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High Field Strength Elements Zr, Nb, Hf, and W as Ocean Tracers: Distributions and Processes in the Southern Pacific Ocean

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The High Field Strength Elements (HFSE), including zirconium (Zr), niobium (Nb), hafnium (Hf), and tungsten (W), are promising tracers for understanding physical and chemical processes in marine environments. These elements are gaining importance due to their increasing use in modern technologies, such as electronics and medical devices, making it essential to study their marine distributions and behaviour. Despite their potential as ocean tracers and their industrial applications, HFSE distributions in seawater remain poorly understood due to their low concentrations and challenges in analytical determination. This study focuses on Zr, Nb, Hf, W concentrations in the Southern Pacific Ocean, using seawater samples collected during the SO289 cruise (GEOTRACES cruise GP21).

After the cruise, the samples were transported to the laboratory, acidified with hydrofluoric acid (HF), and left to equilibrate for over five months. They were then preconcentrated using a refined SeaFAST Offline preconcentration method with NOBIAS resin, followed by analysis with ICP-MS. The method was optimized for the offline preconcentration mode of SeaFAST. A 3.5 mol/kg ammonium acetate buffer (pH 6.0 ± 0.05) was used for column conditioning. An elution acid mixture (1.5 mol/kg HNO_3 – 0.05 mol/kg HF) ensured more effective elution of the analyzed elements.

Influences from hydrothermal inputs, atmospheric dust deposition, and upwelling processes will be explored as potential factors affecting HFSE distribution. While detailed patterns are yet to be confirmed, the first results show an increase of concentrations with depth for Zr and Hf, a largely conservative behaviour of W and also a rather constant depth distribution for Nb, although with more variability as compared to W. Higher concentrations in surface waters indicate the potential role of dust input as a source of these elements.