Influence of deep water formation and boundary scavenging on ^{231}Pa and ^{230}Th distribution in the Mediterranean Sea

M. ROY-BARMAN[1*], S. GDANIEC[1,2,3], L. FOLIOT[1], F. THILL[1], P. BURCKEL[1], P. ANDERSSON[2] M. MÖRTH[3], P. MASQUE[4] AND J. GARCIA-ORNELLA[4]

[1]LSCE (IPSL/LSCE CNRS-CEA-UVSQ), France, Matthieu.Roy-Barman@lsce.ipsl.fr (* presenting author)
[2] Swedish Museum of Natural History, Department of Geosciences, Stockholm, Sweden
[3] Stockholm University, Department of Geological Sciences, S106 91, Stockholm, Sweden,
[4] Departament de Física, Universitat Autònoma de Barcelona, 08193 Bellaterra, Catalunya, Spain

^{231}Pa and ^{230}Th were analyzed in unfiltered seawater and suspended particles collected along the GEOTRACES section of the MedSeA-GA04-S cruise. Seawater concentrations are generally low ($^{231}Pa_{xs}$ =0.08-1.06 fg/kg and $^{230}Th_{xs}$ = 0.6 - 9.4 fg/kg) due to the short water residence time and the high scavenging rate. The $F_{Th/Pa}$ fractionnnation factor is generally low with most values ranging from 1.4 to 4, reflecting a enhanced Pa removal at ocean margins.

Total $^{230}Th_{xs}$ and $^{231}Pa_{xs}$ distributions in the western basin show a clear impact of convective mixing with relatively high surface concentrations, followed by a linear increase through the intermediate waters and constant or slightly decreasing concentrations in the deep water due to homogenization. A balance at the Gibraltar Strait shows that 90 % of the ^{231}Pa and 100 % of the ^{230}Th produced in the Mediterranean Sea is removed to the sediment by scavenging. It implies that low particle settling speed derived from an advection scavenging model (Roy-Barman et al., 2009) are underestimated and that ^{231}Pa and ^{230}Th must be actively removed by boundary scavenging within the Mediterranean Sea possibly in the Alboran basin for example.

The ^{231}Pa and ^{230}Th depth profiles in the eastern basin indicate the presence of young Aegean deep water with low concentrations, while elevated mid-depth concentrations indicate the presence of older uplifted Adriatic water. Contrary to the westen basin, the maximum ^{231}Pa and ^{230}Th concentrations occur at different depths. This reflects Pa-Th fractionation and the faster return of the Th profile towards equilibrium since the easter Mediterranean Transient convective event in the 1990's. A simple sacavenging model representing the transient evolution of the Pa and Th profile is proposed to explain their chromatographic separation.