Abstract
Amphiboles are hydrated mineral silicates five of which occur in asbestiform habits as asbestos grunerite, actinolite asbestos, riebeckite (crocidolite) asbestos, anthophyllite asbestos, tremolite asbestos and actinolite asbestos) and non-asbestiform habits (grunerite, riebeckite, anthophyllite, tremolite and actinolite). The asbestiform varieties are characterized by long, thin fibers while non-asbestiform varieties such as cleavage fragments form short fibers with larger widths. The U.S. regulatory method for counting asbestos fibers (aspect ratio $\geq 3:1$; length $\geq 5 \mu m$) does not distinguish between asbestos and cleavage fragments. The method biases toward increased counts of non-asbestiform cleavage fragments compared to long, thin asbestos fibers. One consequence of this regulatory approach is that workers can be erroneously classified as exposed to concentrations of asbestos (asbestiform amphiboles) above the U.S. 0.1 f/mL exposure standard when in fact they are not exposed to asbestos at all but non-asbestiform amphibole cleavage fragments. Another consequence is that the known carcinogenic effects of asbestos may be falsely attributed to non-asbestiform amphibole cleavage fragments of the same mineral. The purpose of this review is to assess whether amphibole cleavage fragments pose the same risk of lung cancer and mesothelioma characteristic of amphibole asbestos fibers.

Keywords
Amphiboles; Cleavage fragments; Lung cancer; Mesothelioma; Asbestos; Non-asbestiform amphiboles; Grunerite; Talc