Coordinating and integRating state-of-the-art Earth Observation Activities in the regions of North Africa, Middle East and Balkans and Developing Links with GEO related intiatives toward GEOSS

GEO-CRADLE:

Funded under H2O2O - Climate action, environment, resource efficiency and raw materials

ACTIVITY: Developing Comprehensive and Sustained Global Environmental Observation and Information Systems CALL IDENTIFIER: H2020 SC5-18b-2015 Integrating North African, Middle East and Balkan Earth Observation capacities in GEOSS Project GA number: 690133 Total Budget: 2,910,800.00 € Fostering regional cooperation and roadmap for GEO and Copernicus implementation in North Africa, Middle East and Balkans



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Access to Raw Materials Pilot Eleni Christia NOA





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Thematic Areas

linked with the UN SDGs



EARTH OBSERVATIONS





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Access to Raw Materials T4.3 (ARM)



Establishing a roadmap for long-term monitoring, mapping, and management of Quarries & Mineral Deposits in the ROI.



Identification, collection, assessment and use of EO based and in-situ data

Enrichment of the information content of the Regional Data Hub







T4.3 answer to the need defined by WP3

- Five proposals on raw materials pilot projects were submitted from Cyprus (three) and Greece (two). One pilot site was chosen in Cyprus, one in Greece, and a third one is needed in a third country, North Africa preferably.
- Selected examples of the pilot studies sites (Cyprus and Greece) present most interesting mining and post-mining areas which are going to be analysed from the point of view applicability of the EO methods.
- The elaborated methodologies will be the main goal of the pilot. They will be useful for better management of the mining and post-mining areas and reduce their impact on the surrounding areas. In addition, they will have a universal character and could be applied for other RoI.







T4.3 answer to the need defined by WP3

Scope of roadmap for the three test sites:

- 1. Identification of possible study
 - 1.1. Name of the pilot site
 - 1.2. Summary
 - 1.3. Description of the pilot site
 - 1.4. Description of existing data
- 2. Project description
 - 2.1. Objectives and expected results
 - 2.2. Methodology, methods of implementation
 - 2.3. Main activities
 - 2.4. Results of the pilot site analysis
 - 2.5. Sustainability

2.6. Institutional and organizational capacity assessment of the implementation body

3. Key recommendations & next steps







Cyprus pilot site

- Cyprus has 33 mines and 32 of them are abandoned.
- Selected mine is located on the Troodos Ophiolite: Abestos mine (abandoned – under restoration)



Abestos mine







Cyprus pilot site

Geographic and geological characteristics of the site (Asbestos Mine)



- It is located in the central part of Troodos Ophiolite and it is an outcrop of serpentine.
- The Asbestos Mine operated between 1904 and 1988
- It is estimated that 130 million tones of rock have been excavated
- One (1) million tones of asbestos fibers (chrysotile) were produced



Consequences

- adverse effects on the environment
- the enormous open pit
- the extensive waste tips
- pollution of the soil/water
- stability of the waste tips
- the barren nature of the tips











Results of the reclamation works



Cyprus pilot site

Since 1995 the mine is under restoration and the area is a State Forest Land.

The rehabilitation works have included the following:

- Re-profiling and stabilizing of the waste dumps
- Construction of berms and soilcovering
- Reforestation and revegetation of the berms
- Risk assessment due to the existence of the mine
- Future use of the area
 So far 40-50 % of the area of the mine has been rehabilitated.









Cyprus pilot site

Objectives:

Out of all the mentioned problems, the following **main objectives** are defined for the Asbestos Mine pilot study:

- Determination of **ground stability** of the former mining area, taking under special consideration the slope mass movements and vertical ground motions.
- Determination of the **land use changes** and monitoring progress of restoration works.
- Identification of the **local pollution** (if possible) related to former mining activities.







Cyprus pilot site

Methodology:

Determination of the ground stability

The task will be performed using satellite interferometry method.

Space-borne differential synthetic aperture radar interferometry (DInSAR), and in particular new advanced processing techniques such as Permanent Scatterer Interferometry (PSInSAR or PSI), offer a unique possibility for wide-area, regular monitoring of ground surface displacements. Furthermore, under suitable conditions it should be possible to detect precursory deformations associated with the initiation of ground instability, a key element for early warning and hazard mitigation.









Methodology:

Determination of the land use changes

Land use changes will be analysed on the basis of the multitemporal satellite images, covering periods of the mining activity and after mine closure (Landsat MSS, Landsat ETM+, Landsat 8 and Sentinel 2). The results of the satellite analysis will be verified using CORINE maps.

The mapping and classification of existing land-use pattern is essential for planning future developments. Remote sensing methods are becoming increasingly important for mapping land use and land cover.

Cyprus pilot site











Cyprus pilot site

Methodology:

Identification of the potential pollution sources

The analysis will be made on the basis of optical, multispectral satellite images (Landsat 8 and Sentinel 2) and in-situ data. The results will be verified using existing <u>airborne hyperspectral images.</u>

Remote sensing methods are very useful for monitor pollution from mining at less cost and to common standards across the EU. Existing Hyperspectral imaging sensors and multispectral satellite images of new generation which identify and map materials through spectroscopic remote sensing produce data that can characterize the chemical and/or mineralogical composition of the ground surface.





Cyprus pilot site

Main activities:

The following activities are expected:

- Collecting existing data, spaceborne and airborne images, statistical data, maps, reports etc.
- Collecting metadata of new satellite images; radar and optical and sample aquisition of free of charge datasets.
- Sample processing of the satellite radar images, using interferometric software SARScape.
- Sample processing of the satellite optical images, using software; ER Mapper, Global Mapper and ArcInfo 10.0 (for creation GIS database).
- Feasibility study of elaboration of the different thematic maps elaborated in various scales (unstable places, land use changes, pollution sources) as well as statistical graphs and tables. Elaboration of the sample maps.
- Preparation of the final report.









