

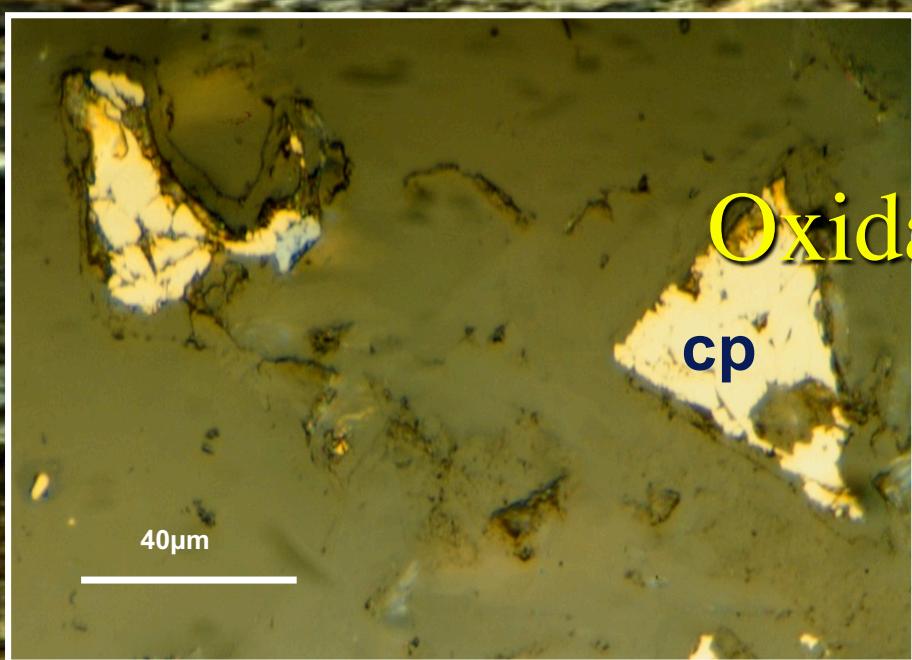


# Remote Sensing of AMD by Google Earth®

Prof. Dr. Bernhard Dold

[www.sumirco.com](http://www.sumirco.com)

[bdold@sumirco.com](mailto:bdold@sumirco.com)



