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MINERVA a Project by Atalaya Mining

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MINERVA
#smartgeocontrol

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Agenda

- **Atalaya at a glance**
- Minerva project
- Stone project
- The journey
- Technologies – Classic sensors & GBSAR
- Technologies - InSAR
- Technologies - ANSI
- Technologies – GeoMonitoring HUB
- Conclusions

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Atalaya Mining at a glance

1.Riotinto Copper Op.

- +350 M € investment
- Producing since 2015
- 15 Mtpa Concentrator
- 52kt Cu in 2023
- 86,62% Cu Recovery in 2023

2.Adjacent deposits

- San Dionisio (Cu-Zn)
- San Antonio (Cu-Zn)

3.Satellite projects

- Masa Valverde

Pacto Mundial
Red Española

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Minerva Project

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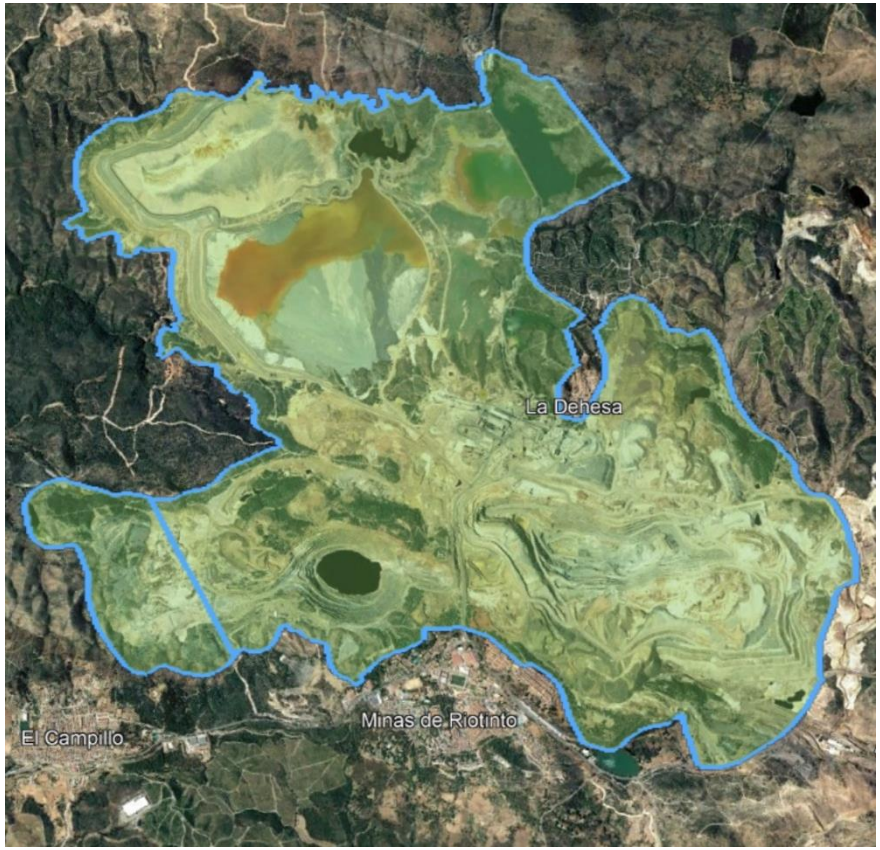

Minerva Project aims:

1. To combine classic and disruptive geodetic and geotechnical monitoring technologies into the same digital platform
2. To monitor and centralize observations from critical structures (tailing dams, open pits, underground mines…)
3. To create a tool capable to identify deformation events 24/7

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Stone Project

(Smart Terraine Control Using Cutting-Edge Technologies)

STONE

CSIC · IGEO · GEO3BCN Geosciences Barcelona - CSIC

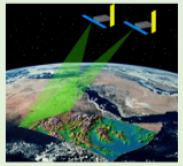
Agencia Estatal de Investigación · Funded by the European Union NextGenerationEU · Plan de Recuperación, Transformación y Resiliencia

WP6 Comunicación
Atalaya Riotinto (S. Rodríguez)

WP0 Coordinación y Gestión del proyecto
Atalaya Riotinto (S. Rodríguez)

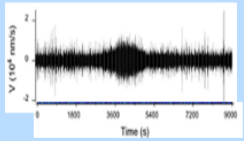
WP0 Coordinación científica
GEO3BCN-CSIC (M. Torné)

