Titanium for the Future:

How Italy can Develop its Mineral Resources for Sustainability

UNFC Case Study
-
Piampaludo Titanium Deposit

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RESOURCE MANAGEMENT WEEK 2023

ASSURING SUSTAINABILITY IN RESOURCE MANAGEMENT

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Introduction

Scope of the Study

- The application of the United Nations Framework Classification for Resources (UNFC) to the Piampaludo titanium exploration project in Liguria, Italy.
- The Piampaludo titanium deposit is reported to be one of the largest titanium deposits in Europe, yet the project remains bounded by social and environmental constraints.
- This case aims to:

1- **Introduce UNFC to Italy**:

  - Italy has no formal national or regional classification or reporting system for raw materials
  - Italy has significant amounts of mineral occurrences & deposits, many of which are CRMs

2- **Classify the Piampaludo project in UNFC**:

  - Sustainable decision-making
  - Ligurian mineral inventory

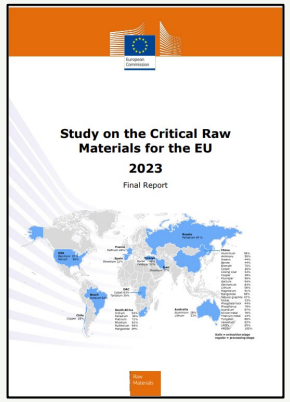
3- **Provide a new approach for UNFC**:

  - UNFC classification based only on publicly available data

Titanium & Sustainable Development

In the European Context

- Titanium Metal: Listed as both Critical and Strategic Raw Material for the EU on March 2023
- Economic Titanium resources are only found in 3 EU Countries.
- Titanium is directly linked with Sustainable Development by supporting renewable energy and energy efficiency, through:
  - Buildings & Construction Materials
  - Advancements in Renewables
  - Battery Innovation
  - Medical Technology



Buildings are responsible for

40%

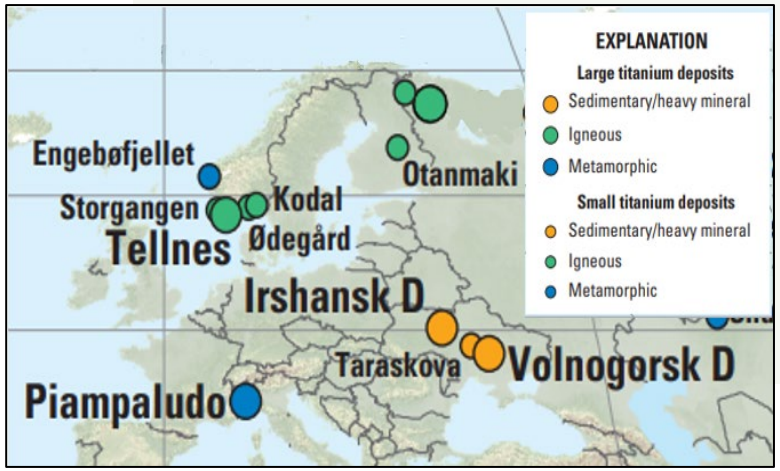
of energy consumption

&

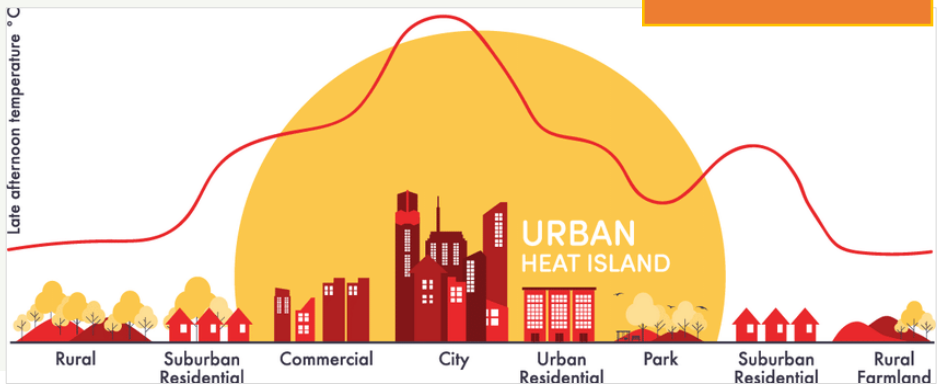
36%

of CO2 emissions

in the EU



	Contained TiO_2 by primary ore mineral (million Mt)
Italy	9
Norway	297
Ukraine	~ 14.5