Oxidation Zone

cp

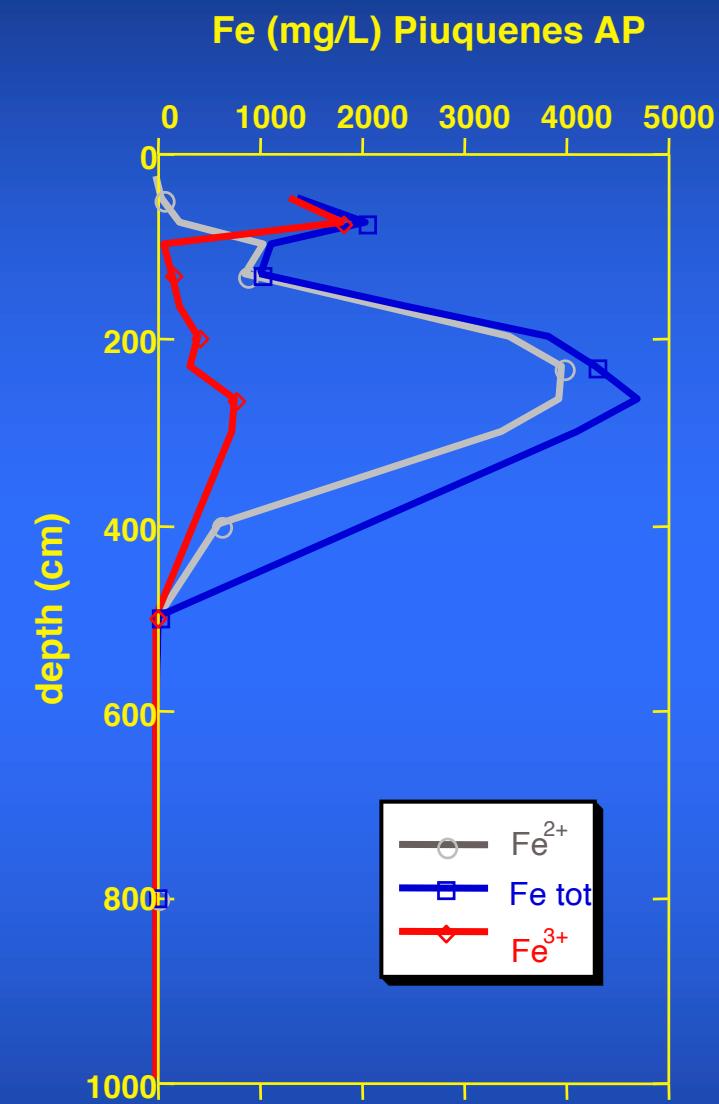
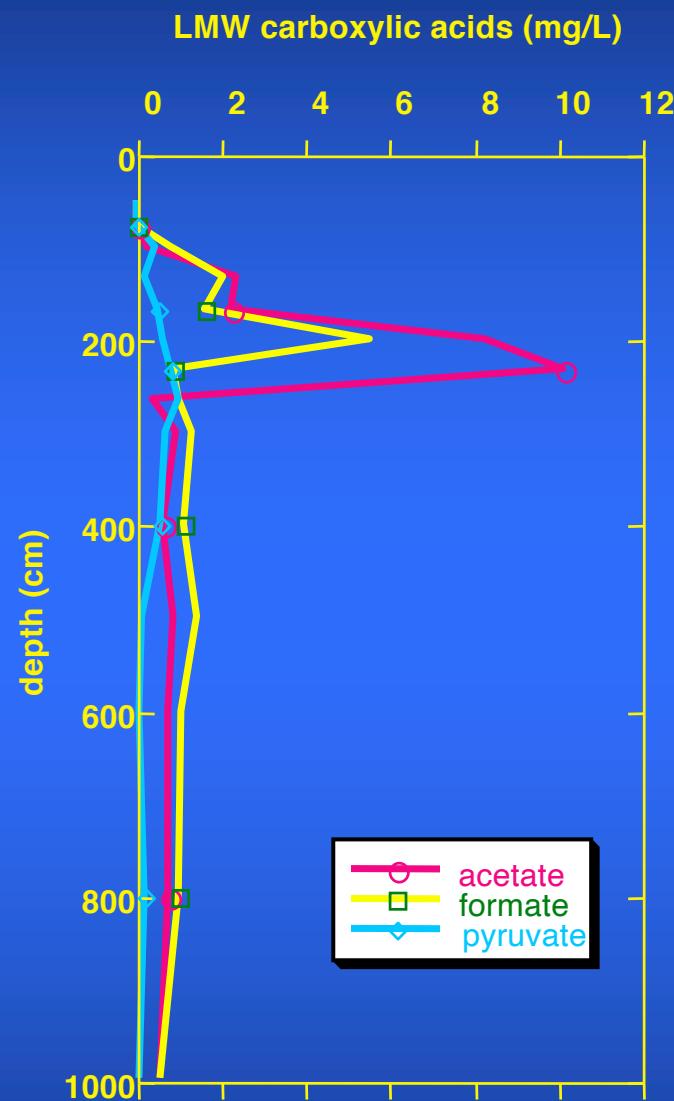
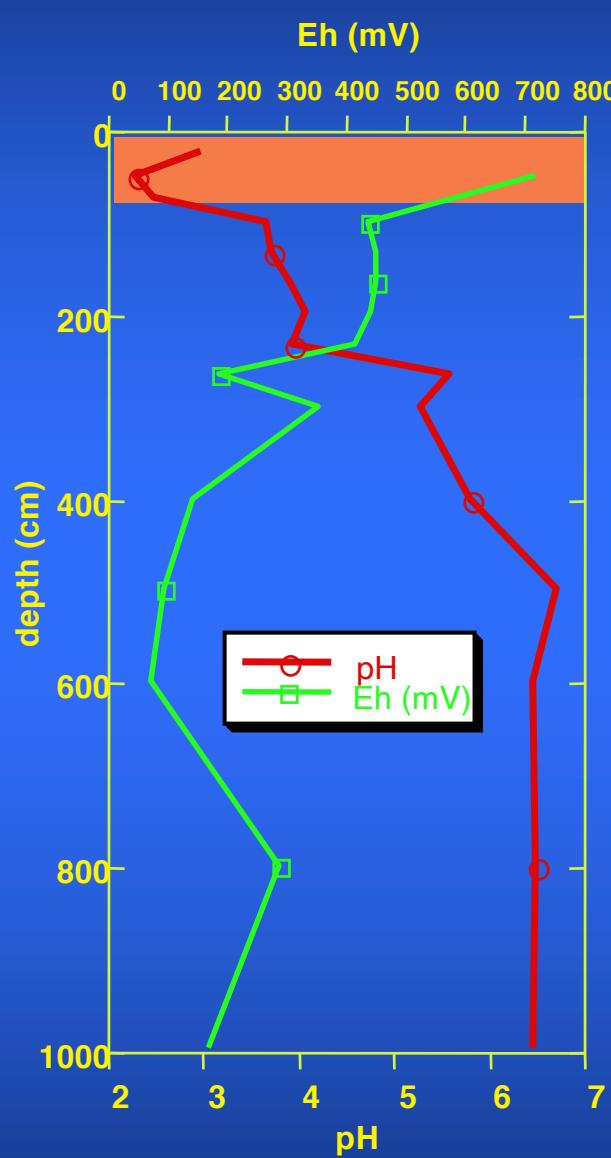
40μm

