NanoSIMS mapping combined to in-situ trace element analyses and U-Th-Pb dating in monazite: a chemical record of three successive events.

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Monazite is an accessory mineral used for U-Th-Pb dating usually displaying complex chemical and isotopic zoning reflecting physical and chemical changes in the host rock. Chemical variations in the monazite were described at nm-scale while isotopic variations are known at few μm scale. In order to better understand the ages recorded by monazite it is necessary to obtain informations at smaller scale. In this context, the NanoSIMS appears to be the best suited tool. We present ^{89}Y, ^{139}La, ^{208}Pb, ^{232}Th and ^{238}U, mapping on monazite from metapelitic xenoliths enclosed in andesitic lava (Slovakia). The xenolith/lava interaction is characterized by the growth of a plagioclase-bearing corona surrounding the xenolith and the overgrowth of magmatic garnet on partially resorbed metamorphic garnet. NanoSIMS images and LA-ICP-MS trace elements measurements evidenced variations of the HREE, Y and Eu contents in monazite correlated to breakdown and/or growth of garnet and plagioclase. Three domains have been distinguished: a first one corresponding to the core of the monazite grains is inherited from the metapelite protolith (308 ± 9 Ma) and characterized by low Y, HREE content and low Eu negative anomaly. A second domain crystallized during the growth of the plagioclase magmatic corona (high negative Eu*) and the resorption of the metamorphic garnet (low HREE and Y contents). A third domain crystallized with the presence of the plagioclase corona (high negative Eu*) and during the crystallization of the magmatic garnet (low Y, HREE contents) is dated at 13 ± 5 Ma, i.e. the age of the andesitic lava. Owing to its small size, the second domain was not accurately dated. ^{208}Pb/^{232}Th map performed with NanoSIMS demonstrates that it has the same isotopic ratio and corresponding age than the third domain. Thus monazite is able to track and date all mineralogic reactions occuring in the metapelites during the thermo-metamorphism resulting from xenolith/lava contact.

Detection of a dissolved alpha emitter by electro-precipitation

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The drinking water distribution system is vulnerable to radioactive contaminations which could arise by nuclear accidents or by terrorist's attack. In this regard, alpha emitters (e.g. Po-210, U-235, Np-237, Pu-239, Am-241) could be brought into reservoirs or water treatment plants. The task of our research is the development of an *in situ* measurement system which bases upon electro-precipitation of the dissolved alphas on artificial surfaces.

Therefore, we wanted to figure out which elements in drinking water disturb our measurements. It consists of the sensor (diamond doped Si-waver), $NaNO_3$ as electrolyte and Am-241 as radioactive tracer. Published median or maximum concentrations for European drinking water were the basis for the synthesis of typical or highly concentrated drinking water for main (HCO_3, Ca, SO_4, Cl, Na, K, Mg, NO_3) and minor elements (Sr, F, Ba, PO_4, Zn, B, Br, Cu, I, Fe, Li, Al).

The results (Fig.1) show that the chemical yield is highest (~25%), if there is only the radioactive tracer next to the electrolyte present in solution. The median concentrations of the main and minor elements disturb only slightly while high concentrations of Ca, Mg, F, Ba, PO_4 let the yield decrease significantly, with a loss of up to 50%.

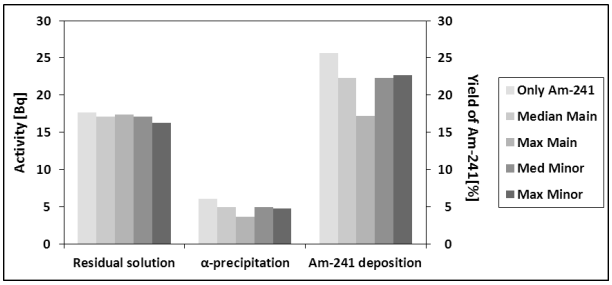

Fig.1: Comparison of the average amount of precipitated Am-241 (initial 21 Bq activity).

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