Piampaludo Titanium Deposit

Geology Data Collection

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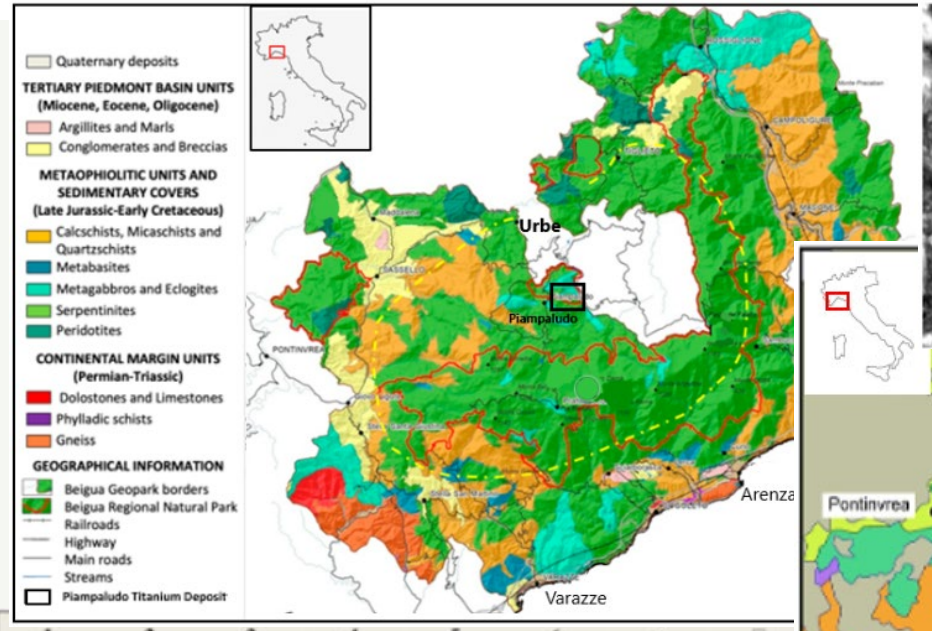
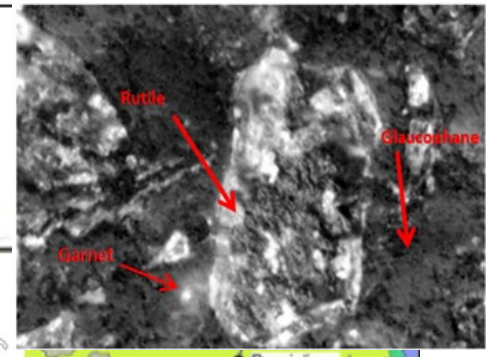
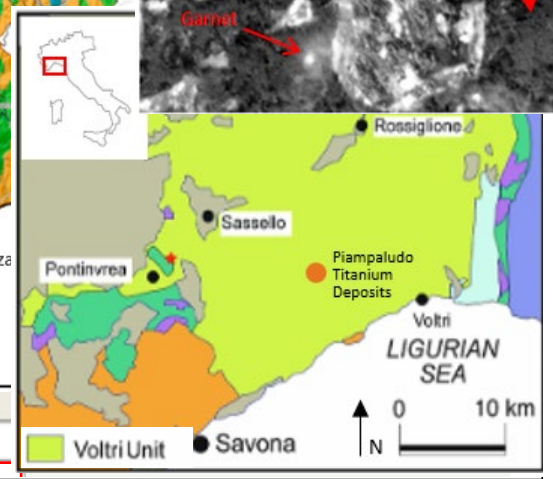
Publically Accessible Information