Enriquecimiento de hasta 0.6% Cu

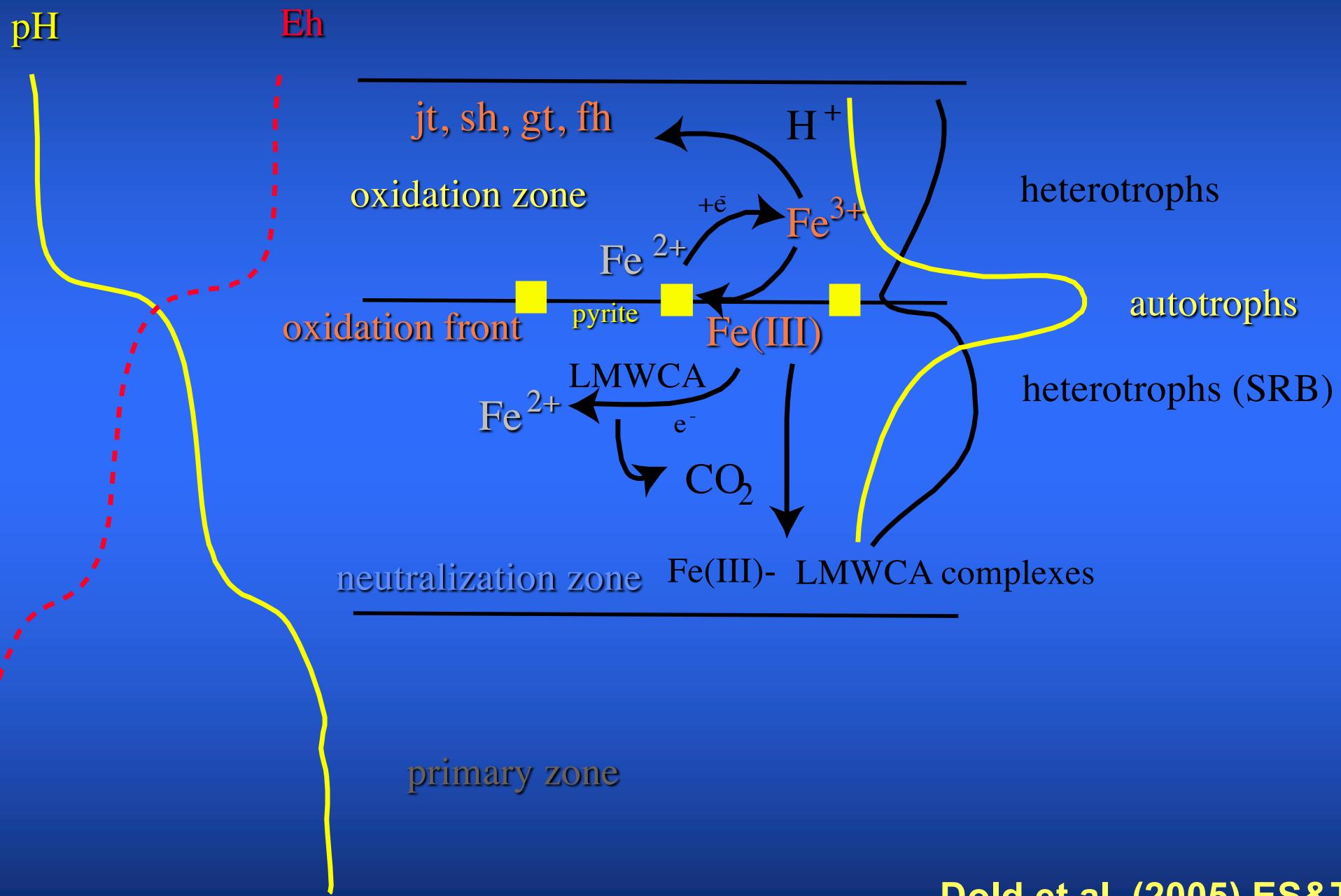
cv cp

sl

40μm



# Role of LMWCA in Fe-cycling



# Bahia de Ite, Peru



# AMD Development

1. Active



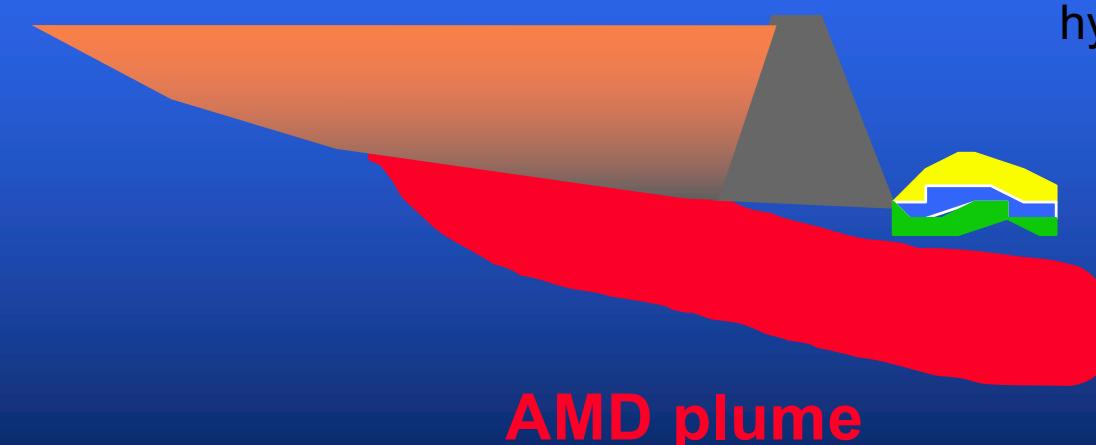
Characteristics: - oxygen due to Dissolution



