MS15-P24 Calcite ($CaCO_3$) epitactic overgrowths on anhydrite ($CaSO_4$) cleavage surfaces

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The mineral replacement of calcium sulfate minerals by calcium carbonate phases is a common phenomenon in numerous Earth's surface environments. This process is usually triggered by the presence of carbonate-rich aqueous solutions. It involves dissolution and crystallization reactions that, when finely coupled, lead to the formation of pseudomorphs. Reactions pathways which involve the formation of different calcium carbonate polymorphs have been observed depending on the specific calcium sulfate mineral. When the calcium sulfate mineral is anhydrite ($CaSO_4$; Amma; a = 6.993 Å, b = 6.995 Å, c = 6.245 Å), the initial stages of the replacement reaction are characterized by the simultaneous formation of dissolution pits and the oriented nucleation of calcite ($CaCO_3$; $R\bar{3}c$; a = 4.941 Å, c = 16.864 Å) crystals on anhydrite crystal surfaces. The progress of the coupled dissolution-crystallization reactions eventually results in the formation of calcite pseudomorphs after anhydrite. In this work we investigate the crystallographic relationships observed during the development of these reactions between calcite crystals and the three main anhydrite cleavage surfaces, (100), (010) and (001).

In all the investigated anhydrite cleavage surfaces, calcite crystals dispose one of their{104} faces in contact and parallel to the substrate. In the case of anhydrite (100) surface the better matching occurs with $[001]_{Anh}$, $[011]_{Anh} \parallel \langle\bar{4}41\rangle_{Cal}$, $\langle010\rangle_{Cal}$. As a consequence, most calcite crystals show this orientation. However, for a few calcite crystals the matching occurs so that $[010]_{Anh}$, $[011]_{Anh} \parallel \langle\bar{4}41\rangle_{Cal}$, $\langle010\rangle_{Cal}$. Although this second matching is characterized by a slightly higher misfit, this still is within the limits required for epitactic nucleation from solution. On anhydrite (010) surface, calcite crystals are oriented according to a similar pattern as observed on (100) surface. Most calcite crystals appear oriented so that $[001]_{Anh}$, $[101]_{Anh} \parallel \langle\bar{4}41\rangle_{Cal}$, 2 x $\langle010\rangle_{Cal}$. This orientation provides an excellent matching. However, also in this case a small number of calcite crystals are oriented with $[100]_{Anh}$, $[101]_{Anh} \parallel \langle\bar{4}41\rangle_{Cal}$, 2 x $\langle010\rangle_{Cal}$. Calcite crystals grown on anhydrite (001) also shown two main orientations, with [100]Anh, $[110]_{Anh} \parallel \langle\bar{4}41\rangle_{Cal}$, $\langle010\rangle_{Cal}$ and $[100]_{Anh}$, $[010]_{Anh} \parallel [\bar{4}41]_{Cal}$, $[48\bar{1}]_{Cal}$.

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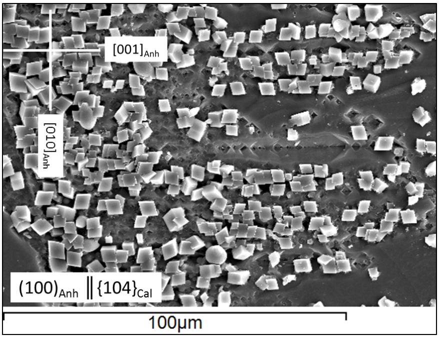

Figure 1. Calcite crystals growing on anhydrite (100) surface. Calcite crystals dispose one of their {104} faces in contact with the substrate. Most of calcite crystals are oriented with $[001]_{Anh}$ and $[011]_{Anh}$ parallel to $\langle-441\rangle_{Cal}$ and $\langle010\rangle_{Cal}$.

Keywords: Anhydrite, calcite, epitaxy, pseudomorph, mineral replacement