Heavy metals and artificial radionuclides records in floodplain sediments of the lower Rhône river (South - East France)

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Sediments in lakes and reservoirs [1], former channels [2], floodplains [3] or riverbanks [4] can be used to asses past contamination history.

The goal of this study was to reconstruct the spatial and temporal trends of trace metal elements (Cu, Cd, Cr, Ni, Pb, Zn, Hg) and artificial radionuclides in the lower Rhône river during the past decades. Riverbanks and floodplain alluvial stores located in the Grand and Petit Rhône were sampled by coring. Temporal informations were given aerial photography, sediment stratigraphy and radionuclides measurements (including ^{137}Cs, unsupported ^{210}Pb, ^{238}Pu and $^{239+240}$Pu).

The high variability of sediment deposit was explained by the morphology of the different studied areas and the local impacts of hydraulic managements. Fluvial input of suspended sediment from the Rhône catchment's area, characterized by global atmospheric fallout isotopic signature, was observed in the systems with the lowest sedimentation rates. Trace metal enrichment factors were relatively low: below 2 for Cr and Ni, between 2 and 6 for Cu and Zn and up to 8 for Pb. However, ^{137}Cs activities one to two orders of magnitude higher than recent activities in suspended particles transferred by the river were measured in intermediate layers of a river bank with high vertical accretion. Remobilisation of these sedimentary storages by flood events or erosion may therefore act as a long term delayed source of contaminants.

This work was supported by the French ANR (National Research Agency), contract n° ANR-06-VULN-005, 2007-2010.

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Metasomatism of continental crust during subduction: The UHP whiteschists from the Dora-Maira Massif (Italian Western Alps)

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UHP Prp-whiteschists from the Dora-Maria Massif represent metasomatic rocks originated at the expense of post-Variscan granitoids by the influx of fluids along shear zones. Whiteschists are strongly enriched in Mg and depleted in Na, K, Ca, Ba, LILE (Cs, Pb, Rb, K, Sr, Ba) and Eu with respect to the average continental crust. Three generations of Prp, with different composition and mineral inclusions, have been distinguished: i) prograde PrpI, as, large cores of megablasts and small cores of porphyroblasts; ii) peak PrpII, as inner rims of megablasts and porphyroblasts and cores of small neoblasts; iii) early retrograde PrpIII, locally constituting an outer rim. Two generations of fluid have been recognised: i) a prograde $MgCl_2$-rich brine (6-28 wt% NaCl eq., with Si and Al) trapped during growth of Prp I; ii) a peak alumino-silicate supercritical liquid containing Mg and alkalis, and subordinate P, Cl, S, CO_3^{2-}, LILE (Pb, Cs, Sr, Rb, K, LREE, Ba), Th and U.

We propose a model, that illustrates the prograde metasomatic and metamorphic evolution of the whiteschists. During Alpine metamorphism, the post-Variscan metagranite experienced a prograde metamorphism at HP conditions (stage A: $P \sim 1.6$ GPa and $T \leq 600$°C), as testified by the growth of an Alm-rich garnet in some xenoliths. At stage B (1.7-2.1 GPa and 560-590°C), the influx of external fluids originated from Atg breakdown in subducting oceanic serpentinites, promoted the increase in Mg and the decrease of alkalies in the orthogneiss towards a whiteschist composition. During successive stage C ($2.1 < P < 2.8$ GPa and $590 < T < 650$°C), metasomatic fluid influx, coupled with internal dehydration reactions involving Mg-chlorite, promoted the growth of Prp I in the presence of $MgCl_2$-brine. At the metamorphic peak (stage D: 4.0-4.3 GPa and 730°C), Prp II growth occurred in the presence of a supercritical liquid, mostly generated by internal dehydration reactions involving phlogopite and talc. The contribution of metasomatic external brines at the metamorphic climax appears negligeable.