



Interaction between calcite $\{10\bar{1}4\}$ surface and Cd-bearing aqueous solutions: An AFM study

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The contamination of natural environments by Cd is especially dangerous because this metal easily incorporates to the alimentary cycle. Recent publications have shown that the interaction between cleavage surfaces of calcite and Cd-bearing aqueous solutions determines a reduction of the bioavailability of this metal as a result of co-precipitation reactions that lead to the formation of layers of the $Cd_xCa_{1-x}CO_3$ solid solution on calcite surface (Prieto et al. 2003, Cubillas et al., 2005). However, although this process leads to a rapid reduction of the concentration of Cd in the aqueous solution during the initial stages of the interaction, calcite cleavage surfaces become inefficient to further remove Cd after a short period of time. Here we present an in situ Atomic Force Microscopy (AFM) study of the molecular mechanisms that control the progressive passivation of calcite $\{10\bar{1}4\}$ surface as a result of the interaction with aqueous solutions containing different amounts of Cd. Our AFM observations demonstrate that Cd-rich islands, approximately 3 nm in height, grow on calcite surface. Those islands are elongated along $[2\bar{2}1]$ direction, showing a clear epitaxial relationship with the substrate. The height of the islands remains almost constant during their lateral advancement and their coalescence leads to the formation of a Cd-rich homogeneous layer, with a composition close to pure otavite ($CdCO_3$), that completely covers calcite cleavage surface. Such nanometric layer armors the calcite substrate from further interaction with the solution, determining the stoppage of the process after a short period of time.

References

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