

Marie Skłodowska-Curie Post-doc Positions at the Department of Physical Sciences, Earth and Environment of University of Siena¹:

“Expression of Interest” for hosting Marie Skłodowska-Curie Fellows

This template should be used by Professor/Doctor interested in hosting post-doctoral fellows within the Marie Skłodowska-Curie fellowship programme.

1. Short Description of the Project idea

Asbestos and asbestos-bearing materials, such as the widespread fiber-cement slates known as Eternit®, represent an emergency in Italy and Europe, due to the known carcinogenic effect of asbestos fibers when dispersed in air and inhaled. According to a recent inquiry by Legambiente (Dossier Legambiente, April 2018, based on Italian regional surveys), currently there are still 58 million square meters of fiber-cement roofing in Italy, both in industrial sites and in public buildings. It is remarkable that only 6 out of 20 Regions provided the requested information, so that the above value is probably strongly underestimated.

On the basis of dedicated legislation, fiber-cement roofing and other asbestos-containing materials must be adequately managed, through confinement, encapsulation or removal operations, with storage in controlled landfills. According to the ISPRA 2018 n. 285 report on hazardous wastes, in Italy there are only 21 controlled landfills for final disposal of asbestos-containing waste (ACW), but more than 300 temporary storage sites, so that huge amounts of ACW are in fact moved every year to foreign landfills (e.g., Germany). The most striking alternative would be the definitive inertization of ACW, through thermal, termo-chemical and/or thermo-mechanical treatment. Despite the considerable effort paid by the scientific community and the availability of hundreds of patents for asbestos inertization and reuse, there is only one inertization plant functioning throughout Europe (Inertam – Europlasma Group, at Morcenx France). This apparent gap is due to the high costs of the asbestos inertization process which, in almost all the existing patents, requires high processing temperature (higher than 1000 °C) for prolonged time intervals (in the order of tens of hours), thus raising severe cost and sustainability problems.

A very promising (and still unique) advancement for the solution of this problem is provided by a recent patent (UIBM: Invenzione Industriale n°25588/17). The significant innovation of the patent relies in the fact that all asbestos fibers in Eternit-like slates are completely decomposed in an exceptionally short time interval (tens of minutes). For this reason, the patent may represent a convincing, definitive and economically sustainable solution for ACW management. Preliminary experiments has been thoroughly tested at the University of Siena and the complete disappearance of asbestos fibers (both chrysotile and amphiboles) has been certified.

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The project intends to explore the potential reuse of the inert (deactivated) material in several different fields such as ceramic and cement industry, industrial floors, decorative plasters, as filler in high technology elastomers and in refractory materials.

The project will develop according to the following actions, aims and methods:

- 1) Inertization (deactivation) of Eternit-like asbestos-cement slates.
- 2) Continuous check of the treated material through focused mineralogical investigation by means of X-ray Powder Diffraction (XRPD), Scanning (SEM) and Transmission Electron Microscopy (TEM) in order to certify the complete disappearance of asbestos fibers.
- 3) Recycling of the inert material. Definition, execution and implementation of the recycling process through repeated tests in collaboration with suitable companies.
- 4) Characterization of new innovative materials: determination of bulk chemical/mineralogical composition, micro- and nano-structural characteristics (e.g., reaction boundaries, grain size and porosity distribution, amount of amorphous material) of test samples; characterization of physical and mechanical properties, such as compressive strength, porosity, freeze resistance.

The project has therefore two main interconnected goals: i) providing a sustainable solution for the asbestos waste problem; and ii) profitable reuse of deactivated ACW as a secondary raw material. Both aims have positive repercussions in human health, sustainable management of the environment and resources, and therefore circular economy.

2. DEPARTMENT/LABORATORY (*Describe briefly the department/laboratory, where the researcher will be employed, including the research team expertise*)

Department of Physical, Earth and Environmental Sciences, University of Siena (Italy)

Available lab facilities:

TEM/EDS lab (JEOL 2010)

TEM sample preparation lab (PIPS, Duo Mill for Ar⁺ ion milling)

SEM/EDS lab

Optical microscopy lab (polarized light, transmitted and reflected light, 3D KH 7700 Hirox),

X ray Powder Diffraction (XRPD) lab

Chemical lab.

