

Relation between NO_3^- and ClO_4^- occurrence in the environment

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There is a positive correlation between the concentrations of natural ClO_4^- and NO_3^- from a wide range of geographical locations and environments. Sample concentrations of ClO_4^- can vary by over 5 orders of magnitude. This relationship appears to be valid for both soil and groundwater samples in semi-arid and arid areas around the world. A conceptually simple explanation is evaporative concentration of atmospheric deposition. This is supported by $\text{NO}_3^-/\text{ClO}_4^-$ molar ratios in wet deposition that are generally consistent with measured ratios in most soil and groundwater samples. However, NO_3^- in all but a few of these occurrences is largely biogenic with only a small fraction of atmospheric NO_3^- . In samples having a substantial atmospheric NO_3^- component, ratios are generally similar with the exception of samples from the Atacama Desert (Chile) in which ClO_4^- is enriched relative to NO_3^- . By systematically exploring the relation between NO_3^- and ClO_4^- occurrence in a variety of environments and simultaneously evaluating the source of the NO_3^- by isotopic analysis, we may gain a more complete understanding of the controls of ClO_4^- occurrence and stability in the environment.

Re-Os reveals ancient mantle components in xenoliths from the Cook-Australs and Samoan hotspots

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Peridotite mantle xenoliths hosted in ocean island lavas offer a means to directly sample the composition of the upper mantle beneath hotspots. Re-Os systematics can be used to investigate ancient depletion events recorded in mantle peridotites. Recently erupted, rejuvenated lavas from the Samoan island of Savai'i and 6-10 myr old lavas from Cook-Austral island of Tubuai host mantle peridotite xenoliths. Extreme isotopic and trace element compositions were identified in a subset of mantle xenoliths from both islands, and they are similar to the EM2 (enriched mantle II) and HIMU (high $^{238}\text{U}/^{204}\text{Pb}$, or ' μ ') mantle endmembers [1]. Os-isotopes have only been reported for a single trace-element enriched xenolith from each island ($^{187}\text{Os}/^{188}\text{Os} = 0.1284$ and 0.1285) [1]. In order to explore the possible range of Os-isotopic variability at both localities, we expanded this initial work to include xenoliths that exhibit a greater range in trace element variability and mineralogy.

Here we report $^{187}\text{Os}/^{188}\text{Os}$ ratios on 12 xenoliths from Savai'i and 8 xenoliths from Tubuai. All xenoliths are opx-bearing. Nd/Yb ratios in clinopyroxene (cpx) separates vary by two orders of magnitude in the xenolith suites from both localities. Xenoliths from Tubuai exhibit $^{187}\text{Os}/^{188}\text{Os}$ from 0.1163 to 0.1304, and Samoan xenoliths span a smaller range (0.1188 to 0.1284). Four xenoliths from Samoa exhibit $^{187}\text{Os}/^{188}\text{Os} < 0.120$, but only 1 xenolith analyzed from Tubuai falls below this isotopic composition. This unusual Tubuai xenolith has a high modal abundance of cpx (23%) that is >4 times higher than in the other Tubuai and Savai'i xenoliths. It is not yet clear why the unusual mineralogy should be associated with unradiogenic $^{187}\text{Os}/^{188}\text{Os}$ in this important sample.

If the xenoliths originated in the oceanic mantle lithosphere, the unradiogenic $^{187}\text{Os}/^{188}\text{Os}$ at both localities may relate to preexisting heterogeneities in the upper mantle that have been modified by recent, plume-related metasomatic processes. It is possible that the unradiogenic Os component in the xenoliths relates to subcontinental lithospheric mantle, ancient plume residues or regions of ancient melt depletion preserved in the depleted MORB mantle.

[1] Hauri *et al.* (1993) *Nature* **365**, 221–227.