2. Starting oxidation

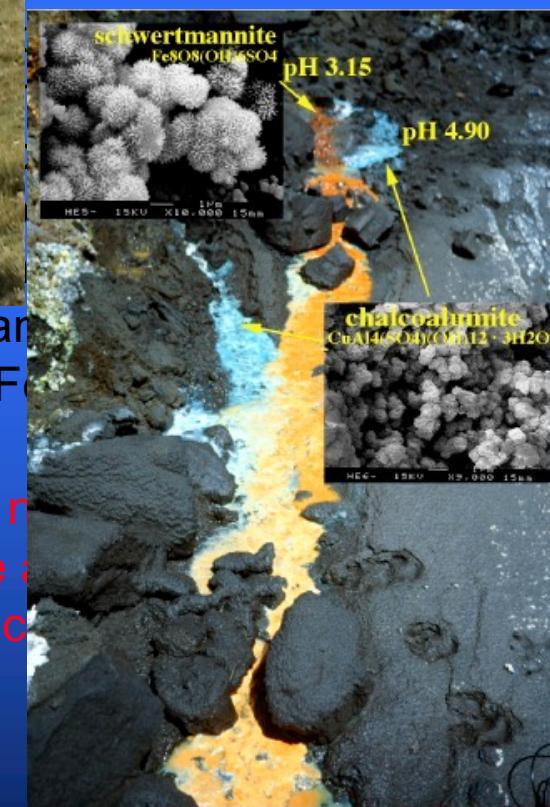


3. Advanced low pH drainage



environment to Fe<sup>3+</sup> and hydrolysis = > AMD Formation

Characteristics: - all reductants consumed. Sulfate and (bi- and trivalent)-rich



Dold (2014)

# Cerro de Pasco, Peru

Ocroyoc

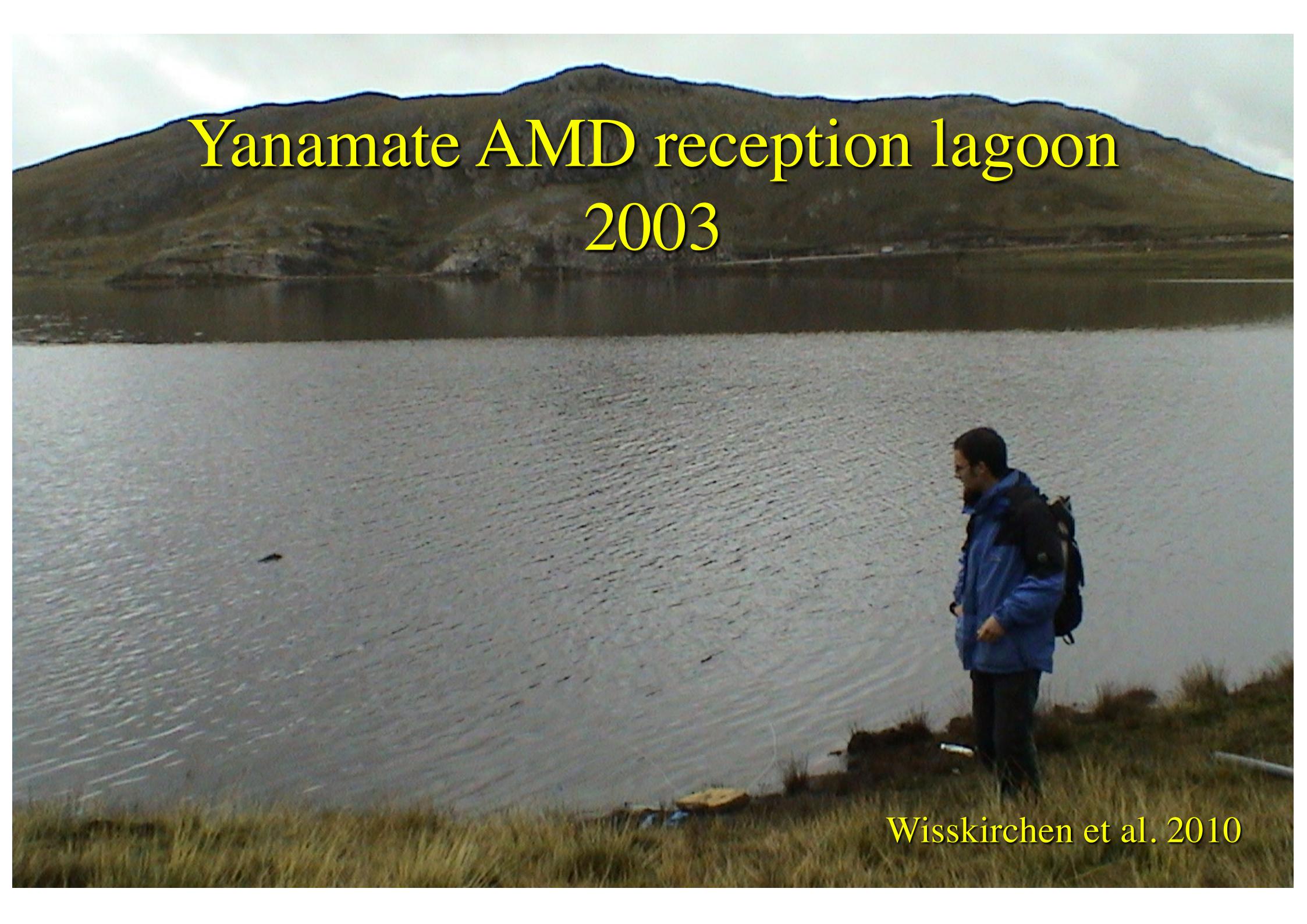
Quiulacocha

Excelsior

Cerro de Pasco, Peru

Yanamate



A photograph of a man standing on the shore of a large, calm body of water, likely a lagoon. He is wearing a blue jacket and a backpack, looking out over the water. In the background, there are rolling hills or mountains covered in green vegetation under a clear sky.

