DISSOLUTION KINETICS OF TREMOLITE IN MIMICKED LUNG FLUIDS. EFFECT OF CITRATE AND OXALATE. PART 1: MACROSCOPIC STUDY

MARISA ROZALEN[1], F. JAVIER HUERTAS[1]*, SAVERIO FIORE[2], FERNANDO GERVILLA[1]

[1]*Instituto Andaluz de Ciencias de la Tierra (CSIC-UGR), Granada, 18002, Spain*
[2]*Istituto di Metodologie per l'Analisi Ambientale- (CNR), Tito Scalo, 85050, Italy*
javierhuertas@ugr.es

Toxicological studies show that interactions between fibrous material and biological environment are strongly dependent on both geometry and crystal chemistry of mineral fibers. Geochemical (in vitro) experiments are essential to understand clearance mechanisms of inhaled particles by human body. The aim of this study is to evaluate tremolite dissolution rates in mimicked human-body conditions, including citrate and oxalate as a proxy for organic acids in alveolar fluids. The effect of citrate and oxalate on the dissolution rate was measured at 37ºC in non-stirred flow-through reactors, using modified Gamble's solutions at pH 4 (macrophages), 7.4 (interstitial fluids) and 5.5 (intermediate check point) containing 0, 0.15, 1.5 and 15 mM of citrate or oxalate. Tremolite from Sierra Nevada (Granada, Spain) was used as a starting material. The logarithm of dissolution rates calculated from Si concentration in the output solutions without organic ligands depend on pH, decreasing when the pH increases from -12.01 (pH 4) to -13.04 (pH 7.4) mol/g·s. Measured Mg/Si ratio shows a preferential release of Mg^{2+} at acid pH decreasing drastically at basic pH. The presence of both ligands enhances dissolution rates at every pH, increasing when the ligand concentration increases until reach approximate one order of magnitude for the highest concentration. Citrate produces a stronger effect as a catalyst than oxalate, mainly at more acidic pHs. The measured Mg/Si ratio in solution is modified by the presence of ligands due to the formation of aqueous complexes or the precipitation of magnesium salts. These results suggest that the ligand-promoted dissolution mechanism promoted needs to be considered in order to quantify asbestos degradation in biological conditions. More studies are necessary to evaluate the species in solution, their interaction with the mineral surface and their role in the dissolution process(es). In this sense electron microscope studies of the solids obtained in these experiments can help us to monitor the changes in fiber morphology induced by the alteration reaction.

Keywords: tremolite, dissolution rate, dissolution mechanism