

Melt extraction and multiple metasomatism beneath French Massif Central: Geochemical and isotopic signatures of ultramafic xenoliths

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Ultramafic xenoliths from Mont Briançon, Ray Pic and Puy Beaunit in the French Massif Central show variable Cr-number of spinels and abundances of HREE in clinopyroxenes (cpx), suggesting a residual origin after various degrees of melt extraction from a fertile peridotite. Pyroxene geothermometer and CO₂ densimeter estimates are 860–1060°C at 0.91–1.10 GPa for southern domain xenoliths (Mont Briançon, and Ray Pic) and 840–940°C at 0.65–0.67 GPa for northern domain xenoliths (Puy Beaunit). Modal compositions, trace element compositions of melt in equilibrium with cpx and Sr–Nd isotopic compositions of cpx suggest the influence of two distinct metasomatic agents and styles: (1) cryptic metasomatism with a component related to the European Asthenospheric Reservoir [1], (2) modal metasomatism with a silicate-rich carbonatite melt related to subducted slab.

Relatively shallow mantle beneath the northern domain is enriched in Sr–Nd isotopic compositions, LILE and LREE with depletion of Zr. Such features were formed by modal metasomatism from a silicate-rich carbonatite melt. Relatively deeper mantle beneath the southern domain is composed of fertile peridotites and is relatively depleted in Sr–Nd isotopic compositions and LILE and LREE, reflecting metasomatism mainly by asthenospheric melts.

[1] Granet *et al.* (1995) *EPSL* **136**, 281-296.

Selectivity in effects of aspartic acid on steps in calcite dissolution

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Interaction between aspartic acid (Asp) and calcite surface has been investigated to elucidate the biomineralization mechanism. Some studies have indicated the selective adsorption of Asp onto the each step of growth hillock and etch pit on calcite surface [1]. However, in most studies, the morphological changes were determined from AFM images, which include some instrumental artifacts.

The present study aimed to determine the effect of L- (or D-) Asp to each step of etch pit in calcite dissolution from *ex-situ* observation using confocal laser scanning microscopy (CLSM) with more accuracy. Step retreat velocity was determined from *in situ* observation using AFM. In the determination of the step retreat velocity, instrumental drift was compensated using morphological information obtained from CLSM measurement.

The etch-pit morphologies changed drastically depending on the L- (or D-) Asp concentration ([Asp]) in the order of rhombus ([Asp] < 0.03 M), pentagon (0.03 M < [Asp] < 0.1 M), and triangle ([Asp] = 0.1 M). The change of obtuse step directions and appearance of the [010] step triggered these morphological changes. Etch pit morphologies in a case of L- or D-Asp were mirror images of one another. The addition of L- (or D-) Asp accelerated all step retreats at [Asp] < 0.01 M [2]. In contrast, at [Asp] > 0.01 M, the retreats of obtuse and [010] steps were inhibited by Asp, whereas the retreat velocities of acute steps were constant irrespective of [Asp]. These results indicated that Asp molecules affect obtuse and [010] steps more strongly than acute steps.

[1] Orme *et al.* (2001) *Nature*, **411**, 775-779. [2] Yoshino & Kagi (2008) *Chem. Lett.* **37**, 508-509.