WP1 - InSAR
Interferometría radar



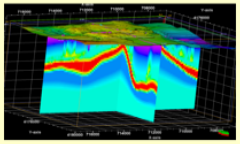
J. Fernández
IGEO-CSIC

WP2 - ANI
Interferometría de ruido ambiente



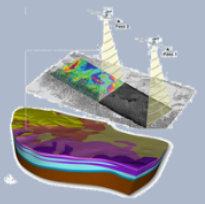
M. Schimmel
GEO3BCN-CSIC

WP3 - 3D
Modelización geofísica y deformación



M. Torné
GEO3BCN-CSIC

WP4
Integración InSAR, ANI y modelo 3D



J. Fernández /
M. Schimmel

Adquisición de datos y procesado

Desarrollo software y modelización

Validación e integración

WP5 Desarrollo de una plataforma de alerta temprana
Atalaya Riotinto (S. Rodríguez)

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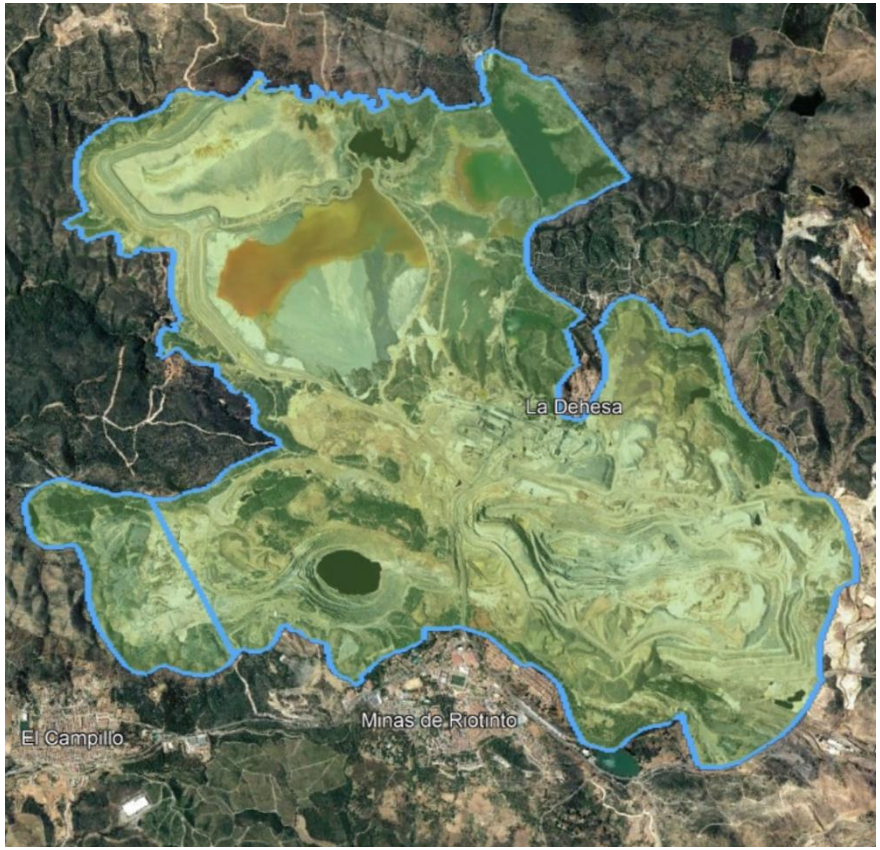
Stone Project

(Smart Terrain Control Using Cutting-Edge Technologies)

STONE



Stone Project aims:

1. To validate two state-of-the-art monitoring systems:
    1. Radar interferometry (GBSAR and InSAR)
    2. Ambient Noise Seismic Interferometry (ANSI)
2. To study the geopotential fields of a selected aera

The project with REF CPP2021-009072 has been funded by the Ministry of Science and Innovation/State Innovation Agency and with funds from the European Union-Next Generation/PRT (Recovery, Transformation and Resilience Plan)