# Yanamate AMD reception lagoon 2003

Wisskirchen et al. 2010



Cerro de Pasco

Google Earth

Image © 2020 CNES / Airbus

3 km



# Yanamate AMD reception lagoon

## 2019

Cretton 2011

# Cerro de Pasco, Peru



Active tailings



Pb-Zn-sulfide tailings  
Carbonate-rich

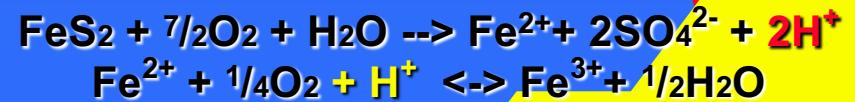


Cu-sulfide tailings  
As-rich



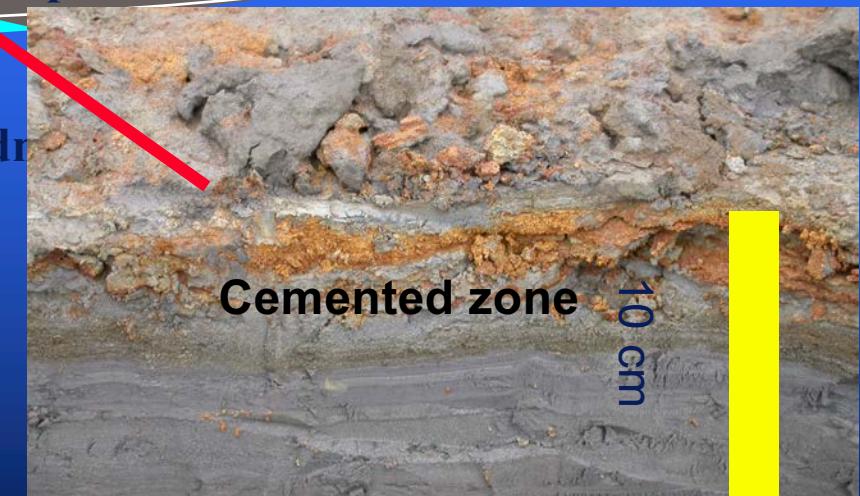
Excelsior waste rock dump

~60 wt% pyrite



Fe-Zn-Pb-plume

cocha tailings impoundment  
~50 wt% pyrite



Cemented zone

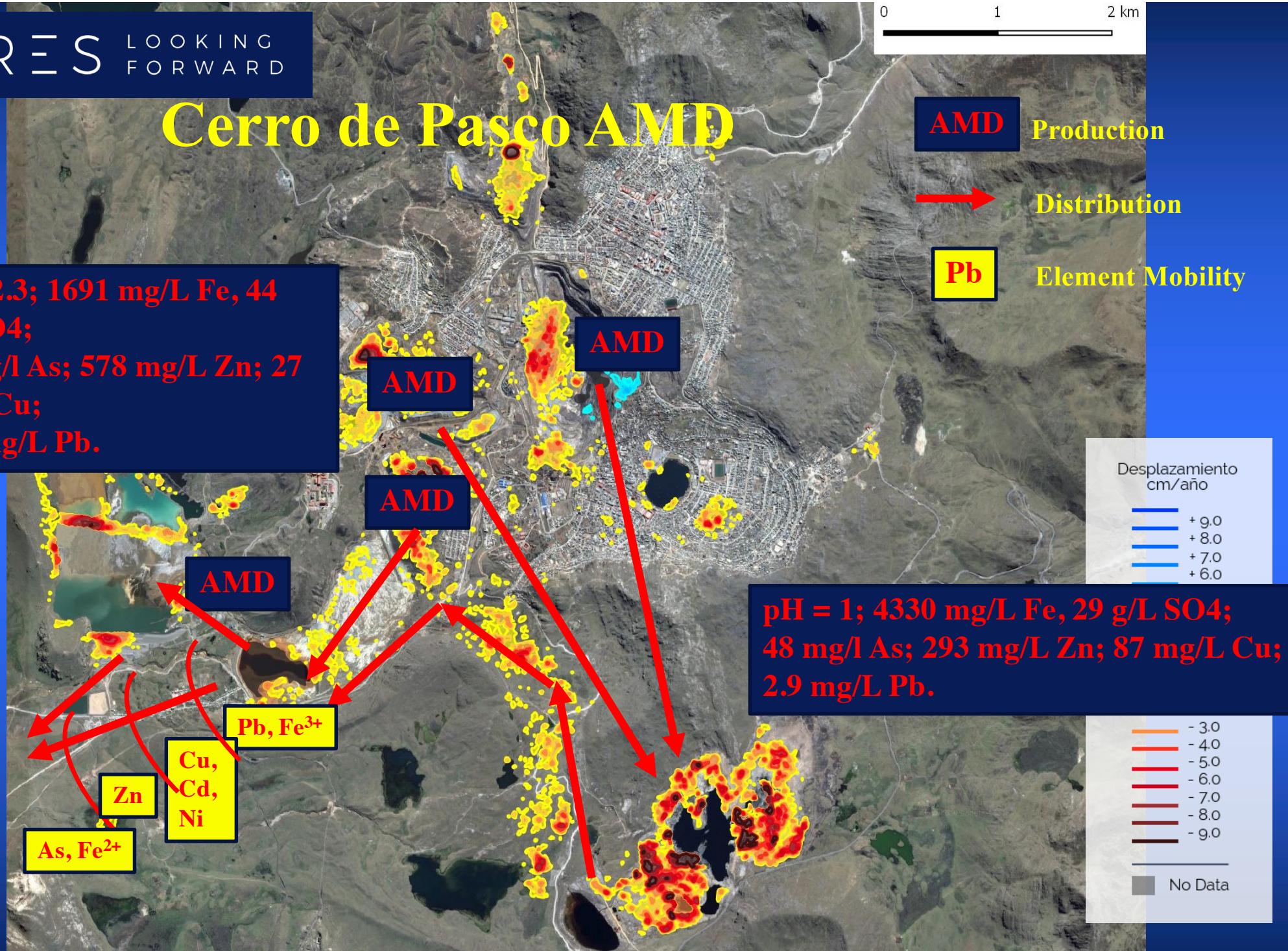
10 cm

An aerial photograph showing a large, irregularly shaped body of water with a distinct orange-red hue in the foreground, transitioning