To the aim of the comprehension of the interactions between minerals and human health, it needs to understand the possible role of the mineral characteristics and the transformations they suffer in various apparatus afterwards their deposition into the organism. Beyond the asbestos and other asbestiform minerals hazard, also respirable silica dust is a crucial frontier in the mechanistic understanding of the interaction between minerals and living matter. Crystalline silica dust (e.g. quartz) is a serious occupational hazard, causing severe lung diseases including cancer. Amorphous silica, the nanomaterial with largest bulk production, is used in many applications, e.g. excipient in drug. Many recent studies aim to correlate relevant surface features with cytotoxicity, cellular uptake, and biocompatibility, that are in turn the outcome of a complex chain of events taking place inside a living cell. The idea for this project is to understand which characteristics control the cells-mineral interactions.

 Samples of amorphous (e.g. opal, pyrogenic and precipitated silica) and crystalline silica polymorphs (e.g. quartz) will be recovered and/or synthetized. Natural –fractured down to respirable size- and synthetic submicrometric samples will be characterized from the mineralogical point of view by using transmission and scanning electron microscopy (TEM, SEM), Raman, chemical analysis (EDS, WDS, XPS). Particles will be in vitro processed at the Department of the Molecular and Clinical Sciences of the Università Politecnica delle Marche and Centre for Toxicology and Applied Pharmacology, Université catholique de Louvain,
Bruxelles. Cell-contacted particles will be further characterized to investigate the possible chemical-physical transformations. The possible transformation models will be verified by studying the crystalline silica recovered from exposed workers (ex-vivo investigations).

Besides, the ability of these mineral particles to interact with various model membranes (erythrocyte or liposome) will be investigated by means of computational modelling of silica surfaces interacting with selected biomolecules and model membranes by molecular dynamics, in order to complement experimental findings and highlight effective interactions (UniTO & Focas Institute, Dublin Institute of Technology, Dublin).

The aim of the project is to reveal the possible chemical, physical, and morphological variations of the silica particles both submitted to the treatment with cells simulating lung environment and extracted by lungs and to describe the interaction with cell membranes. This aim will be reached by the micro-structural, morphological, and chemical characterization of the silica particles.

Le spese di funzionamento del presente progetto di Dottorato saranno finanziate nell’ambito dei fondi di ricerca ex-60% concessi alla prof.ssa E. Belluso.