Coupled biological, geochemical and physical processes in acidic mine lakes: Model development and application.

S.U. Salmon[1], C.E. Oldham[2] and M. Hipsey[3]

[1]School of Environmental Systems Engineering, University of Western Australia, (ursula.salmon@uwa.edu.au)
[2]School of Environmental Systems Engineering, Univrsity of Western Australia, (carolyn.oldham@uwa.edu.au)
[3]Centre for Water Research, Univrsity of Western Australia, (hipsey@cwr.uwa.edu.au)

Existing water quality models for aquatic ecology and hydrodynamics have been extended to include representation of (bio)geochemical processes of relevance for acidic lakes and their sediments. The developed model allows quantitative investigation of biological, geochemical, and physical processes and their intereactions, to assess controls on key water quality parameters, such as acidity.

The initial case study for model development was acidic Lake Kepwari, a decommissioned and flooded coal mine pit in Collie, southern Western Australia. Largely without calibration, the numerical model prediction of Lake Kepwari water quality over an annual cycle closely reproduced the patterns of stratification and overturn observed in the lake, as well as evapoconcentration. The model also reproduced major temporal and spatial patterns for non-conservative species, such as NH4, DOC, pH and Al. A sensitivity analysis indicated that even though the lake is now at full capacity, surface and groundwater inflows may still be important factors in the long-term evolution of the lake water quality. The model also allowed us to test the importance of geochemical processes for lake water quality, for example solubility equilibrium control of pH by Al hydroxide phases.

The modelling study of Lake Kepwari demonstrated the capability of the model to reproduce the main features of the current water quality in the lake, and highlighted the need for testing against data sets which include e.g. well-constrained water and mass balances over the lake.

It should be noted that the generic process descriptions in the developed model can be applied to almost any aquatic system. While the initial field site was a coal mine pit lake, the model is based on sophisticated process description and parameterisation; this allows immediate application to mine lakes of widely varying water quality.

We now require a comprehensive validation exercise of model predictions against high quality datasets from acidic water bodies; it is essential to increase our confidence in the simulation results. In particular, there is a need for testing model performance against long-term data sets from acidic systems with well constrained groundwater inflow, sediment fluxes and aquatic food web data, as well as hydrodynamic and geochemical state variables. The result will be an improved tool for management and remediation of acidic water bodies, including design optimisation for future field and laboratory sampling campaigns.

U-Pb age and REE data (SHRIMP II) on zircons in mantle xenoliths from alkaline basalts (Vitim area, Transbaikalia): Implication for the upper mantle partial melting

A. K. Saltykova [1], L. P. Nikitina [2] and D.I. Matukov[1]

[1]Centre of Isotopic Research,VSEGEI, St.Petersburg, Russia; (Anna_Saltykova@vsegei.ru)
[2]IPGG RAS, St-Petersburg, Russia; (PN@LN10839.spb.edu)

Isotope dating of the upper mantle ultramafic rocks is difficult because their isotope systems are disturbed and mineral isochrones yield volcanic episode age. We report the U-Pb age and REE pattern of zircons from peridotite nodules in Cenozoic alkaline basalts of the Vitim volcanic area to display complicated evolution of the upper mantle.

The zircons 0.06 – 012 mm size were separated from nonmagnetic heavy concentrate. U-Pb and REE analyses have been curried out using SHRIMP-II in the CIR VSEGEI.

The protogranular spinel-garnet peridotite formed at P-T conditions of 45-50 kbar and 1400-1500 ^{o}C (data on Gar – Opx equilibria, Nikitina, 2000) bears prismatic or rounded zircons, colorless, with abundant fluid-melt and mineral inclusions. CL – images show their oscillatory and sectorial growth zoning and convolut recrystallization domains.

The dating results are grouped in four age-spans with concordant $^{206}Pb/^{238}U$ ages of 1462±19 - 1506±4.0 (PR_2), 264.0±7.3- 295.7±0.76 Ma (P_1), 164.6±1.6 – 183.4±2.0 (J_2) and 135.5±2.7 to 141±3 Ma (K_1). Regression through two discordant data points has lower intercept of 138,0±5,7 Ma falling within K_1 age group. Its upper intercept of 1891±26 overlaps with other Proterozoic $^{207}Pb/^{206}Pb$ ages, ranging 1835 -1955 Ma. No volcanic episode age (48 – 28 Ma, Ionov *et al*. 1992) was noticed.

Chondrite-normalized REE distribution patterns in zircons show a LREE and HREE enrichment up to 100 and 1000 normalized units respectively. They are complicated by Ce maximum and Eu minimum. Total REE content and magnitude of the Eu anomaly increase with the age.

The ages obtaned are in agreement with main Phanerozoic intraplate magmatic events in the Central Asia region (Yarmoljuk *et al*., 2000). The studied zircons crystallized during partial melting of the peridotites initiated by gas-saturated fluid. Variation of the REE pattern with the zircon age indicates the multiple partial melting.

References

Ionov D. A., Jagoutz E., (1992), *DAN 301, 1195-1199 (in rus.)*.
Yarmoljuk *et al*., (2000), *Geotectocs*, **5,** 3-29 1199 (in rus.)
Nikitina L. P., (2000), *Theophrastum contr.*, **3**, 44-53