

The effect of aspartic acid on dissolution of calcite

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Interactions between some amino acids and crystals of calcium carbonate have been investigated to elucidate the biomineralization mechanism. Among amino acids, aspartic acid (Asp) particularly draws attention because, during the process of biomineralization, some Asp-rich peptides are known to control the polymorphism and structure of calcium carbonate. The present study aimed to clarify the effect of Asp on the dissolution of calcite from measurements of dissolution rate and surface morphology.

The dissolution rates were determined directly from $[Ca^{2+}]$ increasing with calcite dissolution reaction in Asp 0–0.1 M aqueous solutions. Initial condition of reaction solution was adjusted to pH = 8 and ionic strength = 0.1 M using NaOH, HCl, and NaCl. The obtained dissolution rate indicated that Asp inhibited the surface reaction process and accelerated the transport process in calcite dissolution. The crossover of these contrastive effects caused the transition of rate-determining processes of calcite dissolution.

AFM observations of calcite surface in Asp 0–0.1 M aqueous solutions were performed in an AFM flow-through cell. Dissolution rate of calcite was also determined simultaneously from the difference of $[Ca^{2+}]$ between the input and output solutions. The pH of input solution was adjusted to 8 using NaOH and HCl. With increasing [Asp] the obtained dissolution rate increased for [Asp] lower than 0.03 M and decreased for [Asp] higher than 0.03 M. AFM observation revealed that etch-pit density on cleaved surface of calcite increased with [Asp] up to the concentration of 0.03 M. This result is consistent with the [Asp] dependence on the dissolution rate. In addition, we observed not only triangular etch-pit, which was reported by Teng and Dove (1997), but also pentagonal etch-pit in the condition of [Asp] = 0.03–0.07 M. Our study suggests that this morphological change derived from stabilization of [010] step caused by Asp.

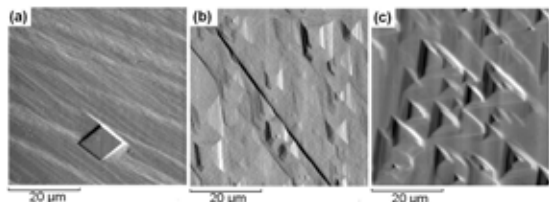


Figure 1: AFM images of cleaved surface of calcite taken at an hour later from starting of dissolution: (a) Asp-free (b) Asp 0.03 M (c) Asp 0.1 M.

Cenozoic alkaline and carbonitic magmatism in northeastern Tibetan Plateau: Implications for mantle plume

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The volcanic rocks of kamafugites and carbonatites outcropped geographically the range of E. 33°50'–34°15' in longitude and N. 104°15'–105°15' in latitude of Western Qinling, Gansu Province, and located in Tianshui-Lixian Cenozoic basin, North-eastern borderary of Tibetan plateau on the geotectonics. The extrusive carbonatites, specially emphasized, have strato-volcanoes and associated with tephra cones, tuff rings, diatremes and contemporaneous kamafugite lava or tuffs. The studies on the mineralogy, petrology show that there are those end members of potassic volcanic rocks, such as mafurite, ugandite, katungite, alnoite, aillikite and calcitite et al. The Ar/Ar isotopic dating for 6 individual phlogopites respectively demonstrate volcanic activity of the kamafugite and carbonatite in west Qinling occurred at Neogene (23Ma).

Both kamafugite and carbonatite are characterized by strong enrichment in incompatible trace elements and LREE. A variable but coherent initial $^{87}Sr/^{86}Sr$ (range is 0.70383–0.71336, mean $^{87}Sr/^{86}Sr$ is 0.70524 for kamafugite and 0.70934 for carbonatite), $^{143}Nd/^{144}Nd$ (range is 0.512221–0.512928, mean $^{143}Nd/^{144}Nd$ is 0.512794 for kamafugite and 0.51261 for carbonatite), and ϵNd (the range is of 1.3–5.58 for kamafugite and 2.4–5.7 for carbonatite), and Pb isotopic ratios (e.g. 18.149–22.4 for $^{206}Pb/^{204}Pb$, 15.476–15.727 for $^{207}Pb/^{204}Pb$, 37.613–39.33 for $^{208}Pb/^{204}Pb$ both kamafugite and carbonatite). The mean ratios of La/Nb, Ba/Nb, Ba/La, Zr/Nb and Sm/Nb are 0.84, 12.7, 15.6, 3.4 and 0.13 for kamafugite, and 1.04, 23.9, 23.6, 5.4 and 0.15 for carbonatite respectively. All of the data plotted respectively in the diagrams of ϵNd vs $^{87}Sr/^{86}Sr$, ϵNd vs Sm/Nb, Zr/Nb vs La/Nb and Ba/La vs Ba/Nb, and fell the area near the OIB and EM1 or EM11. For this reason mentioned above, we suggest that there are mixtures of the endmember composition at least two types of source materials. The geochemical characteristics of the OIB coupled with the geophysical information, temporal and spatial association with collision of Indian and Eurasian continents and strong uplift of Tibetan plateau, are thought to indicate that the WQL kamafugite and carbonatite magmatism formed as a consequence of asthenosphere upwelling pulled by plume.

[1] Yu XH *et al.* *Acta Petrologica Sinica* 17, 366–377. [2] Yu XH *et al.* *Science in China (Series D)* 44, 155–161. [3] Yu XH *et al.* *Acta Petrologica Sinica* 19, 105–112. [4] Yu XH *et al.* *Acta Petrologica Sinica* 20, 483–494.