DISSOLUTION KINETICS OF TREMOLITE IN MIMICKED LUNG FLUIDS. EFFECT OF CITRATE AND OXALATE. PART 2: MICROSCOPIC STUDY

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The increasing concern of the scientific community about ultrafine particles, from different nature, and their harmful effects for human health make necessary to complement classic degradation studies with morphologic studies that help to monitor particle size distribution and identify the most dangerous ones. The aim of this study is to analyze and compare the changes in tremolite particles before and after dissolution in mimicked alveolar fluids, including citrate and oxalate as a proxy for organic acids. Tremolite particles were altered at 37ºC for 2 months in non-stirred flow-through reactors, using modified Gamble's solutions at pH 4 (macrophages) and 7.4 (interstitial fluids) without and with organic acids (15 mM citrate or oxalate). After the alteration samples were deposited on carbon stubs and then coated with a carbon film for SEM study. The raw tremolite is composed of a wide range of fibrous particles (10-340 um in length): big fibers (length:diameter ratio L/D >10, 20-30 um diameter D), thin and long fibers (L/D >50, aprox. 5 um D), cleavage fragments (L/D 2-3, aprox. 30 um D) and fine particles (<20 um L, <4 um D) that are the most abundant. At pH 4, particle surface smooths out and the amount of fine particles decreases significantly. However at pH 7, cleavage fragments with irregular terminations become the most abundant particle type and their surface is extensively etched following c axis direction. Big fibers are almost absent. Ligands produce a decrease in the abundance of big fibers and a prevalence of cleavage fragments. Surface etching is intense, both along cleavage planes and perpendicular to c axis, where the coalesce of etch pits generates cracks. This phenomenon was more developed in oxalate than in citrate solutions. These results suggest that two mechanisms of particle breakage coexist during the process of dissolution. Fibers length decreases by splitting parallel to the main cleavage plane (fiber longitudinal direction), with developments of kinks along the fibers. Coalescence of etch pits perpendicular to c axis induces breakage and particle shortening, particularly intense in the presence of ligands.

Keywords: tremolite, SEM, dissolution mechanism