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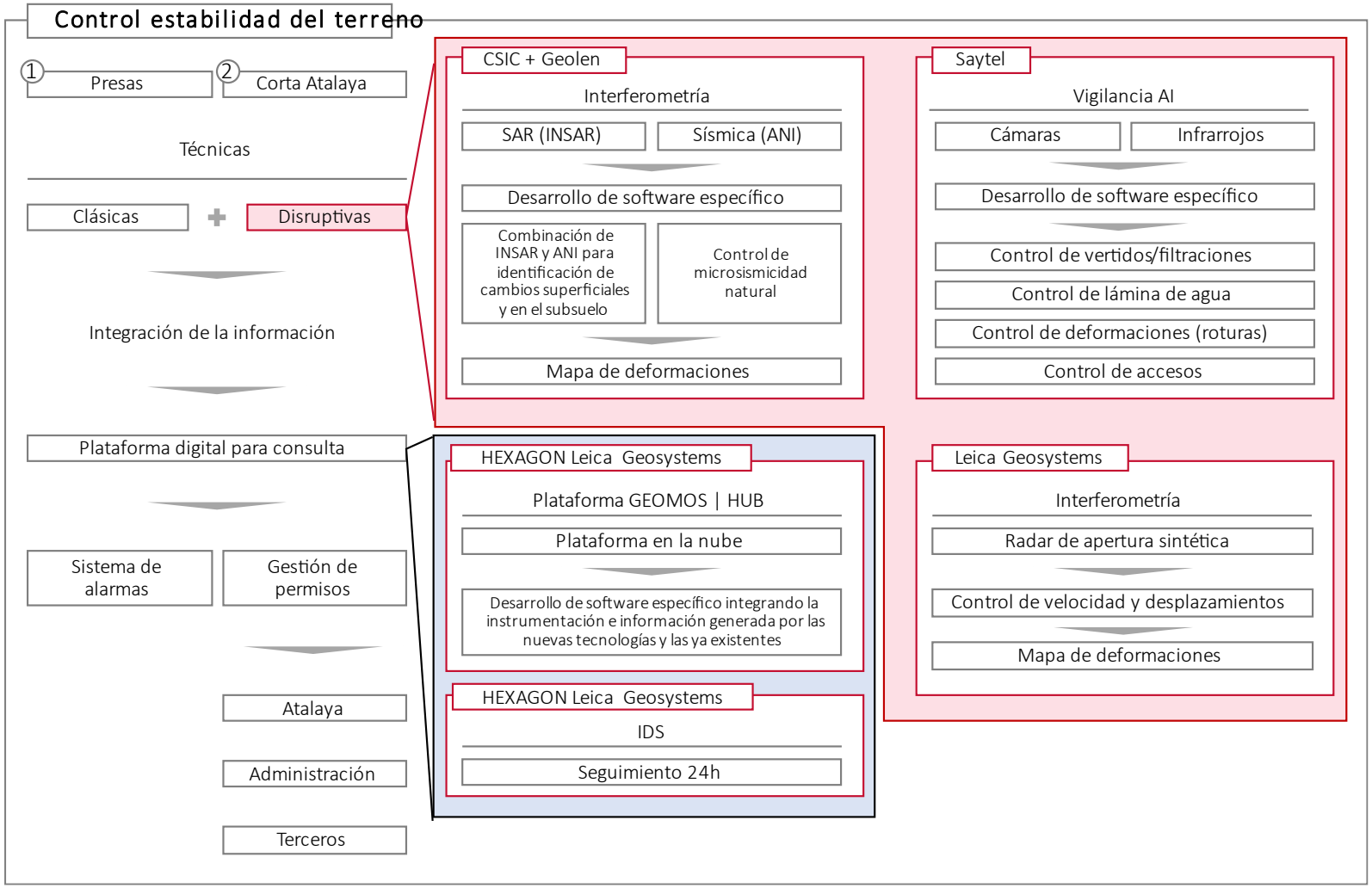
The journey – From this to…



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The journey – …to this

HEXAGON

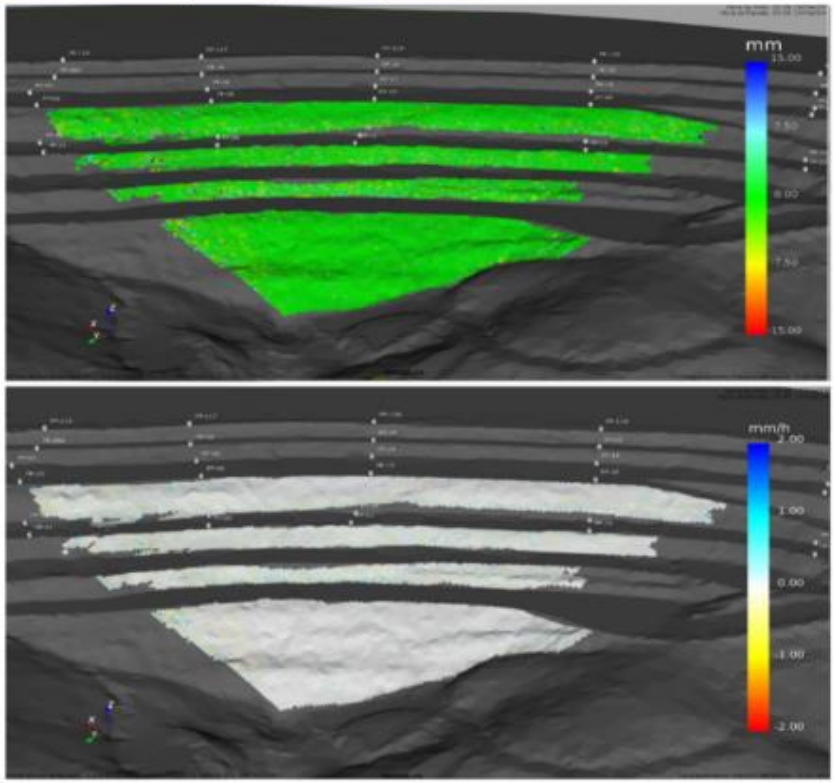
Reporte diario de Monitoreo
Estructura: Muro Vaguada Norte
Periodo analizado: 03/13/2024 - 03/14/2024
Reportado por: Laura Barros Rodriguez

