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Rare Earth Elements and Nd isotopes as tracers of modern ocean circulation in the central Mediterranean Sea

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Seawater Rare Earth Element (REE) concentrations and Nd isotopic composition (ϵ_{Nd}) are increasingly applied as valuable tracers of oceanographic processes such as water mass mixing and lithogenic inputs to seawater. However, their measurements are basically lacking in the Mediterranean Sea water column. This study analyzes 9 seawater stations around the central Mediterranean Sea to clarify the relative importance of external sources, vertical (biogeochemical) processes and lateral water mass transport in controlling REE and ϵ_{Nd} distributions. Concentrations of REE do not show nutrient-like profiles with depth, likely indicative of relatively young waters with limited accumulation of remineralized REE. Light REE (LREE) present a non-conservative behavior, which largely peak at surface waters and rapidly decrease with depth. The negative correlation of surface LREE enrichment with offshore distance highlights the influence of continental input from the western Italian coast to the Tyrrhenian surface waters. In contrast to other regions with reported boundary exchange, this process does not modify the ϵ_{Nd} values here. On the other side, distributions of dissolved heavy REE (HREE) and ϵ_{Nd} display a conservative behavior that can be explained by mixing of western- (MAW and WMDW) and eastern- (LIW and EMDW) originated waters. We test this hypothesis with an Optimum Multi-Parameter Analysis (OMPA) including HREE and ϵ_{Nd} parameters. Even though the limited data set, consistent results of water mass fractions are obtained for the four main water masses although with some particularities. While LIW take on major importance when considering HREE in the model, EMDW fractions are preferentially detected with ϵ_{Nd} . This latter finding implies a noticeable deep water flux across the Sicily Strait into the Western Mediterranean that was not clearly evidenced before.

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