Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.30213

Health effects of cristobalite dusts: comparison of their physico-chemical and mineralogical features in different occupational settings

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Long-term investigation of the health effects of exposure to respirable crystalline silica dust has led a significant improvement in knowledge of the specific features that may determine these effects as a variable entity. The molecular and mechanistic foundations of respirable crystalline silica toxicity have been explored both under controlled laboratory conditions and directly in occupational settings, allowing close comparisons between model and real-world exposure conditions.

Because of its abundance and ubiquitous use, quartz would be expected to play a major role in the toxicity issue. However, a number of recent cases of occupational exposure to silica dust have the second most abundant polymorph, cristobalite, in common. All of these cases have occurred in occupational settings not previously claimed as critical for silica risk and in countries where industrial hygiene practices have reduced workers' occupational exposure of to low levels.

In the present contribution, we aim to closely compare the cristobalite-bearing materials coming from three of these recent cases through a thorough multi-method mineralogical and chemical investigation. The materials are the artificial stone, the gold microcasting, and the dental alginate preparation. The specific aim of this study is to compare the results of experimental studies carried out in different contexts where cristobalite is used as a raw material or as a byproduct in industrial production processes. The techniques used are XRD, SEM, TEM, and spectroscopic EPR investigations. The results derived from this comparison have been interpreted in the light of a detailed consideration of the peculiarities of each production line, especially with respect to the steps where a significant dust generation is observed. This comparison suggests that each occupational context is characterised by its own specificity, with the low crystallinity of cristobalite being the only parameter common to all settings. Accordingly, one could infer that the toxicological effects of cristobalite should be sought in the organisation of the surface structural terminations (i.e. the nearly free silanols that act as toxicological primer for quartz), in close relation with the diffuse structural defects observed in all industrially produced/modified cristobalite materials.