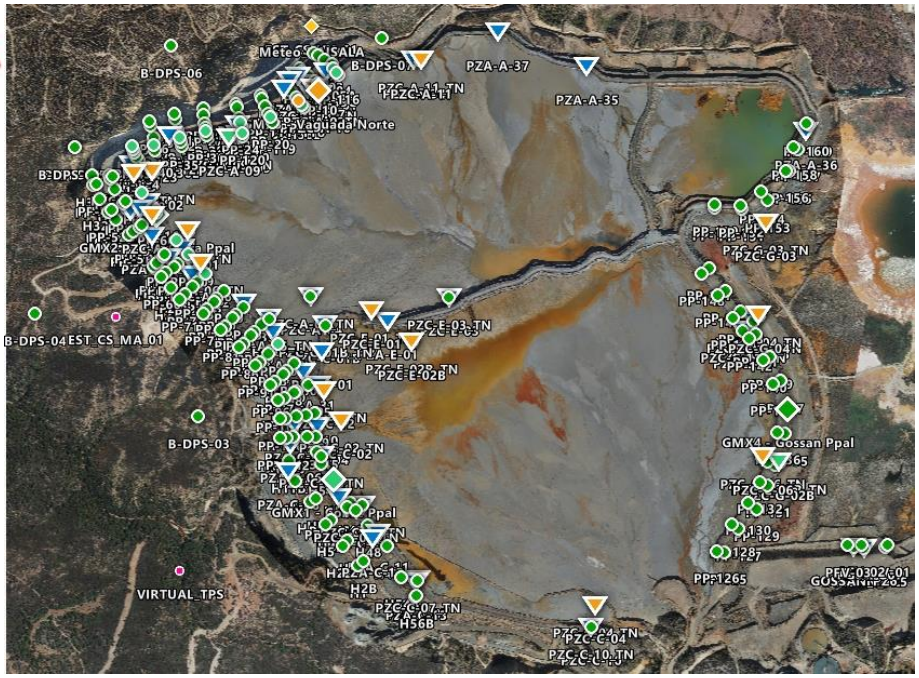
ATALAYA RIOTINTO

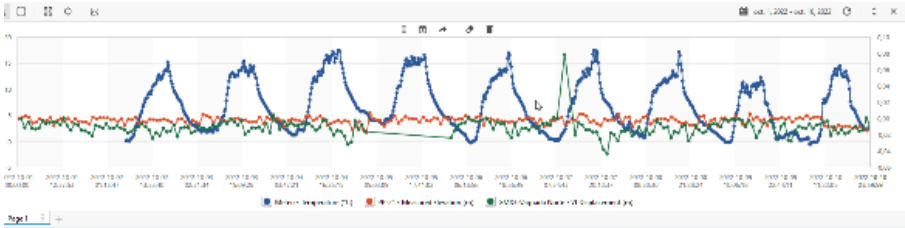
Fecha: 03/14/2024

Reporte: 251

8. DATOS GBSAR - Mapa de Desplazamiento y Velocidad







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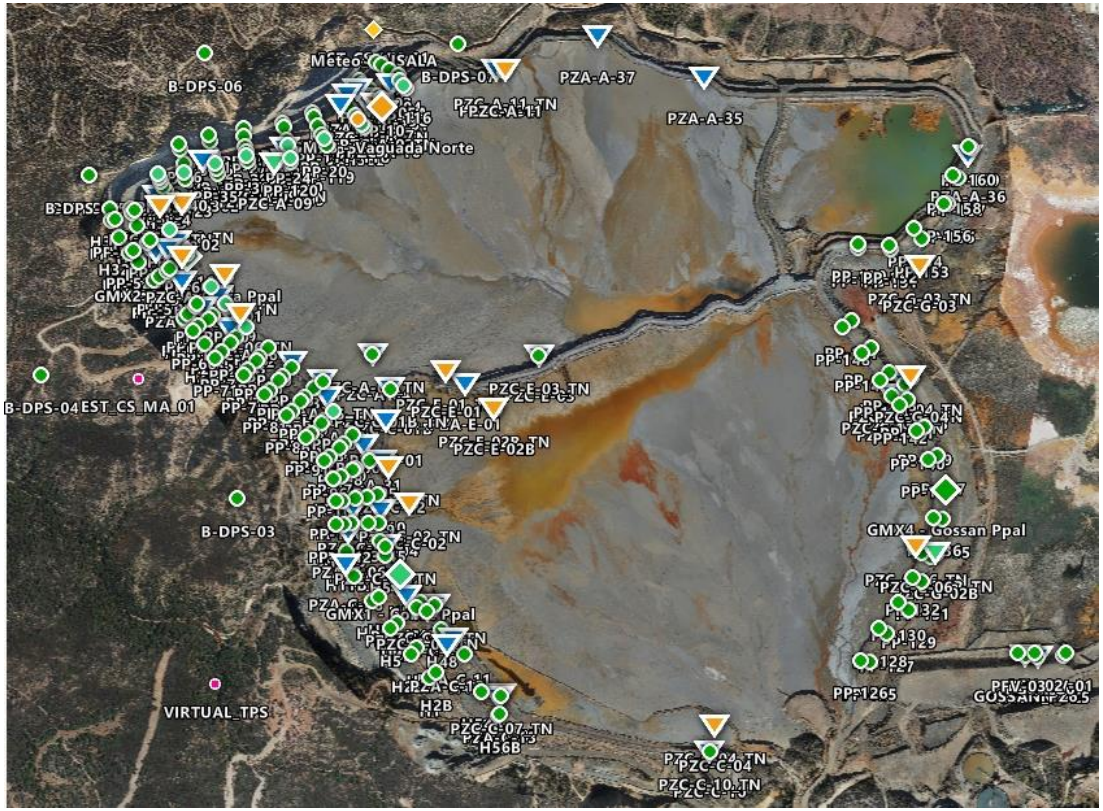
Classic sensors and GBSAR

Geodetic and Geotechnical sensors installed:

- 46 OPW
- 30 CSP
- 21 Inclinometers
- 150 Prisms
- 9 Markers GCP
- 4 GMX GNSS
- 1 IBIS-FM EVO GBSAR

