

# Clays for the Sustainable Anthropocene

(Proposer: Prof. Luca Valentini)

As the World population is approaching 8 billion people (<https://www.census.gov/popclock/world>), two of the most urgent societal and technological challenges to be addressed are demographic growth and urbanization. Urban sprawl has a strong impact on the Anthropocene dynamics, as soil is consumed and landscape is modified by quarrying of raw materials and construction activities. Moreover, the production of building materials such as Portland cement contributes to a large share of the total anthropogenic CO<sub>2</sub> emissions, due to limestone decarbonation ( $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$ ) occurring during the production process. On the other hand, construction materials represent a fundamental resource for our society, since availability of a decent house is a basic human right, considering that about one billion people are still living in slums.

This project will face the challenge of providing low-CO<sub>2</sub> and low-cost building materials for a transition to a sustainable urban future. Calcined clays can potentially play a pivotal role in the future construction industry due to large worldwide availability, moderate cost and small environmental footprint upon thermal treatment. The PhD candidate will select and characterize suitable clay soils by laboratory techniques including XRD, XRF and thermal analysis. The selected clays will then be used to formulate alternative cement binders, using statistical approaches based on experimental design. Specific tests will be carried out in order to reconcile small-scale properties, assessed by lab measurements such as SEM and X-ray tomography, and macroscopic material properties such as mechanical strength, dimensional stability and durability. The relationship between microscopic processes and macroscopic properties will be explored by means of thermodynamic and kinetic models.

Collaborative research will be performed with the Meru University of Science and Technology (Kenya) as part of an Erasmus+ KA107 agreement, by which the PhD candidate will be able to apply for a funded visiting period of three months in the partner institution.

