

The biogeochemistry and speciation of Fe in the Sea of Galilee (Lake Kinneret)

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Iron, the fourth most abundant element in earth's crust, is one of the least soluble metals in oxic surface waters. Since only dissolved Fe is available for uptake by phytoplankton, the biological demand for Fe can not be met in many aquatic ecosystems. In addition, a growing body of evidence has been linking the redox transformations between the dominant, insoluble Fe(III) and soluble Fe(II) and the bioavailability of Fe in oxygenated waters. This study explores the dynamic biogeochemical cycle of Fe in Lake Kinneret, including the lake's Fe budget, physico-chemical speciation of Fe, its interactions with algae including Fe availability, and its redox transformations.

Thirty one detailed lake water profiles were sampled between 1998 and 2001 to determine Fe concentrations and its distribution between particulate, dissolved, reactive (oxine-labile), and Fe(II) fractions. The lake's total Fe is dominated by Jordan River inputs, as shown by the remarkable agreement between river water discharge and Lake Kinneret Fe inventories. These findings imply that other Fe sources like eolian dust, sediment resuspension, and Fe mobilization from the sediments, are of minor importance. The behavior of Fe in the lake was compared with other trace elements and nutrients, and a conceptual approach for describing the behavior of these elements in lake water was developed.

Particulate Fe is the predominant form of Fe in Lake Kinneret. Particulate Fe should not be directly available for phytoplankton, thus confining the bioavailable pool to dissolved Fe (as Fe(III) and Fe(II)) and to easily dissolved reactive particulate Fe. The fraction of reactive Fe, tested by ligand competition with oxine, ranges from winter minimum of 10% to summer maximum of 70%. This high Fe reactivity might explain the linear relation between dissolved and particulate Fe concentrations throughout the study.

The measured nanomolar concentrations of dissolved Fe can only be explained by the presence of yet unidentified strong complexing organic ligand, probably of anthropogenic (agriculture/domestic) origin. The thermodynamically unexpected high Fe(II) concentrations detected in the oxygenated surface waters of Lake Kinneret are related to algal-mediated redox transformations. This biological-mediated redox cycle was extensively studied, combining field-measured Fe(II) concentrations with laboratory experiments of bio-mediated Fe(III) reduction and bio-retardation of Fe(II) oxidation.

Geochemical and geochronological investigations of TTG rocks from the Ntem Complex, Congo craton and implications for post magmatic evolution

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TTG rocks [1,2] from the Sangmelima region of the Ntem complex (Congo craton) range in modal composition from rocks of the charnockitic suite of low water activity formational conditions (presence of hypersthene), to tonalites and granodiorites. They display a wide spectrum of SiO₂ composition (54–74 wt%), defining intermediate varieties that tend to be metaluminous (0.56 < A/CNK < 1) and acid varieties that are essentially peraluminous (1 < A/CNK < 1.08). Members of the charnockitic and tonalitic suites represent a typical trondhjemitic differentiation trend as found elsewhere in the Ntem Complex [1] while granodiorites portray a slight potassic calc-alkaline affinity. Their trace element abundances are characterized by a negative anomaly in Nb. REE degree of fractionation (La_N/Yb_N) varies from 2-28 in the charnockitic suite, 12-114 in the tonalitic suite to 18-99 in granodiorites. Samples with overall least abundance in REE show a positive Eu anomaly and most likely represent first partial melts of the protolithic source. Sr and Nd isotopic systematics coupled with Mg#-SiO₂ compositions as well as trace element signature (negative Nb anomaly) for investigated samples are consistent with derivation from melts of a subducted basaltic crust, metamorphosed in the eclogite facies [3].

U-Pb conventional data from charnockitic and granodioritic members indicate emplacement timing of 2984 ± 24 Ma and 3094 ± 37 Ma, respectively. In the concordia diagram, data points plot close to the lower intercepts of 499 ± 33 Ma for the charnockitic suite and 565 ± 41 Ma for granodiorites, indicating considerable Pb-loss during the Pan-African orogeny (most likely through leaching by circulating fluids). Most ²⁰⁷Pb/²⁰⁶Pb zircon evaporation data show a large scatter between 2900 Ma and 2700 Ma, probably indicating various degrees of radiogenic Pb loss. Some older ²⁰⁷Pb/²⁰⁶Pb zircon evaporation data (2960 ± 10 Ma to 3016 ± 10 Ma) are however identical with U-Pb conventional data and therefore seem to reflect the crystallization timing for these rocks. Biotite Rb-Sr systematics on the other hand portray young ages of 1997 ± 19 Ma, 2064 ± 20 Ma and 2299 ± 22 Ma that we interpret as reset ages which accordingly are a signature of Eburnean reheating in the Ntem complex.

References

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