Greece pilot site

Monitoring of Quarrying Activities in Greece

The needs: There are three different types of activity that the Ministry of Environment -Inspectorate needs to survey: (a) Exploitation of 'quarry minerals' in quarry sites that own valid permits; (b) Potential illegal activities that are mostly taking place in old/abandoned/without an active permit quarries; and (c) Occasional exploitation activity from unpermitted sites.

The problem: In spite of the existing legislative framework for Quarrying, Greece is facing problems, particularly with illegal aggregates' quarrying activities. This issue was highlighted by UEPG (the European Aggregates Association) particularly for countries in the Balkan region, during the implementation of two EU co-funded projects, SARMa and SNAP-SEE (in which IGME was a core partner). Illegal quarrying is related to severe economic, social and environmental impacts affecting not only the restricted area where such activities take place, but also wider areas.

<u>The Aim</u>: Mitigation of illegal quarrying activities by developing a Monitoring System (Tool) with the use of EO data. This Tool may be used to track any detectable potential changes of surface morphology, land use, etc. related with such activities.







Greece pilot site

The feasibility study will include description of the following tasks:

Description of the Problem: Illegal Quarrying

Documentation:

- Relevant Legislation
- Current situation existing databases with licenced Quarrying activities
- Description of available:
 - Geological data / maps
 - Medium / High resolution Digital Elevation Models
 - Existing & new multispectral and radar satellite images:
 - Multispectral satellite images (Sentinel 2, Landsat, ASTER, Ikonos, WorldView 2 stereoscopic images);
 - Radar satellite data ERS 1/2, Envisat, Sentinel 1 (A and B)

Methodology to be applied:

- Change analysis monitoring based on satellite Sentinel-2 data.
- UAV flights over a selected sites for more detailed mapping
- Lidar (airborn)
- Field verification of interpretations of Earth Observation data
- Validation of the status of Quarrying activities sites with in situ inspections by the respective Authorities (Inspectorate of Mines Dept.).

Preparation of the final report.









Greece pilot site

Activities during GEO-CRADLE project:

Initial processing for change analysis monitoring based on satellite Sentinel-2 data for the pilot project areas of Attica region & Cephalonia island.

- Regional ecology and vegetation patterns
- Documentation of the conditions of lands adjacent to quarries / mines
- Disturbed / undisturbed land
- Reclamation monitoring / rehabilitated areas
- Waste deposition operations
- Land use / cover changes
- Delineation of areas where potential excavations activities are taking place
- Track changes of the activities can be implemented through the comparison of historical images
- Identification and characterization (by the competent Greek authority) of the nature (authorized or unauthorized) of the changes observed







- For the purpose of this study and the proposition of possible site for a "pilot project", a consultation with the General Directorate of Mineral Resources – Inspectorate of Mines Dept., Directory of Southern Greece of the Ministry of Environment and Energy (YPEN) has taken place.
- After the consultation several sites have been proposed by the competent authority, i.e. the relevant Inspectorate of the Ministry (YPEN), to be included as pilot project areas
- These sites are located in Attica region and Cephalonia island

Greece pilot site









Greece pilot site

Selection criteria for the Pilot Areas:

- 1. Areas hosting intensive quarrying activity (legal and/or illegal) regarding exploitation of: i) mineral raw materials for the production of aggregates; ii) industrial minerals, and iii) marbles and other ornamental stones. Amongst these, the aggregates' mineral raw materials exploitation consists a core activity that is more susceptive to illegal activities;
- 2. Regions where legally bounded areas, for the exploitation of aggregates' mineral raw materials, have not been delineated yet and in which the consumption needs for aggregates is high (e.g. islands, densely populated urban areas);
- 3. Remote areas not easily accessible for regular in situ inspections (e.g. islands) ;
- 4. Small number of granted aggregates' exploitation permits, to cover the actual needs;
- 5. Areas where illegal quarrying activity has been noticed.







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Greece pilot site - Attica



Five pilot project areas have been selected^{*}

- 1: 2.5 km², illegal activity.
- 2: 2.7 km², illegal activity.
- 3: 157.6 km², legal activity.

4: 22.4 km². In the subarea of the ancient marble quarry sites there is occasional illegal marbles' exploitation.

5: 80.7 km², illegal activity.

* Following consultation with the General Directorate of Mineral Resources – Inspectorate of Mines Dept., Directory of Southern Greece of the Ministry of Environment and Energy







Greece pilot site - Cephalonia island

- Various scattered extraction sites are identified on the island
- Based on 2009 data (IGME Report) 7 aggregates' quarries were under operation
- Based on 2014 data there is no QA defined in Cephalonia island, for aggregates' production
- Apart from aggregate quarries, there is an important quarry operation on the island for the production of calcium carbonate (Argostoli-Minies quarry)
- Production of 130.000 tonnes and 15.000 tonnes of crude CaCO3
- Quality characteristics:

IAASARS

>99,6% CaCO3, <0,07% Al2O3, <0,02% SiO2 каι <0,01% Fe2O3



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Area size of Cephalonia island 783 km² Sentinel 2 image of Cephalonia island (Date: 3/3/2017)









Greece pilot site - Cephalonia island

Images of the Argostoli-Minies Quarry site: Bing Maps vs Sentinel 2 of 3/3/2017











Roadmap Access to Raw Materials

The methodology described in the feasibility studies can be applied in any place in Greece but also in any country in the Region of Interest. After the completion of GEO-CRADLE project, the feasibility studies can be used as proposals requesting funding.









PADLE

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For more information