to a greyish-blue color further back. The water is surrounded by a dark, rocky shoreline. To the right, a steep, grassy hillside rises. In the background, there are more hills and a clear sky.

Ocroyoc active tailings  
impoundment

# Cerro de Pasco AMD

pH = 2.3; 1691 mg/L Fe, 44 g/L SO<sub>4</sub>; 6.5 mg/l As; 578 mg/L Zn; 27 mg/L Cu; 0.63 mg/L Pb.



# Chañaral, Chile



Image © 2006 DigitalGlobe  
© 2006 Europa Technologies

Chañaral

Chañaral, Atacama, Ch

©2006 Google

Pointer 26° 18'46.90"S 70° 39'14.26"W elev 23 ft

Streaming

100%

Eye alt 19775 ft

October 2003

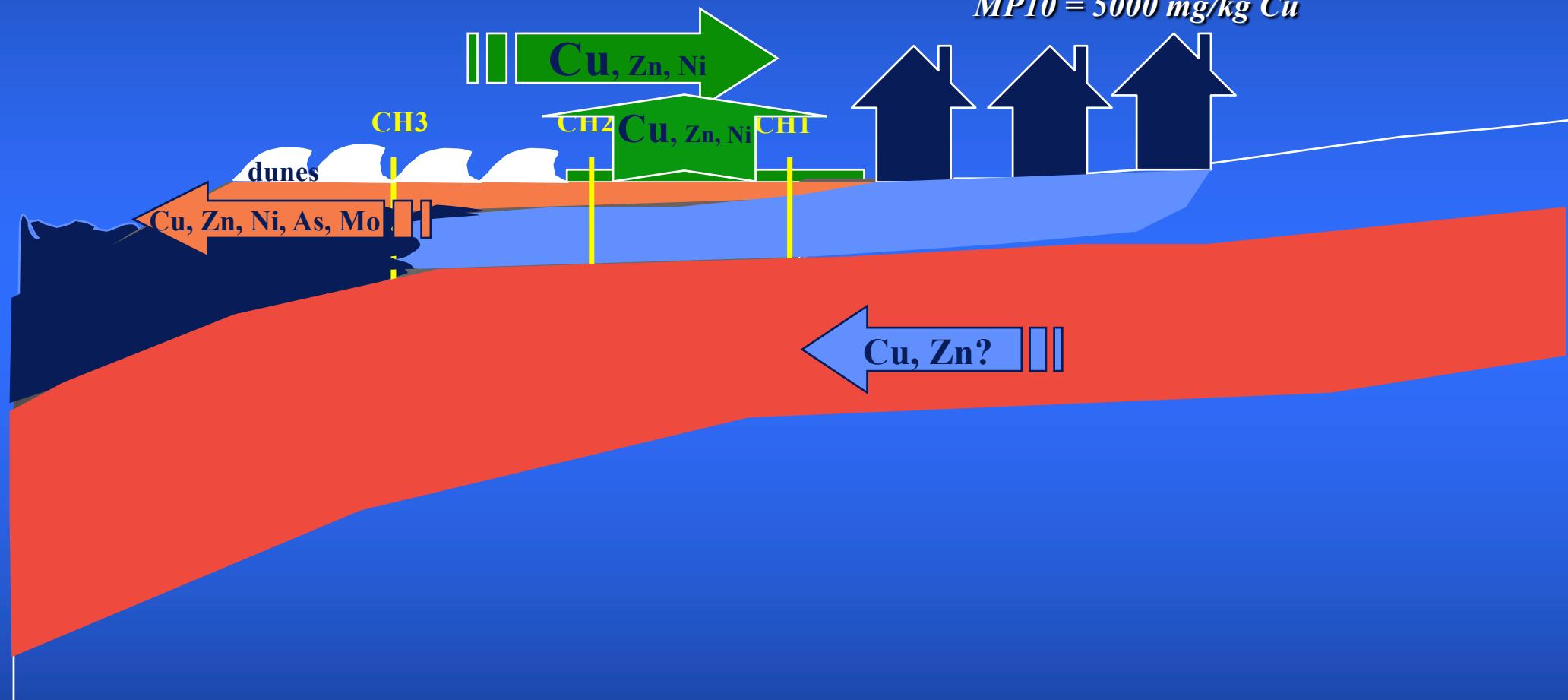
Eriochalcite  $\text{CuCl}_2 \cdot \text{H}_2\text{O}$

