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Interfacial processes at dissimilarly charged mineral surfaces in contact – a surface forces apparatus study

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When two mineral surfaces are in close contact, nanometers to microns apart, the proximity of another surface can significantly influence the pathways of chemical reactions happening in the interfacial region. Apart from affecting the kinetics of dissolution and nucleation reactions in spatial confinement, the proximity of charged surfaces can lead to electrochemically induced recrystallization processes. The latter may happen in an asymmetric system, in which two surfaces have a dissimilar surface charge. The charge and mass transferred during electrochemical reactions can induce dissolution or growth of solids and can significantly affect the local topography of surfaces, causing them to smooth out or to roughen. In this work, we present the experimental study of reactive mineral interfaces, immersed in geologically relevant electrolyte solutions, obtained with the electrochemical surface forces apparatus (EC-SFA). EC-SFA setup consists of one mineral surface and one gold surface (working electrode), the surface charge of which is controlled by applying an electrical potential. EC-SFA can, therefore, monitor electrochemically induced surface recrystallization processes. As the SFA technique is based on white light interferometry measurements, the changes in mineral thickness during recrystallization can be determined with an accuracy better than a nanometer over micrometer-large contact regions. Moreover, SFA allows in situ measurement of surface forces acting between mineral surfaces, which can provide additional information about how the surface reactivity influences the cohesion between mineral surfaces by modifying adhesive and repulsive forces acting between them at small separations.