Lawsonite as a potential repository of Th and REE in subduction zones: Blueschists from Tavşanlı (Turkey)

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Constraining the processes by which crust is recycled back through the mantle wedge and into volcanic arcs is one of the most challenging issues in modern geochemistry. Discussion is mostly centered around the dichotomy of fluid vs melt transport and subsolidus dehydration vs melting, in which the mobility of Th and REE has particular significance. In this context, production of fluid or melt by breakdown of hydrous minerals such as lawsonite, and the consequences for trace element mobilization remain largely unconstrained.

Here we combine EMP, LAM-ICP-MS and confocal microRaman spectroscopy with THERMOCALC modelling of four samples of lawsonite and garnet bearing blueschist from the Tavşanlı Zone, Turkey, a melange metamorphosed under blueschist to lawsonite-eclogite facies conditions. Our aim was to monitor trace element redistribution during high-pressure–low-temperature metamorphism. Two samples have low concentrations of Th, REE and K, suggesting an essentially oceanic crust protolith, while the other two samples are enriched in K (up to 2.89% K_2O), Th and REE, implying the presence of a continent-derived terrigenous component.

Equilibrium assemblages are lawsonite + glaucophane + chlorite + phengite + titanite + apatite +/- garnet +/- quartz and iron oxides. Garnet is the major host for HREE, phengite contains most LILE and titanite and zircon are the dominant carriers for Nb, Ta and Zr, Hf, respectively. Lawsonite and apatite carry almost all Sr and a significant proportion of the REE. In Th rich samples, lawsonite is extremely enriched (up to 100 ppm) in Th, giving rise to high Th/La ratios up to 1.0, at relatively low Sm/La (down to 0.4).

The high Th/La ratios observed in lawsonite are significantly higher than in average crust and normal arc volcanics, but similar to those in Mediterranean lamproites, rare ultrapotasic orogenic lavas occurring within Alpine-Hymalayan belt. This “fingerprint” may result from the incorporation of lawsonite-bearing blueschists into their melting source, and subsequent melting. High Th/La can be liberated only by direct melting, ruling out prograde recrystallization into new mineral phases, which redistribute trace elements differently.

Mercury biogeochemistry and its biomagnification in the fish food web in Three Gorges Reservoir after 175m impoundment

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Three Gorges Reservoir (TGR) is a giant canyon-shaped reservoir located in the lower section of the upper reaches of the Yangtze River. Concern about human consumption of fish contaminated with MeHg had been raised even before the construction of TGR. This study tried to investigate the total mercury concentrations in fish and biomagnification characters of mercury along food chains in TGR after 175m impoundment. We collected eleven fish species from three main stem sections and seven typical tributaries of TGR from 2011 to 2012. Result showed that mercury concentrations in fishes from TGR had not obviously increased after impoundment. But spatial difference was found among different sections of main stem. Due to the enhanced sediment deposition along reservoir, there was a decreasing trend of mercury concentration in fish from upper stream to lower stream within TGR. Mercury concentrations in the fishes from Luoqi in up area of reservoir (88.0μg/kg, average) was significantly higher than those from Wushan in middle area of reservoir (43.1μg/kg, average) and tributaries (57.1μg/kg, average). The mercury concentrations in fish from tributaries were comparable to those from main stem, and there were no significant difference among most tributaries. While Log-transformed mercury contents were consistently correlated with $\delta^{15}N$ values for the fish food web in all sampling sites, the slope of the relationship with $\delta^{15}N$ (biomagnification power value) was significant higher in Shennong River than that in Wanzhou and Wushan section. This indicated that biomagnification power of mercury is greater in tributary than in main stem of TGR. Data of $\delta^{15}N$ and $\delta^{13}C$ showed that fishes in tributary rely more on pelagic primary production while those in main stem tend to take allochthonous materials carried by runoff. In conclusion, the difference between body type of tributary and main stem after impoundment may be an important reason of different mercury bioaccumulation within TGR.

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DOI:10.1180/minmag.2013.077.5.23