



*Passive seismic techniques for
environmentally friendly and cost-
efficient mineral exploration*

PACIFIC

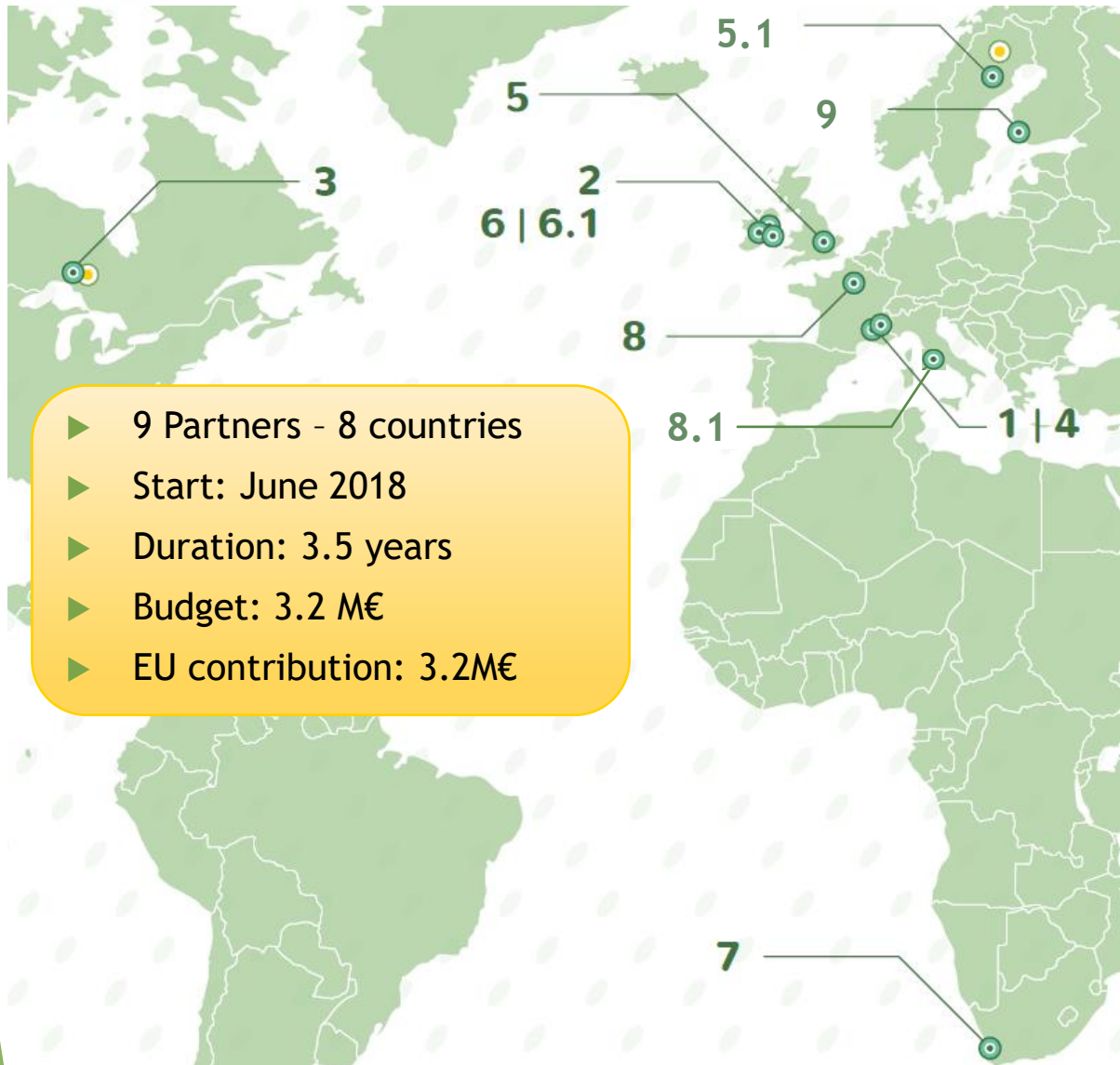
Project presentation



*PACIFIC has received funding from the European Union's Horizon 2020
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PACIFIC : facts and figures



- ▶ 9 Partners - 8 countries
- ▶ Start: June 2018
- ▶ Duration: 3.5 years
- ▶ Budget: 3.2 M€
- ▶ EU contribution: 3.2M€

The PACIFIC consortium brings together mineral exploration and mining industry, technology and service-providing SMEs, academic and research institutes and geological surveys:

1. Université Grenoble Alpes (UGA)
2. Dublin Institute for Advanced Studies (DIAS)
3. Generation PGM Inc. (GEN)
4. SAS Sisprobe (SISP)
5. Beowulf Mining Plc (BEOW)
- 5.1 Jokkmokk Iron Mines Ab (JIMAB)
6. Geological Survey Ireland (GSI)
- 6.1 Economic and Social Research Institute (ESRI)
7. Institute of Mine Seismology (IMS)
8. ARTTIC (ART)
- 8.1 CIAOTECH Srl (CTECH)
9. Oy Fennoscandian Resources Ab (FRA)

- Marathon test site
- Kallak test site



Rationale

Mineral exploration techniques have not evolved: **innovative and sustainable technologies** are needed:

- to discover **new deposits**, particularly those buried beneath the surface, and
- to **expand the resource base** of known deposits.





PACIFIC innovative approach

PACIFIC is developing two radically new and complementary techniques, both based on passive seismic imagery. These techniques must have:

- Sufficient **accuracy** and **resolution** for the minerals industry
- A **relatively low cost** and **have a minor impact on the environment**

PACIFIC also conducts research on social acceptance and public perception of risk for mining activities.



Objectives

- ▶ Two major developments of the traditional passive seismic method:
 1. The passive reflection seismic technique: extraction of **body-waves** from ambient seismic noise to acquire reflection seismic sections.
 2. The multi-array passive seismic imaging: using several vertical arrays combined with a surface array to obtain a better resolution at depth.

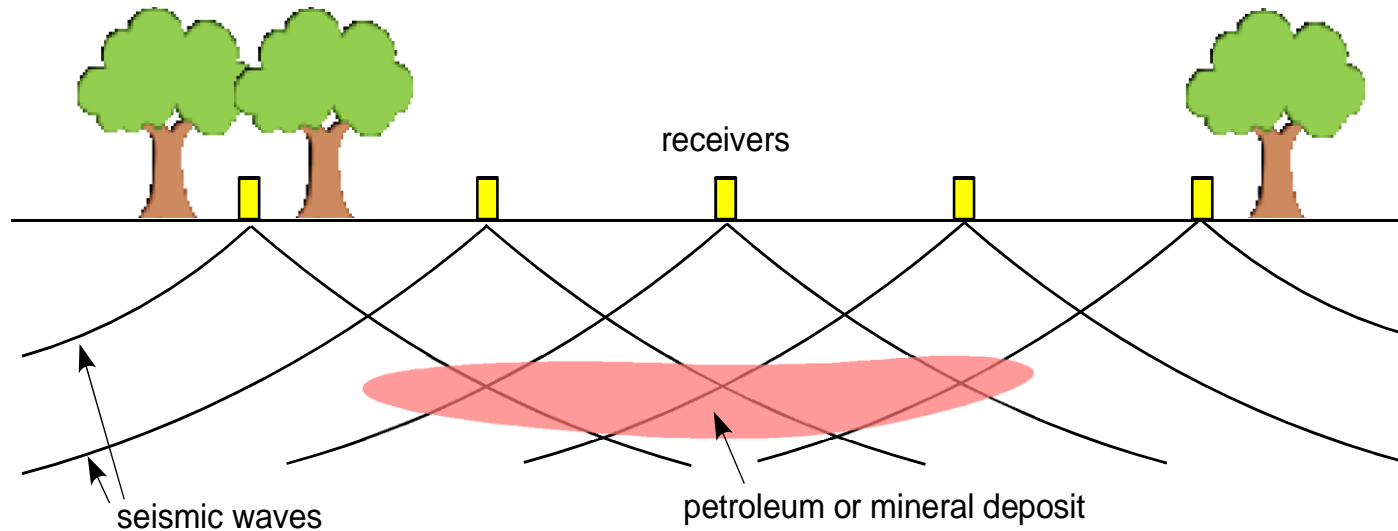
- ▶ Research on social acceptance and public perception of risk for mining activities.



The seismic reflection technique

- ▶ Array of receivers deployed at the surface
- ▶ Each receiver records **ambient seismic noise** (ocean waves, traffic, small earthquakes, etc), then acts as source for receivers
- ▶ **Difference in signal between receivers** used to determine the nature of the sub-surface.

Schematic illustration of the passive seismic technique.