3. Position, scientific requirements (es. n of publications), topic, discipline*:

We seek a candidate for an experimental **Post-doc Position**

*Please tick: (according to scientific subject areas, defined by MSCA):

***Chemistry (CHE)**

***Environment and Geosciences (ENV)**

DESCRIPTION OF THE SUPERVISOR (max. 200 words)/Contact person: (name and e-mail address)

Cecilia Viti email cecilia.viti@unisi.it

Associate Professor in Mineralogy (since 2005) at the Department of Physical, Earth and Environmental Sciences (DSFTA), Siena University.

Main research fields:

- Micro/nanostructures and micro/nanochemistry of geological, experimental, synthetic, environmental, archaeological samples by application of high-resolution analytical transmission electron microscopy (HR-TEM and AEM).
- Serpentine mineralogy and serpentinitic rocks. Asbestos and fibrous minerals.
- Micro/nanostructures, mineral reactions and deformation mechanisms in natural fault rocks and experimentally-deformed rocks.

Author of more than 80 papers in peer-reviewed international journals, among which Nature, Geology, Earth and Planetary Science Letters, American Mineralogy, Contributions to Mineralogy and Petrology, Lithos, Structural Geology.

H index 28 - total publications 86 (WOS source – April 2019)

H index 28 - total publications 82 (Scopus source – April 2019)

International cooperation with members of Earth Science Departments of Prague University, Ostrava University, National Geological Survey of the Czech Republic, ETH Institute of Zurich, JAMSTEC Institute, Japan; Durham University UK; Penn State University, USA; Idaho University; Otago University NZ.

Technical and Scientific Main Responsible of the TEM LAB and ion-milling LAB at the DSFTA, University of Siena.

4. Previous Related Projects / Research Experience

FIRB Progetti Autonomi 2001: Studio nanotessiturale della decorazione a lustro nella ceramica rinascimentale (12 mesi - Responsabile del Progetto).

PAR Progetti Ateneo Siena 2002: Il processo di serpentizzazione: modalità ed origine dei fluidi (12 mesi – Responsabile del Progetto).

PRIN 2004: Mineralogia delle fasi responsabili della mobilizzazione e rimozione dell'arsenico: implicazioni ambientali (24 mesi – Responsabile dell'Unità di Ricerca). 30 nov 2004-30 nov 2006

PRIN 2009 - Not funded (evaluation: 58/60). Titolo del progetto "Reazioni minerali e micro/nanostrutture in rocce di faglia: caratterizzazione dei meccanismi deformativi nella crosta sismogenetica" (proposta come Coordinatore Scientifico Nazionale).

FP7 ERC 2010 StG GLASS: InteGrated Laboratories to investigate the mechanics of ASeismic vs. Seismic faulting. (60 mesi - team member).

Team member of FIRB 2013 - Enrico Mugnaioli.

Marsden application 2015-2018, Marsden fast-start grant, \$300,000 (Responsible Prof. S. Smith Otago University, New Zealand), "Slow Creep or Fast Rupture in Faults? Linking Nature and Experiment to Understand the Earthquake Source". Responsabile dell'Unità di Ricerca Siena: TEM investigations (grant received in 2017).

Admitted to the Italian grant FFABR 2017.

Marsden application (Responsabile Prof. S. Smith – Otago University, New Zealand)- 2019-2021 total grant \$837,000 "Reacting to rupture: the role of chemical reactions in earthquake behaviour at plate boundaries". Unità di Ricerca Siena: TEM investigations.

5. SPECIFIC REQUIREMENTS/PREFERENCES *(Describe the specific requirements/preferences for the MSC fellow if necessary for the development/implementation of the project eg. required language, degree field, research experience, etc.)*

Solid background in electron microscopy (EM) theory.

Skill in EM experimental work (EM sample preparation, SEM and TEM observations)

Expertise and knowledge on inorganic materials (natural and synthetic) and nanomaterials.

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