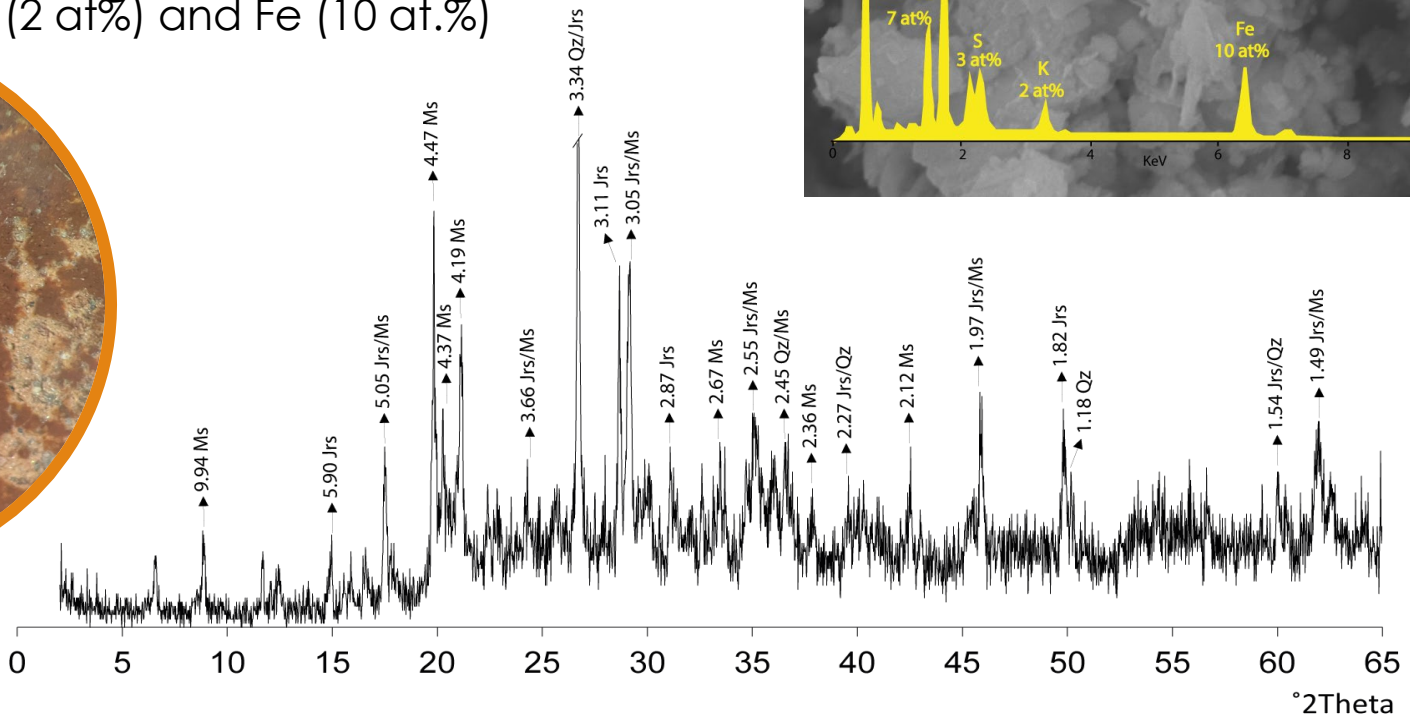


Results

- Jarosite (Iron hydroxysulfate)

