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Evaluating the behavior of the ^{230}Th and ^{3}He constant flux proxies across a carbonate preservation gradient

IVA TOMCHOVSKA[1], **FRANK PAVIA**[2], WILLIAM R GRAY[3], PATRICK A RAFTER[4], WILLIAM M BERELSON[5], JESS F ADKINS[1] AND KENNETH A. FARLEY[1]

[1]California Institute of Technology
[2]University of Washington
[3]LSCE Laboratoire des Sciences du Climat et de l'Environnement, CEA-CNRS-UVSQ, Université Paris-Saclay
[4]University of South Florida
[5]University of Southern California

Initial excess ^{230}Th ($^{230}Th_{xs,0}$) and extraterrestrial ^{3}He ($^{3}He_{ET}$) are powerful tracers of sediment mass accumulation rate (MAR) in marine sediments. These two "constant flux proxies" can isolate vertical sediment accumulation from lateral transport because they arrive at the seafloor at a nominally constant rate. Any environmental processes causing deviations in the burial flux of ^{230}Th or ^{3}He would cause MARs derived from their measurement to be biased. Previous studies have questioned whether $CaCO_3$ dissolution at the seafloor could bias $^{230}Th_{xs,0}$-based MARs, if ^{230}Th adsorbed onto $CaCO_3$ was released and transported away from a given location following $CaCO_3$ dissolution. Since $^{3}He_{ET}$ is bound in cosmic dust particles and not subject to post-depositional loss during $CaCO_3$ dissolution, it is expected to be insensitive to carbonate dissolution.

We evaluate whether ^{230}Th is lost during $CaCO_3$ dissolution by comparing ^{230}Th and ^{3}He constant flux proxy behavior across a depth and $CaCO_3$ preservation transect on the Cocos Ridge in the eastern Pacific. In-situ porewater analyses directly constrain $CaCO_3$ burial efficiency and dissolution at our core sites. Despite large downcore increases in $CaCO_3$ content at two of our core sites, $^{230}Th_{xs,0}$-derived MARs are consistent with $^{3}He_{ET}$-derived MARs and show no evidence of thorium loss during $CaCO_3$ dissolution even at core sites with $CaCO_3$ burial efficiencies as low as 2%. Our results suggest that any ^{230}Th liberated during $CaCO_3$ dissolution at the seafloor is re-adsorbed locally, and that $^{230}Th_{xs,0}$-based MARs are not biased by $CaCO_3$ dissolution. We end by briefly discussing deglacial patterns of $CaCO_3$ fluxes with depth at the Cocos Ridge and their implications for ocean alkalinity and $CaCO_3$ preservation during the last deglaciation.