# Metal Flows at Chañaral, Chile

Seawater: pH 7.96,  
Cl 17.8 g/L, Na 11.5 g/L

*Study about As, Pb, Cd in the blood of the population of Chañaral:  
No anomalous concentration were found. Cu was not analyzed.*

$$MP10 = 5000 \text{ mg/kg Cu}$$



(Dold, 2006, ES&T)



N



1642 m



2004

Chañaral

Image © 2016 TerraMetrics  
© 2016 Google

Image © 2016 CNES / Astrium

Imagery Date: 3/6/2016 26°19'34.13" S 70°36'48.35" W elev 23 m eye alt 7.26 km

Google Earth

## Mirada satelital a la catástrofe en el norte



Chañaral 27 de junio de 2014

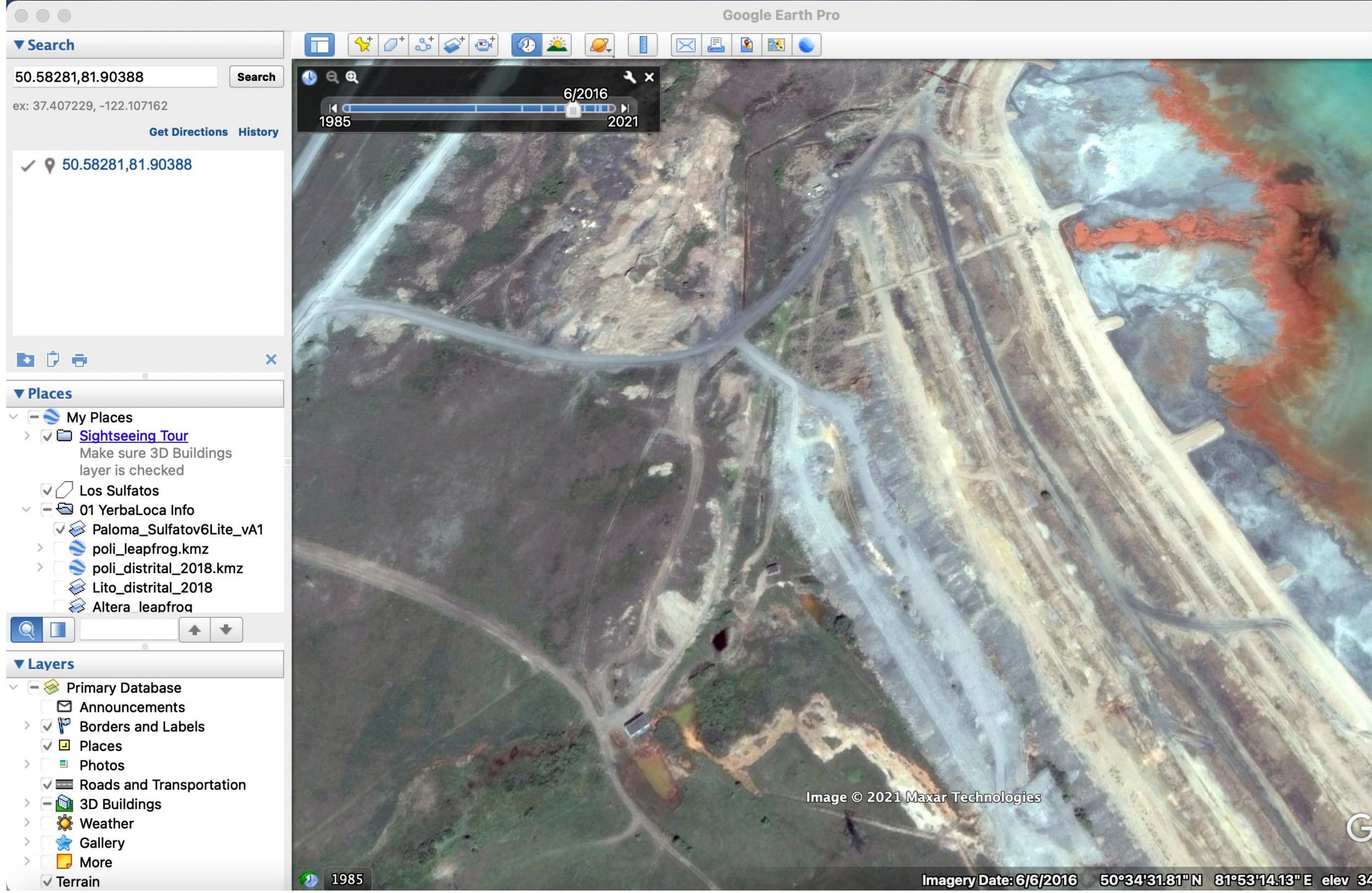


Chañaral 28 de marzo de 2015

Una imagen reciente de Chañaral captada por el satélite FASat Charlie que opera la Fuerza Aérea de Chile permite dimensionar el impacto de la crecida del río El Salado, al compararla con una toma del año pasado.