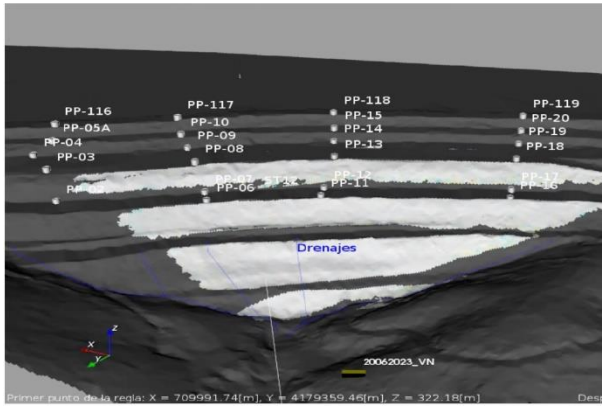


Classic sensors and GBSAR

Robotic Total Station

GNSS

GBSAR IBIS-FM EVO



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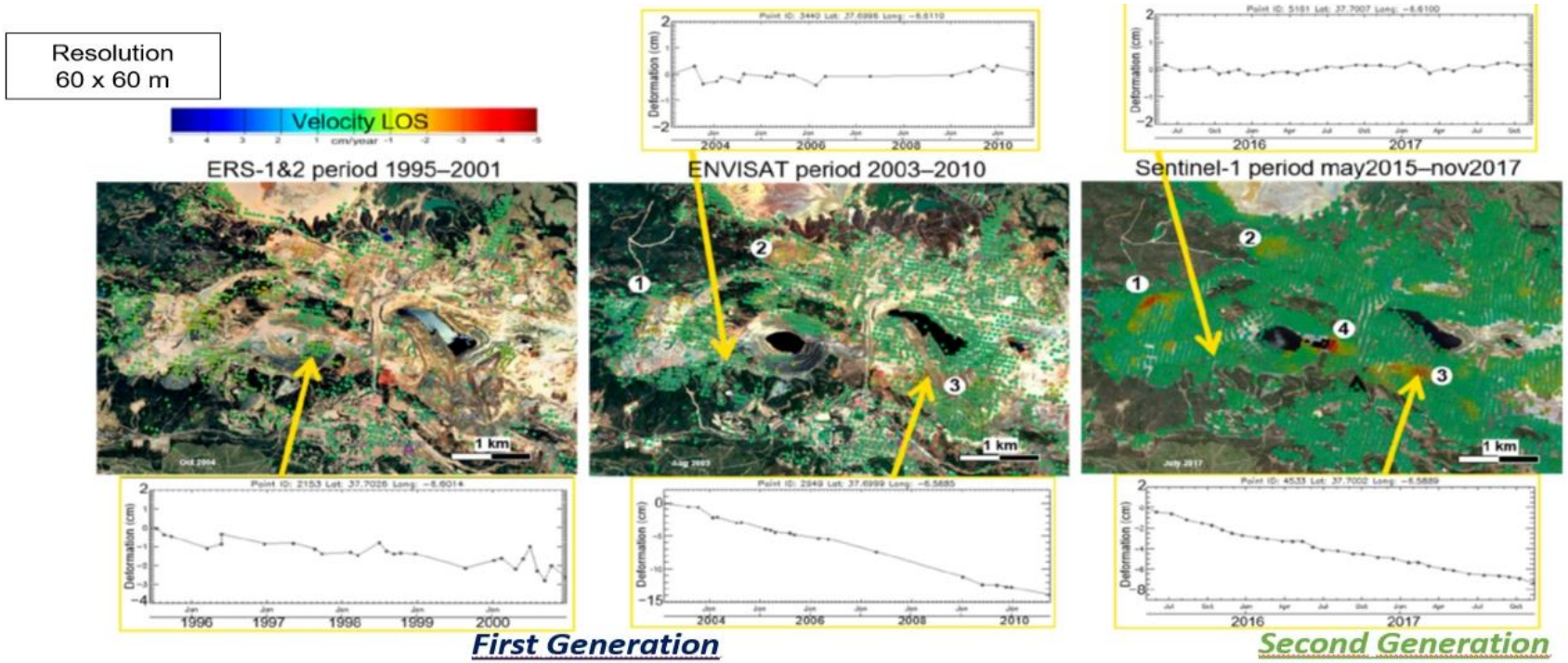
InSAR



Historical review of Riotinto mine with 3 ESA satellites: ERS-1&2, ENVISAT, and Sentinel-1. Result for descending orbits. Dots represent mean velocity values (cm/y, in line of sight direction, LOS) of