

Transfer of uranium isotopes, thorium and their decay products to edible plants

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Some of the primordial radionuclides (uranium, thorium and their decay products) are the main source of both external and internal radiation for humans. They can be incorporated metabolically into plants and can be transferred to animals and humans via the foodchain. However, there is a lack of data concerning the Earth crust derived actinides measured in edible plants. Furthermore their main sources as well as their mechanisms of transfer are still misunderstood. Indeed, whereas radionuclides such as uranium and radium would be transferred by root uptake, others radioelements like ²¹⁰Po and ²¹⁰Pb are preferentially carried by atmospheric particles. The aim of this work is firstly to understand the differences in activity between various plants species. The appreciation of the equilibriums and the disequilibriums between radionuclides in the decay series as well as the uptake of radionuclides by roots and the inputs by the atmosphere and irrigation should be taken into account to clarify the transfer mechanisms responsible of these differences. Secondly, the objective consists in studying the variability of natural radioactivity in edible plants, according to uranium content in soils from various areas with different geological characteristic and anthropic influence like the nuclear fuel cycle which may enhance the activity in local foodstuffs.

Fluid-mobile element enrichment in mantle wedge of subduction zones

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Our previous work has shown that supra-subduction zone ophiolites, which form in the mantle wedge of nascent subduction zones, preserve mantle lithologies that formed in response to hydrous melting and represent the refractory residuum of that process [1-3]. In this study we document the a new algorithm for using fluid-mobile element (FME) concentrations in unaltered residual pyroxenes to calculate the composition and flux of slab-derived fluids in the mantle wedge during melting.

We use high-precision laser ablation ICP-MS analyses (Element 2 ICP-MS with 213 nm laser) of relic pyroxenes in supra-subduction zone peridotites for B, Be, Rb, Th, Ba, Li, and Pb – analyzed in conjunction with a suite of non-fluid mobile elements including the REE and high-field strength elements, which are used to assess melt extraction and melt percolation. Pyroxenes in all SSZ ophiolite samples display enrichments in the FME relative to depleted MORB mantle. In contrast, melting models based on the MREE-HREE and HFS elements show that the FME should have concentrations that are effectively zero after significant melting. We derive an algorithm may be used to calculate the FME:

$$C_{wr,add} = [C_{cpx-obs} / \{ [D_{cpx} / (D_{bulk} - PF)] * [1 - (PF/D_{bulk})]^{(1/P)} \}] - [C_{0,wr}]$$

Where $C_{wr,add}$ = concentration of FME added to mantle wedge, $C_{cpx-obs}$ = observed pyroxene, D_{cpx} and D_{bulk} = mineral and bulk partition coefficients, P = melt proportion, and F = melt fraction.

Melt models require enormous fractions of FME if the peridotite and fluid are ‘mixed’ prior to melting. However, if the calculated fluid is added continuously so that it is in equilibrium with the observed refractory pyroxenes, fluid addition models provide reasonable results.

Our results show that high concentrations of fluid-mobile elements in supra-subduction peridotites can be attributed to a flux of aqueous fluid or fluid-rich melt phase derived from the subducting slab. Further, our calculated FME-enriched source yields model melts with the trace element signatures of the arc volcanics.

[1] Choi *et al.* 2008 *Cont Min Pet* **155**, 551–576. [2] Choi *et al.* 2008 *Geology* **36**, 595–598. [3] Jean *et al.* 2010 *Cont Min Pet* **159**, 113–136.