- **Academic and Scientific Research**
  - Geological mapping
  - Geophysical & geochemical studies
- **Laboratory Analysis**
  - Chemical and Mineralogical testing
  - X-ray diffractometer Eclogites & rutile
- **Field Sampling**
  - Boreholes up to 115 meters deep
  - Surface sampling
- **Exploration project**
  - Surface developments
- **Online Publications**
  - Court cases







% Oxides	1	2	3	4	5	6	x	
SiO_2	0.10	0.18	0.19	0.13	0.18	0.21	0.16	0.04
TiO_2	98.35	98.05	98.51	98.19				
Al_2O_3	0.13	0.11	0.17	0.37				
FeO	0.41	0.22	0.32	0.48				
V_2O_3	-	-	-	0.54				
MgO	0.05	0.10	0.11	0.04				
CaO	0..06	0.12	0.08	-				
Na_2O	0.12	0.23	0.17	0.17				
Total	**99.22**	**99.01**	**99.55**	**99.92**				

Ore mineral	Rutile (TiO_2)
Ore occurrence	Aggregates ~ 0.5-3mm
Ore tonnage	9Mt
Ore grade	~ 6%
Orebody morphology	Large concordant lens
Orebody orientation	20°Dip to the South
Associated minerals	Garnet, Glaucophane, Titanite, Ilmenite, Serpentine, Talc, Magnetite, Actinolite

CET Mining Plan

Piampaludo Titanium Mining

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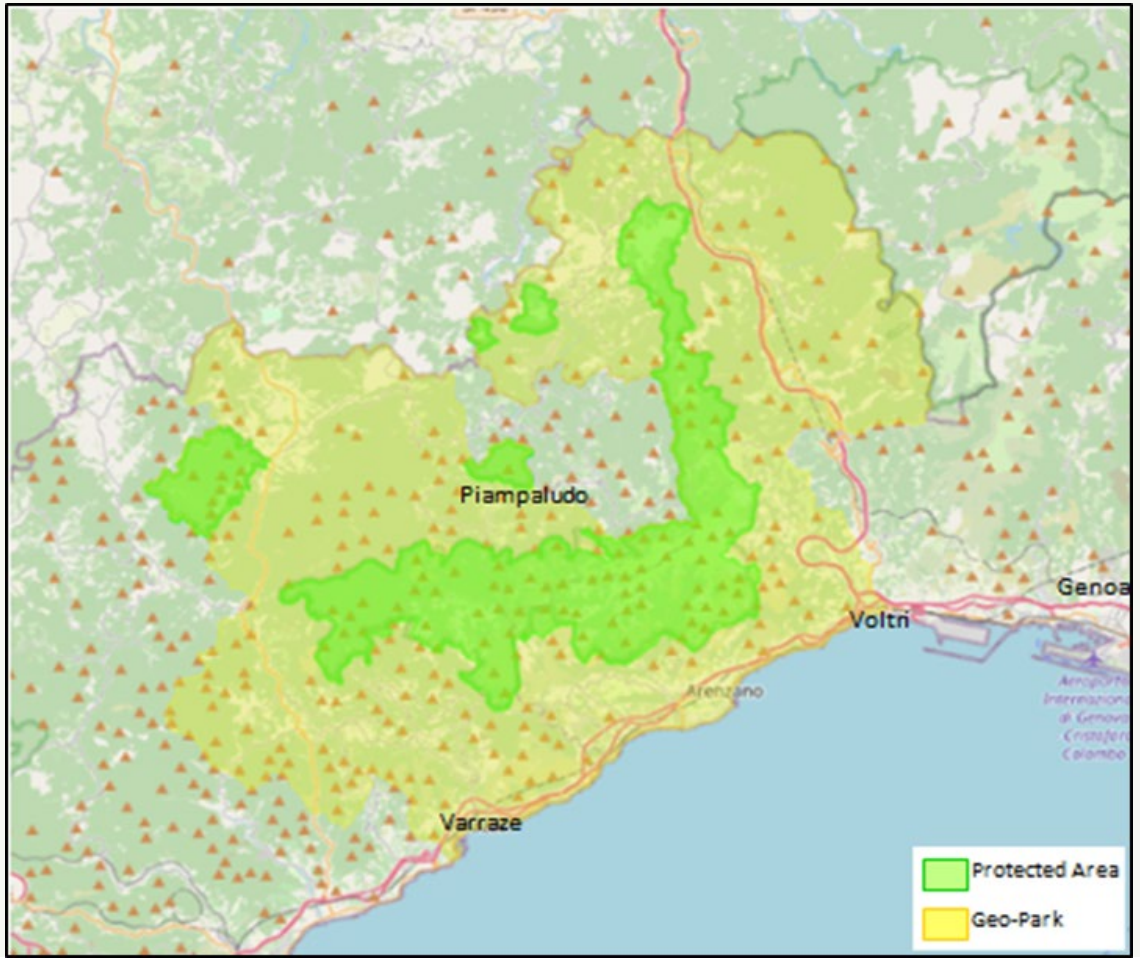
- Compagnia Europea per il Titanio (CET)
- Mining Concession in 1985
- Prefeasibility Study
- Technical and geologic investigation
  - Surface developments
  - Coring and surface sampling
- Geophysical and Chemical analyses
- CET Mining Plan
  - Rutile recovery
  - Garnet as by-product