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Google Earth Pro

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50.58281,81.90388 Search  
ex: 37.407229, -122.107162

Get Directions History

50.58281,81.90388

Places

- My Places
  - Sightseeing Tour  
Make sure 3D Buildings layer is checked
  - Los Sulfatos
  - 01 YerbaLoca Info
    - Paloma\_Sulfatov6Lite\_vA1
    - poli\_leapfrog.kmz
    - poli\_distrital\_2018.kmz
    - Lito\_distrital\_2018
    - Altera leapfrog

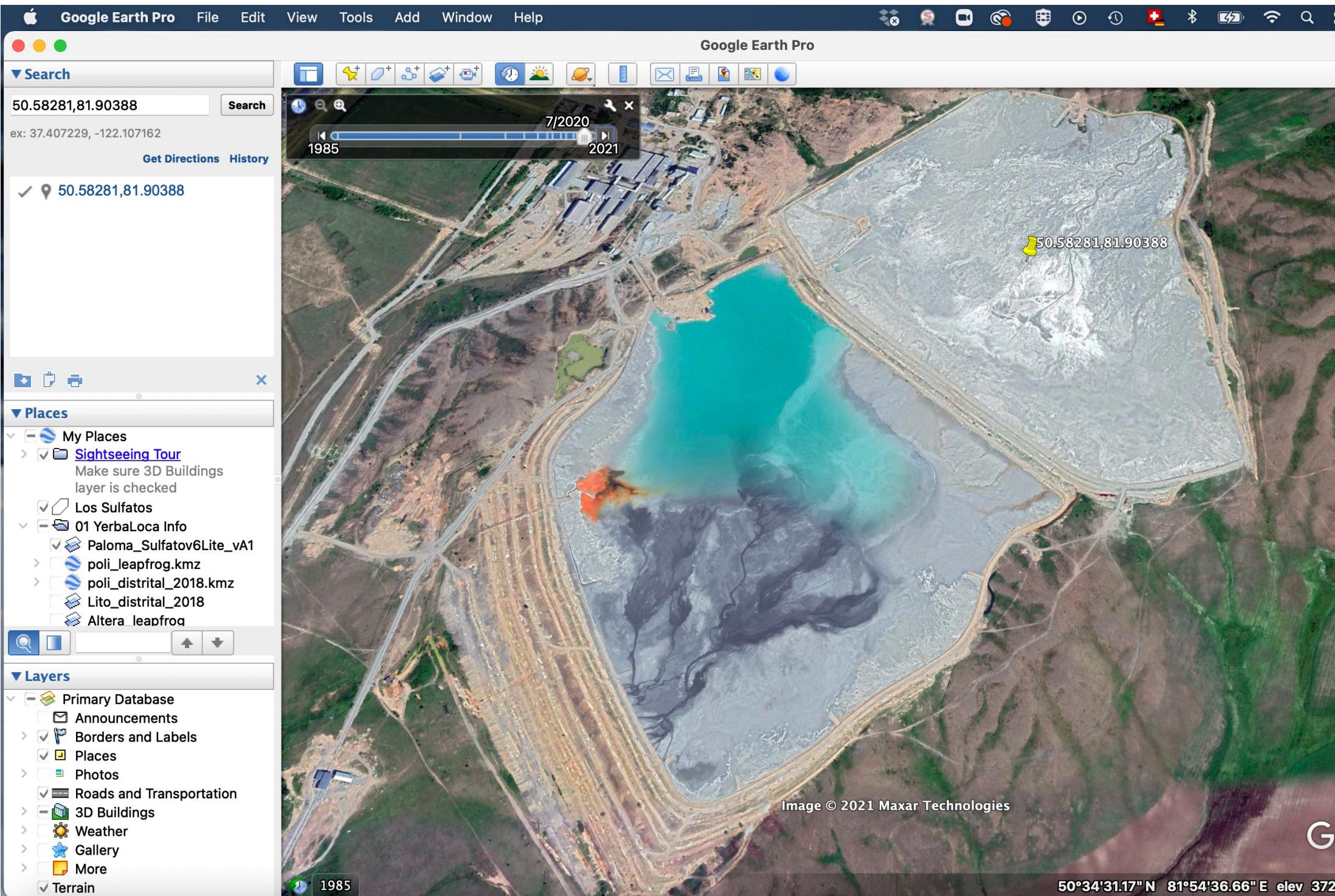
Layers

- Primary Database
  - Announcements
  - Borders and Labels
  - Places
  - Photos
  - Roads and Transportation
  - 3D Buildings
  - Weather
  - Gallery
  - More
- Terrain

Image © 2021 Maxar Technologies

50°34'43.31" N 81°53'02.38" E elev 339 m

1985 8/2015 2021



A wide-angle photograph of a rugged mountain range under a clear blue sky. In the center-right, a volcano is erupting, sending a large, billowing plume of grey smoke and ash high into the air. The mountains in the foreground and middle ground are dark and shadowed, while the sky is a vibrant, uniform blue.

Thank you!

[bdold@sumirco.com](mailto:bdold@sumirco.com)