each cell. Green dots mean stable and reddish colors mean movement away from the satellite. The numbers on the maps show four areas under deformation discussed in the following sections. The graphics show accumulated deformation in stable and unstable points. It is worth noting the coverage improvement with Sentinel-1.

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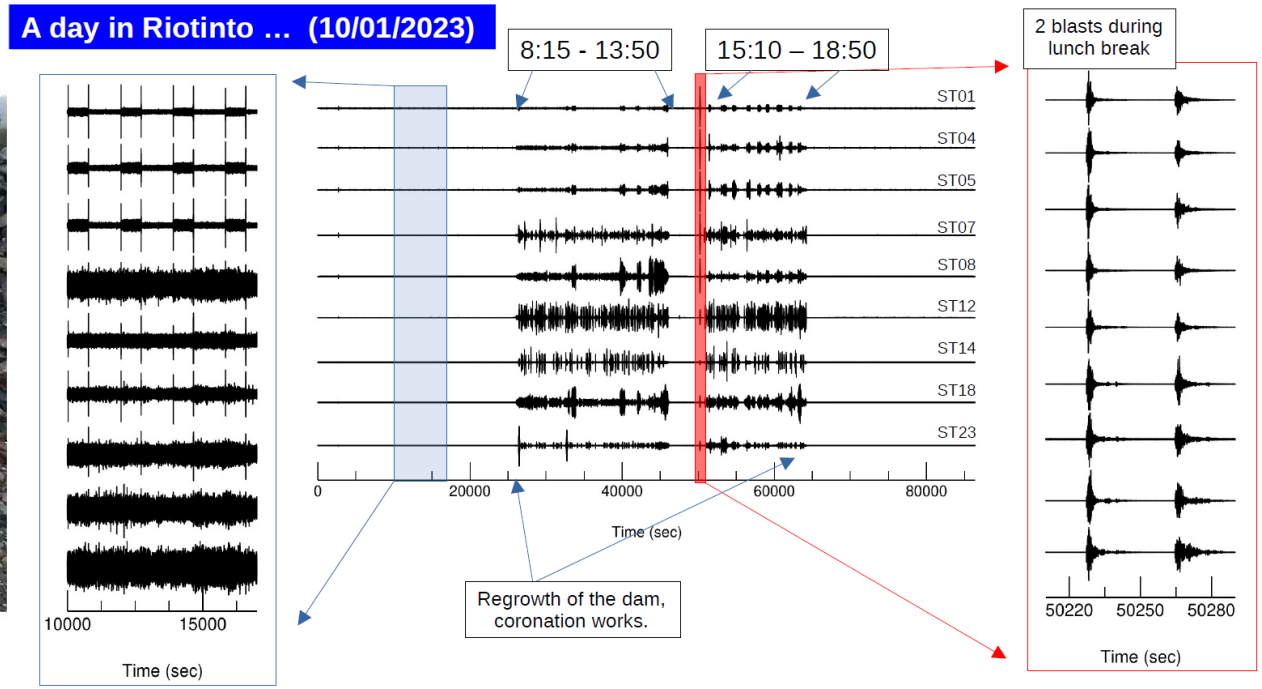
ANSI



