Abstract

Calcite is one of the most abundant naturally occurring carbonate minerals in the earth crust, and it is believe to play a crucial role in the long-term effectiveness of geochemical process works such as geological carbon sequestration. Due to the ease in which clean, flat calcite surfaces may be prepared, a lot of dissolution studies have been carried out on its (104) cleavage plane. However in geologic media, natural calcite grains consist of alternate surface terminations that do not display similar crystallographic properties as the (104) cleavage plane. This study focuses on the effect of miscut and step orientation on the long-term dissolution behavior of polished calcite surfaces in close to equilibrium fluid conditions with respect to calcite. The polished calcite surfaces were prepared by tilting the (104) cleavage plane at a varying miscut angle to produce forced obtuse step vicinal, forced acute step vicinal, and fully stepped miscut surfaces. Inductively coupled plasma (ICP) and profilometry results revealed that miscut angle has negligible influence on the average transient, long-term and mean dissolution rates. Furthermore, the ICP and microscopic results from atomic force microscopy (AFM) revealed that in the long-term, crystallographic step orientation is not a dominating influence since all vicinal surfaces as well as the fully stepped surface adopt similar surface morphology and hence exhibit comparable steady dissolution rates. Therefore we conclude that in CO2 sequestration environments, differently terminated calcite surfaces will have similar kinetic behavior in the long-term regardless of their crystallographic properties or step orientation.