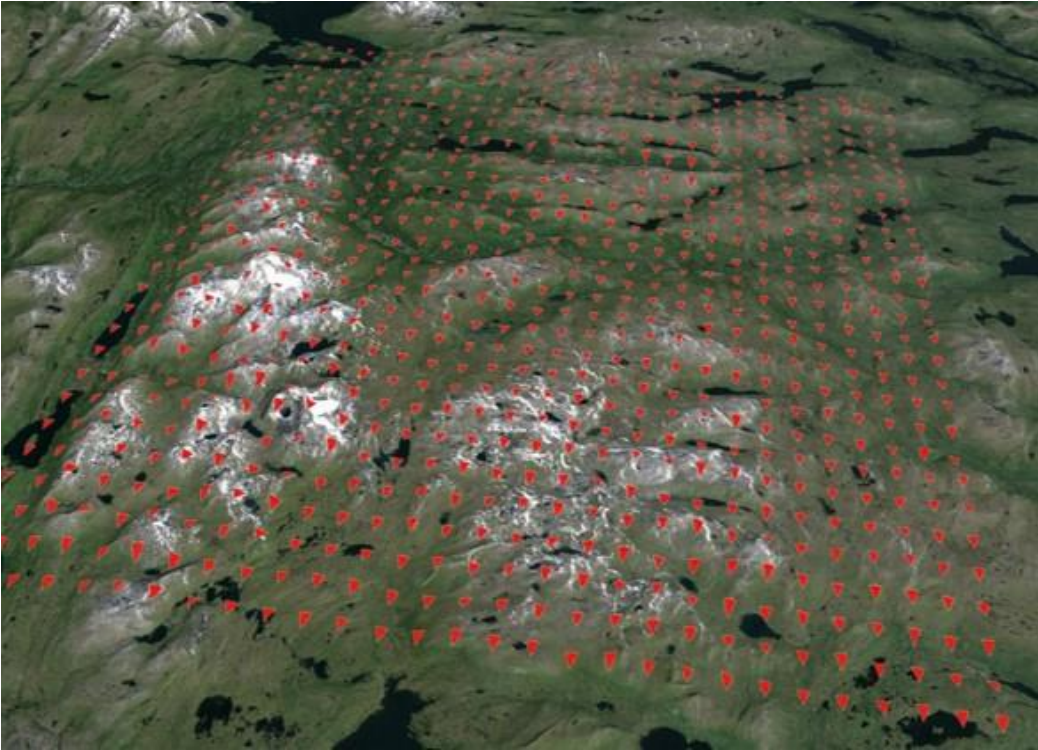


The seismic reflection technique

A receiver (node)

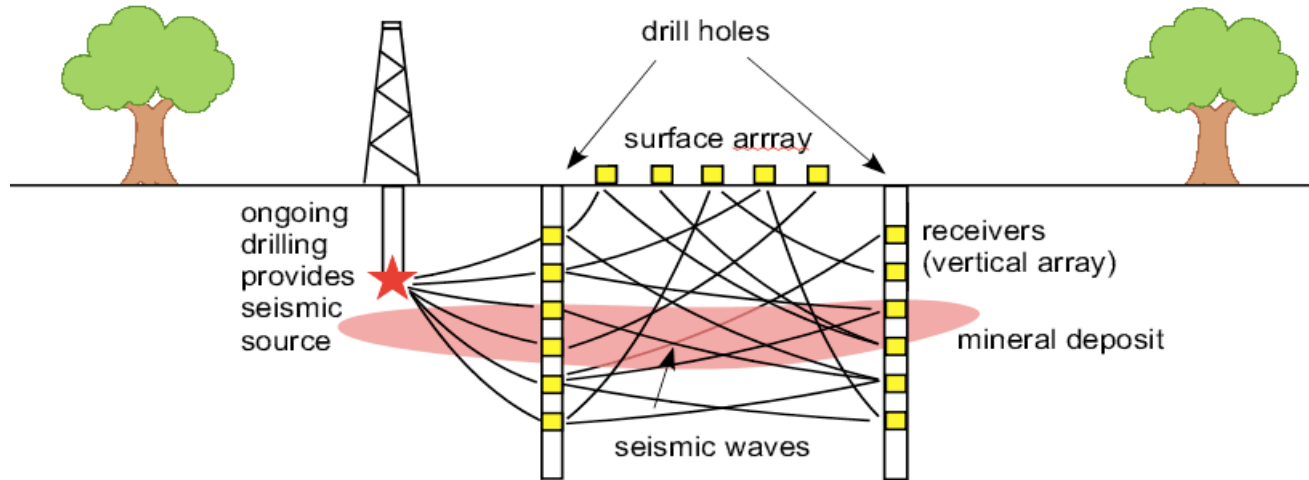


An array



The multi-array approach

- ▶ The multi-array approach developed by PACIFIC is complementary to the traditional passive seismic technique.
- ▶ Surface arrays are used in conjunction with vertical arrays.



Schematic diagram illustrating the deployment of two vertical arrays of receivers in drill holes capturing a signal from drilling in a third hole.