Main objectives:

- Data acquisition
- Seismic noise characterization
- Identification of benefits & limitations
- Monitoring structural health

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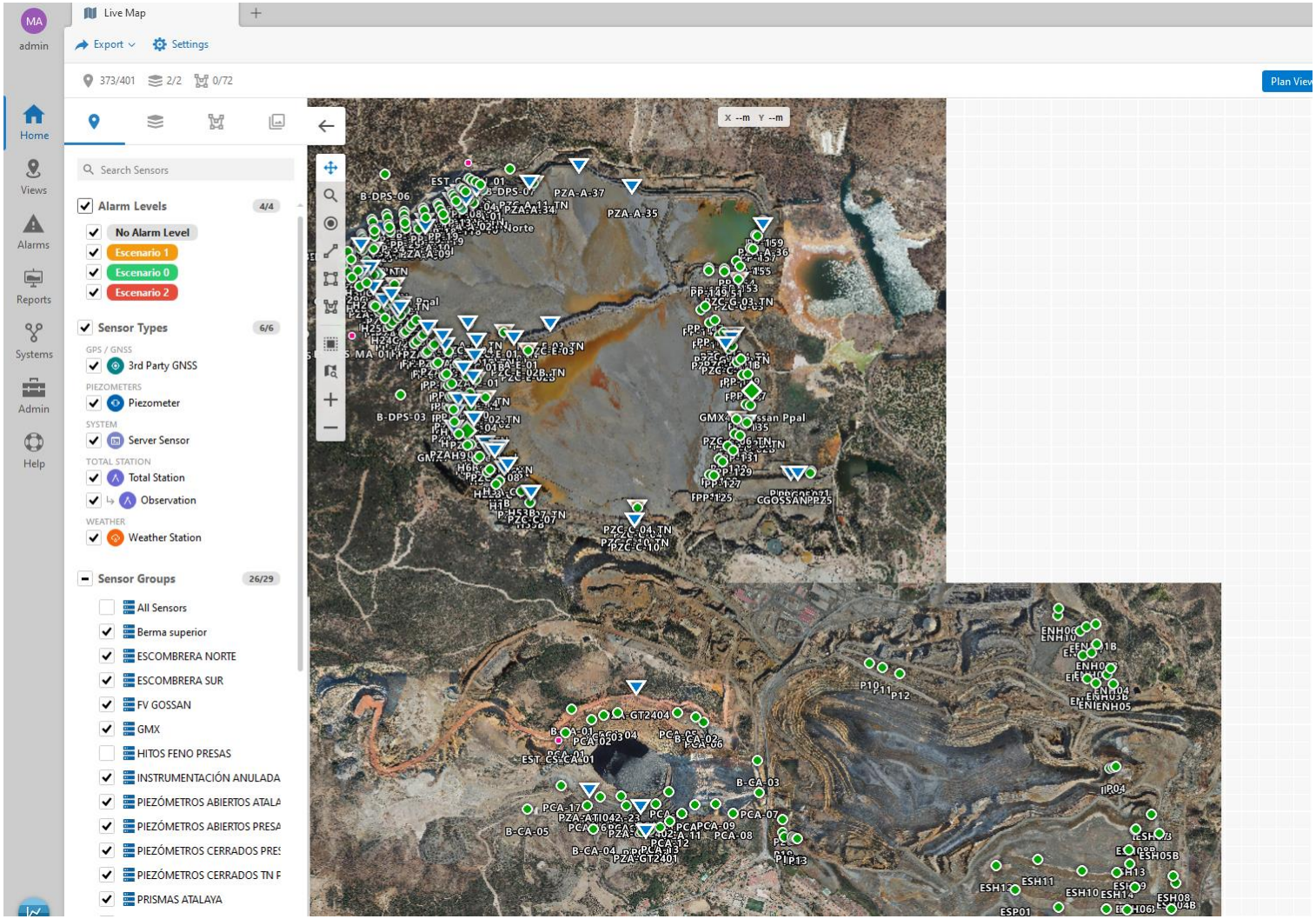
GeoMonitoring Hub