CET Proposed Mining Plan as part of the Piampaludo Prospect Project	
Type of Mining	Surface
Mining Method	Open Pit
Mining Technique	Drill & Blast
Surface Area	90 Hectares
Maximum Pit Slope	60 °
Operating Days per Year	265
Operating Shifts per Day	2 shifts of 8 hours each
Production	10,000 t/d
Production Unit Cost	1.37 $/t ore*
Waste Rock	48.4 %
Ore Mining Features	
Ore Hardness	Hard Rocks (Eclogites)
Length	~ 1,800 m
Width	500 m
Thickness	300 m
Wall-Rock Alteration	None
Ore Control	Fracturing
Latest Ore Record	1991

*Subject to conversion into today's market price

Social and Environmental Contingencies

Facing the Piampaludo project



G3 + G4 classification on the G axis

The degree of confidence in resource estimates

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- Geologic knowledge is based on Scientific Research
  - Lab and field tests
  - Regional geology and ore mineralogy
- Subject of many researches
- No reporting publicly disclosed on resource estimates
- Estimates from studies between 1979-1998
- Moderate to low levels of confidence
- G3 + G4 Classification

Category	Definition
G3	Product quantity associated with a project that can be estimated with a low level of confidence.
G4	Product quantity associated with a Prospective Project, estimated primarily on indirect evidence

E3.2 classification on the E axis

The Environmental-Socio-Economic Viability

- Classification based on court rulings, permit, social and environmental opposition, and economics.
- Exploration permit until 2024 by Liguria Regional Council
- CET has full exclusivity for exploration in this area
- Exploration granted on the deposit in areas outside the Natural park
- Under Italian law, exploration permit allows to carry out EIA and SEA
- The deposit is valued at a minimum of 120 B€
- Garnet as potential by-product
- No social consent
- E3.2 Classification

Category	Definition
E3	Development and operation are not expected to become environmentally-socially-economically viable in the foreseeable future or evaluation is at too early a stage to determine environmental-socioeconomic viability.
Sub-Category	**Definition**
E3.2	On the basis of realistic assumptions of future conditions, it is currently considered that there are not reasonable prospects for environmental-socio-economic viability in the foreseeable future