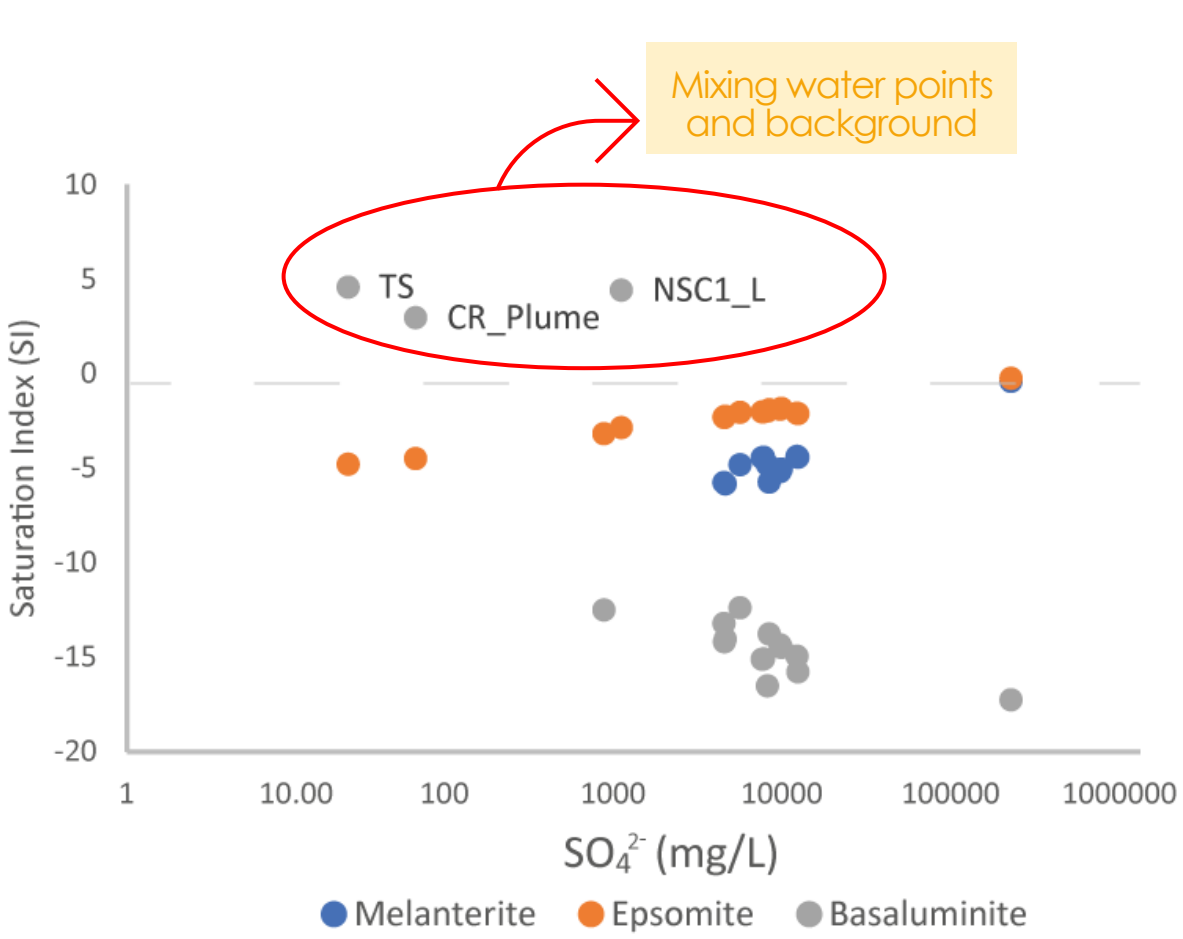
- **Mineral phase:** Jarosite, quartz and muscovite
- **Morphology:** irregular particles
- **Chemical composition:** O (68 at.%), Al (7 at.%), Si (10 at.%), S (3 at.%), K (2 at%) and Fe (10 at.%)