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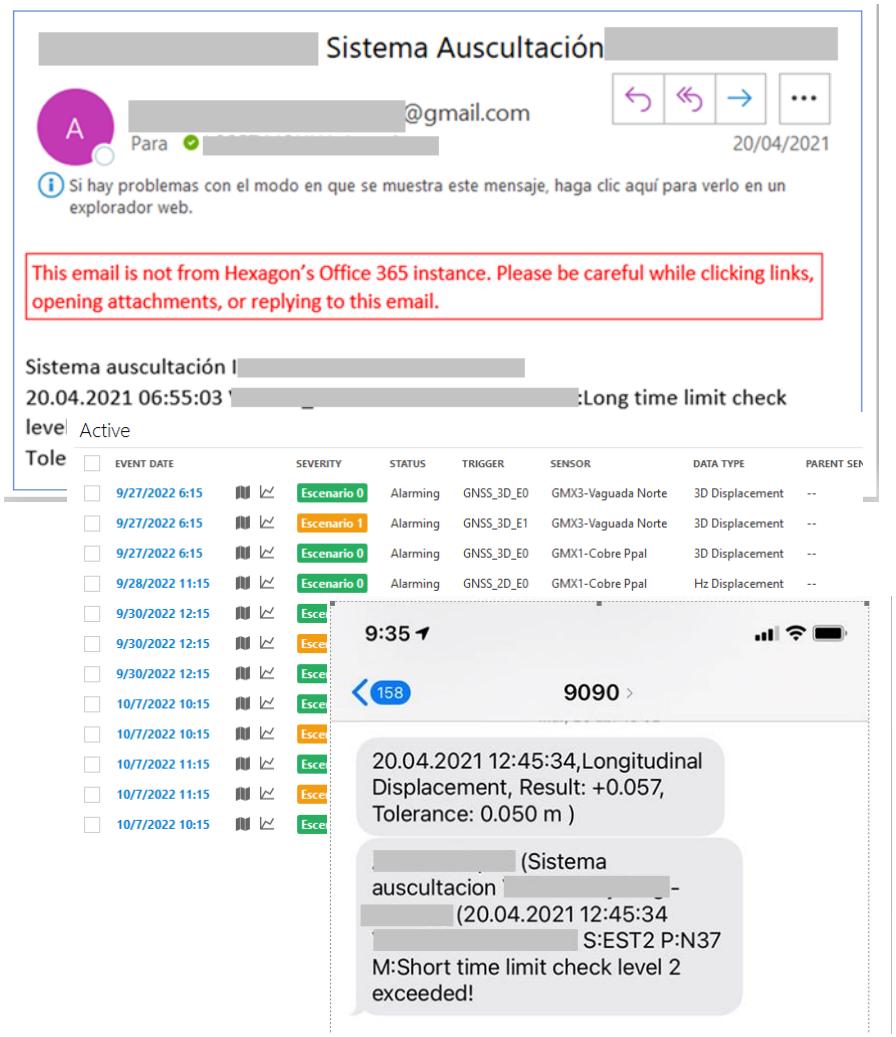
GeoMonitoring Hub



The Hub enables:

1. To integrate all data in a single platform
2. Better understanding of data
3. To correlate different technologies
4. To define a set of warnings from different scenarios
5. To create an early warning tool to notify events 24/7
6. To elaborate periodic automatic reports

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Conclusions

1. Minerva project has been incorporating technological innovations and realizing a digital transition towards a comprehensive geodetic and geotechnical monitoring of the entire mining area and specifically the tailing dam. It resulted useful for surveillance of mining facilities, civil structures, and any element or structure that requires monitoring.

2. The classical instruments and sensors such as Total stations and prisms, GNSS, inclinometers, piezometers and GBSAR allowed Atalaya to detect and analyze displacements that are linked to the expected movement of the structure.

    a. None of the displacements reported were greater than 50 mm in a period of 3 months.

3. A specific area of the tailing dam known as Vaguada Norte had been monitored 24/7 by a third party.

    a. This service was found of high interest, therefore Atalaya decided to extend the service to the whole tailing dam.

4. The investigation is continuing with STONE project with the aim to also integrate satellite data (InSAR) and the ambient noise (ANSI) to the GeoMonitoringHub, in order to complete the classic observation technique and reduce the risk inherent in mining environments.

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