

Interface induced crystallization of carbonate polymorphs

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Carbonate polymorphs occur widely in geological and biological environments. A number of external factors, particularly the presence of organic and biological molecules and templates, are known to be able to effectively direct the crystallization of specific carbonate polymorphs. Here, we conducted crystallization experiments to explore whether minerals through the presence of surface functional groups can selectively induce the crystallization of carbonate polymorphs. Three types of minerals, simple oxide, framework aluminosilicate, and phyllosilicate, were used in this study. Experimental results demonstrate that minerals indeed have the ability to influence carbonate polymorphic formation. For simple metal oxides, it appears that their polymorphic selectivity is related to the minerals' surface charge conditions. Specifically, negatively charged surfaces favor the formation of non-calcite polymorphs while zero or positive charges are more selective for calcite. The charge-polymorph relationship is supported by the results of phyllosilicate experiments, but does not fit to interpret the behavior of silicon oxides. Whereas the presence of permanent structural charges on phyllosilicates may have facilitated the crystallization of non-calcite polymorphs, calcite is the dominant polymorph in silicon oxide experiments despite the negatively charged substrate surfaces. The discrepancy may be related to the more significant dissolution of SiO₂ at alkaline conditions under which carbonate crystallization take place, as suggested by the observations on K-feldspar that show amorphous SiO₂ coating induces preferential formation of calcite.

Unravelling complex magmatic processes using amphibole: A case study from El Misti, Peru

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The prominent role of amphibole in arc magmatic systems has gained renewed focus of late. We report on a study of the 2000 BP eruption of El Misti in Peru in which juvenile blocks reveal heterogeneous crystal populations. Plagioclase crystals suggest multiple populations and generations of antecrysts and phenocrysts. Amphiboles appear to be more restricted and represent two distinct populations of phenocrysts implicating the intimate mingling of two magmas; an amphibole-plagioclase rhyolite and amphibole-plagioclase andesite. Amphiboles in the rhyolites are dominantly pargasitic, with rare ferro-edinites. They contain relatively low Al^{IV} ~1.8, have Mg#s of <70, and are rimmed by reaction products. Amphiboles in the andesite are also dominantly pargasitic and broadly similar to those in the rhyolites, however some cores have lower Al^{IV} ~1.7, but higher Mg#s of 74-75. All crystals in the andesite are euhedral and slightly zoned, but do not contain reaction rims. These characteristics present a conundrum; broadly similar amphiboles are found in equilibrium with two liquids of quite different composition that were erupted simultaneously after the two magmas mingled, yet only the amphiboles in the rhyolite show reaction rims. We will present new results of trace element analyses of amphibole cores and rims using laser ablation ICP-MS techniques that will address the origin of the two populations of amphiboles and the petrogenesis of the system.