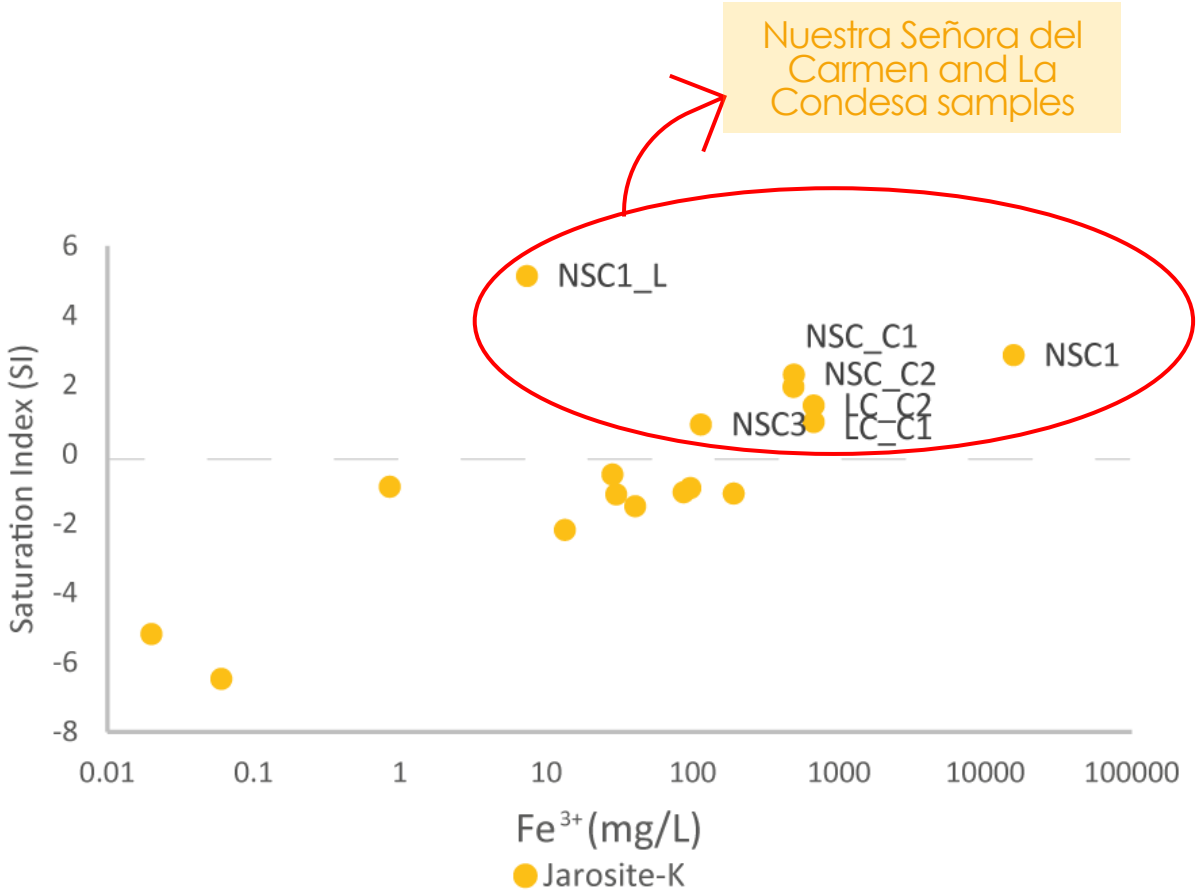




Results

- Geochemical modelling





Geochemical modelling was conducted using PHREEQC code (version 3.7.3.15968) with the WATEQ4F database.

Conclusions

- The Trimpancho mining complex displays the characteristics of an abandoned mining area with severe AMD issues.
- Variations in hydrochemical patterns may be attributed to differing meteorological conditions during sampling periods, such as low flow in the Trimpancho River and stagnant water in 2022.
- Identification of diverse secondary minerals that may act as sinks for potentially toxic elements and metals in the environment.
- Although it has been abandoned for decades, the area still presents a significant environmental risk of water contamination due to ongoing issues with AMD and the presence of secondary minerals.
- Urgent need rehabilitation

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WEST VIRGINIA MINE DRAINAGE TASK FORCE

Thank you for your attention!

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