F2.2 classification on the F axis

The technical feasibility

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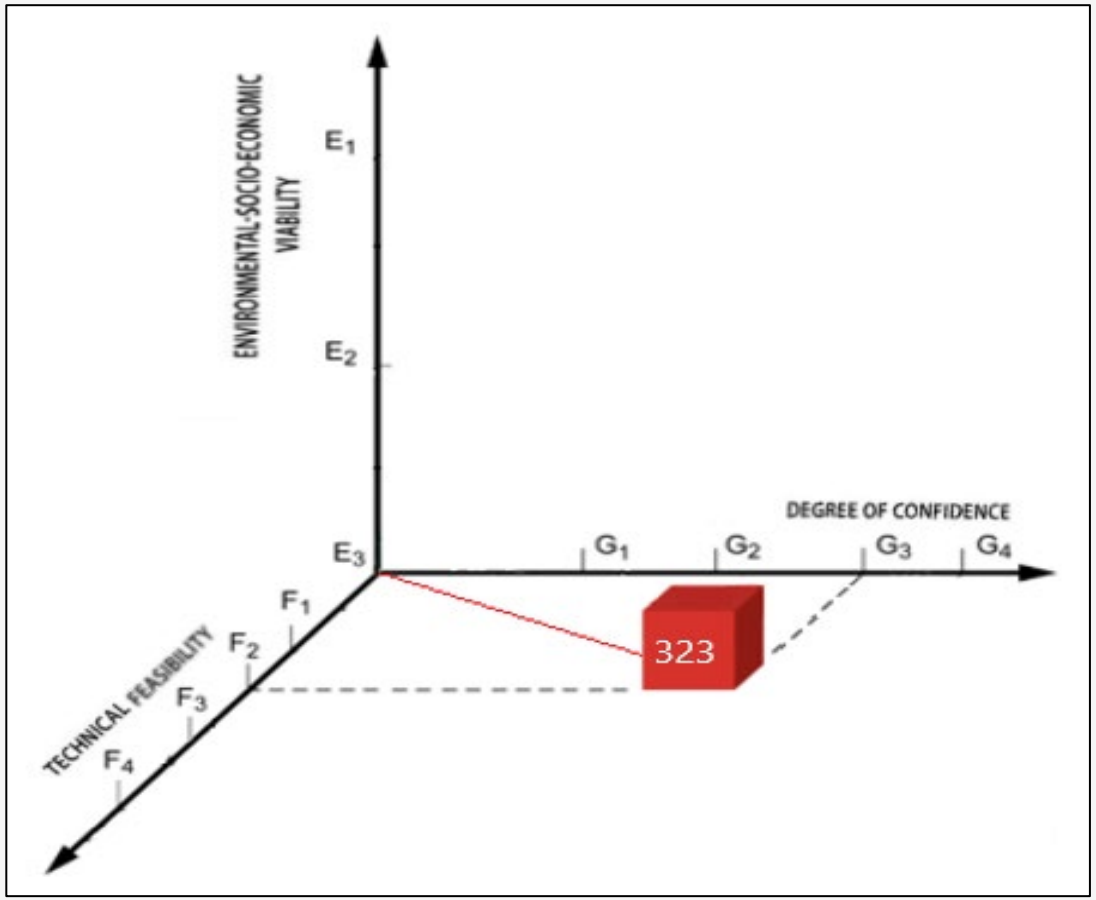
- Based on CET's preliminary mining plan, early developments, and research
- Prefeasibility plan indicates potential development
- Clear resource definition (more data acquisition is needed)
- Early developments (trenches, adits, shaft)
- Advancement still pending due to ongoing environmental and social impediments
- Technical feasibility is still at preliminary stages
- Considered highly prospective for Titanium
- F2.2 Classification

