Large iron isotope fractionation at the oxic-anoxic boundary in Lake Nyos

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Lake Nyos is a volcanic crater lake in northwest Cameroon, which suffered a sudden catastrophic release of CO_2 in 1986 that killed about 1700 people. It is permanently stratified with an oxidized epilimnion of about 55 m magnitude during overturn in the dry season. Its deep water contains high concentrations of $CO_{2(aq)}$, HCO_3, Ca, Mg and Fe and its composition is governed by the dissolution of local rock. It is continuously fed by a source of warm water with a high partial pressure of geogenic CO_2, which accumulates in the deep water of the lake. To avoid the recurrence of a catastrophic CO_2 outgassing, the lake is now artificially degassed by a tube that drains water from 203 m depth to the surface.

The degassing of Lake Nyos provides the opportunity to study the strong isotopic variation of dissolved Fe(II) and to identify the governing processes by reaction-transport modeling. Two depth profiles sampled in the lake in March 2004 and 2005 reveal an increase in iron concentrations and δ^{57}Fe from 1.6 mg L^{-1} and −1.88 ‰ at 55 m to 344 mg L^{-1} and +0.83 ‰ at 210 m, respectively. A steep increase in δ^{57}Fe was observed across the oxic-anoxic boundary.

As many biological and geochemical processes are known to fractionate Fe isotopes, we used a calibrated reaction-transport model to disentangle the processes governing the Fe cycle. The model combines the isotopic signatures of dissolved Fe(II) and settling Fe(III) particles with the concentration profiles and settling fluxes of the Fe particles in the lake.

We explore the possible processes that could create the δ^{57}Fe depth profile, with empasis on the large shift across the oxic-anoxic boundary.

Tectonostratigraphic controls on the localization of Archaean komatiite-hosted nickel-sulphide deposits and camps in the Yilgarn Craton

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Komatiite-hosted nickel-sulfide deposits in Archaean granite-greenstone terrains generally occur in clusters. We investigate the early craton-scale litosphere architecture that favoured the emplacement of large komatiite systems and the development of nickel-sulfide deposits and camps in the Yilgarn Craton in Western Australia. Our investigation to date focus on the 2.9 Ga belts of the Youanmi Terrain. The combination of belt-scale tectonostratigraphic reconstructions and chemiostratigraphic studies of mafic and ultramafic volcanic assemblages point toward a complex stratigraphic evolution. From the Marda Complex in the north to the Ravebthorpe greenstone belt in the south, the supracrustal greenstone pile varies considerably along strike: Barberton-type komatiites are dominantly present in the north, whereas Munro-type sequences are located mostly in the south. In addition, the greenstone stratigraphy is dominated by tholeiites in the north, whereas the ultramafic rocks are dominant in the south. We argue that this broad setting may reflect a larger-scale lithospheric architectural control which may be essential to the onset of nickel mineralisation.

We report U-Pb SHRIMP ages on zircon grains from coherent and volcaniclastic dacites along the Lake Johnston Greenstone Belt, where the Maggie Hays deposit is located, of 2920 ± 10 Ma for the coherent sequences and 2873 ± 4 Ma for the volcaniclastic rocks. In-situ Lu-Hf isotopic data on zircon grains from the dacites display epsilon Hf values ranging between 0 and -10. The results exhibit an intermediate signature between a juvenile and a reworked older source.

The significance of the genetic and spatial relationship between komatiites and felsic sequences in the 2.9 Ga belts of the Youanmi Terrain is currently being investigated, because it bears significant similarities with the 2.7 Ga belts of the Eastern Goldfields where numerous world-class Ni deposits are hosted.