- ▶ Advantages - better targeting and less drilling.



PACIFIC test site n° 1

Marathon deposit, Canada





The Marathon array



Deployment of 1200 nodes





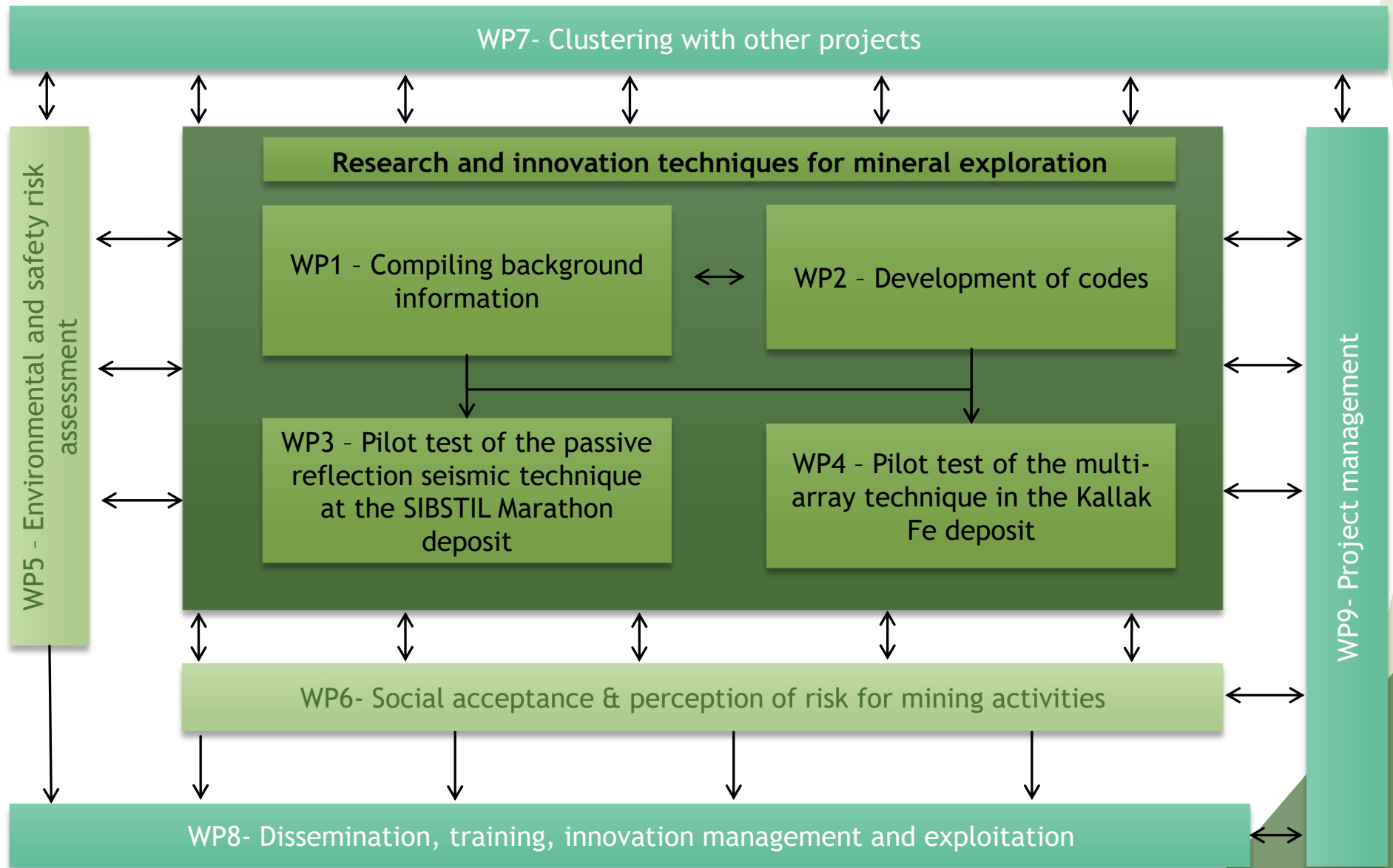
PACIFIC test site n°2

Kallak Iron Ore deposit, Sweden





Workplan structure



Expected impacts

Develop a cost-effective,
environmentally friendly
exploration tool

Deliver another
method to explore for
buried ore deposits

Decrease the
environmental footprint of
mineral exploration

Inform geoscientists about passive
seismic methods

Bridge the gap between geophysical
and geological models of ore deposits

Improve public
awareness and
acceptance of mineral
exploration

Help ensure a
sustainable supply of
raw materials for the
EU

Reduce the EU's
dependence on imported
mineral products





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