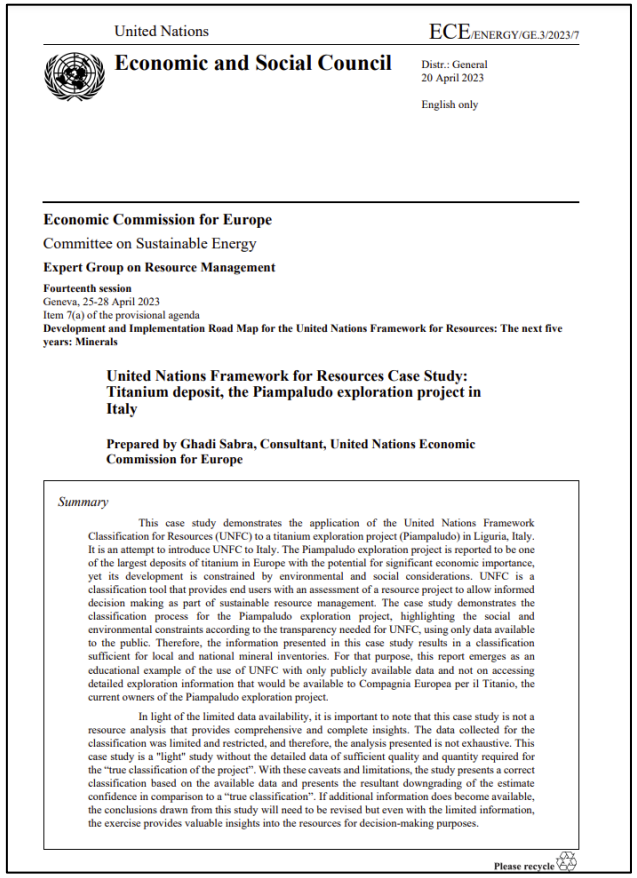
Category	Definition
F2	Technical feasibility of a development project is subject to further evaluation.
Sub-Category	**Definition**
F2.2	Project activities are on hold and/or where justification as a development may be subject to significant delay.

Conclusions and Challenges

Piampaludo titanium deposit

- Piampaludo's titanium deposit is one of the largest eclogite-hosted deposits in EU
- Lower titanium supply risks in Italy and across Europe.
- Piampaludo project into a hiatus from Social and environmental concerns
- E3.2F2.2G3+G4
- No Garnet classification as by-product
- Case Study shows how to deal with a deposit when you only have limited information
- Liguria's Mineral Inventory, national database for resource management
- If additional information becomes available, the conclusions drawn will need to be revised





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Committee on Sustainable Energy

Expert Group on Resource Management

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Item 7(a) of the provisional agenda
Development and Implementation Road Map for the United Nations Framework for Resources: The next five years: Minerals

United Nations Framework for Resources Case Study: Titanium deposit, the Piampaludo exploration project in Italy

Prepared by Ghadi Sabra, Consultant, United Nations Economic Commission for Europe

Summary

This case study demonstrates the application of the United Nations Framework Classification for Resources (UNFC) to a titanium exploration project (Piampaludo) in Liguria, Italy. It is an attempt to introduce UNFC to Italy. The Piampaludo exploration project is reported to be one of the largest deposits of titanium in Europe with the potential for significant economic importance, yet its development is constrained by environmental and social considerations. UNFC is a classification tool that provides end users with an assessment of a resource project to allow informed decision making as part of sustainable resource management. The case study demonstrates the classification process for the Piampaludo exploration project, highlighting the social and environmental constraints according to the transparency needed for UNFC, using only data available to the public. Therefore, the information presented in this case study results in a classification sufficient for local and national mineral inventories. For that purpose, this report emerges as an educational example of the use of UNFC with only publicly available data and not on accessing detailed exploration information that would be available to Compagnia Europea per il Titanio, the current owners of the Piampaludo exploration project.

In light of the limited data availability, it is important to note that this case study is not a resource analysis that provides comprehensive and complete insights. The data collected for the classification was limited and restricted, and therefore, the analysis presented is not exhaustive. This case study is a "light" study without the detailed data of sufficient quality and quantity required for the "true classification of the project". With these caveats and limitations, the study presents a correct classification based on the available data and presents the resultant downgrading of the estimate confidence in comparison to a "true classification". If additional information does become available, the conclusions drawn from this study will need to be revised but even with the limited information, the exercise provides valuable insights into the resources for decision-making purposes.

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https://unece.org/sed/documents/2023/04/working-documents/united-nations-framework-resources-case-study-titanium

Thank you!

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