Riparian soils control metal loading of natural organic carrier phases

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Dissolved organic carbon (DOC) originating from wetland and riparian soils is known to effectively bind rare earth elements, uranium, aluminum and iron and play an important role for the mobilization and transport of these elements from soils to the surface waters [1]. In this study we present long-term data from 15 nested streams and several riparian soils draining granitic till covered soils ranging over almost three pH units. We analyze for which metals dissolved organic matter can function as carrier across scales and during varying hydrochemical conditions.

Metal loading (mM Metal per mM Carbon) in the various subcatchment changes over scales in a very characteristic manner that is dominated by the relative distribution of the three prevailing landscape types: forest, wetland and sediment area. The almost constant relationship between La and U loading of organic matter throughout the whole $68 km^2$ large catchment is controlled by homogeneous mineralogy in the source areas, flow pathways and metal release in the riparian soils.

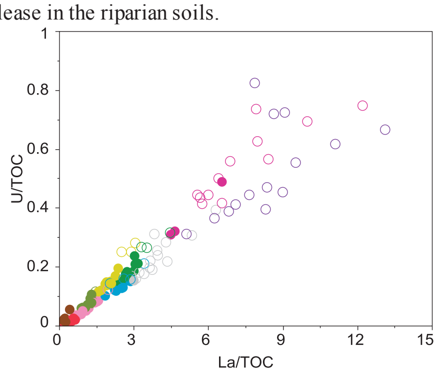

Fig. 1 Organic matter loading of U and La at all sites.

Soil solution data from one detailed soil catena along a hypothetical flowline indicate that organic matter leaches increasing amounts of trace metals during the riparian soil passage. The very similar Al and Fe loadings from 10 other riparian soils from different subcatchments are in accordance with the gradual change observed in the above transect for Al [2]. Our experimental data for metal speciation are in general accordance with those modelled using Visual Minteq [3] and confirm the importance of organic matter for metal mobility across scales from riparian soils.

[1] Andersson, K. et al. (2006) GCA, **70** (13), 3261-3274. [2] Cory, N. et al. JGR-Biogeosciences 2007, **112** (G3). [3] Gustafsson, J. P. et al. (2003) *Environ. Sci. Technol.*, **37** (12), 2767-2774.

Multiple growth events in diamonds from Murowa; evidence from FTIR mapping of N and H defects.

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The Murowa kimberlites [1] are located near the southern edge of the Zimbabwe craton. The few available measured ages suggest that the xenoliths and diamonds in the kimberlites date to 3.2 Ga and the kimberlite exhumation dates to 0.5 Ga, giving a residence time in the mantle for the diamonds of 2.7 Ga [2].

Here, we present FTIR maps of Murowa diamonds that show a range of growth histories. Whereas most diamonds show uninturrupted octahedral growth, or transitions from cubic to octahedral growth, a few show very clear evidence for at least two growth events. For example, one diamond (Mur-82) contains 130 ppm N in the core which is 82% aggregated to B centres, and a rim zone with 630 ppm N and only 16% aggregation. If both core and rim are assumed to be close in age, with a mantle residence time of 2.7 Ga, the core gives a temperature of 1205°C and the rim a temperature of 1087°C. A drop in lithospheric temperature of 120°C over a short time scale seems unlikely, so alternative scenarios with various combinations of temperature evolution through the period of growth have been modelled. Consideration of both the nitrogen aggregation zoning in individual diamonds, and the residence temperatures obtained for the collection of diamonds as a whole suggests that more than one period of diamond growth may be sampled. The implications of the results to models of the evolution of the craton (e.g. [3]) will be discussed. Detailed maps of hydrogen incorporated in diamond can also be obtained, and in some cases (e.g. Fig. 1) there is a hydrogen-rich zone or overgrowth at the rim. This implies a late stage growth event, possibly from a hydrogen-rich fluid.

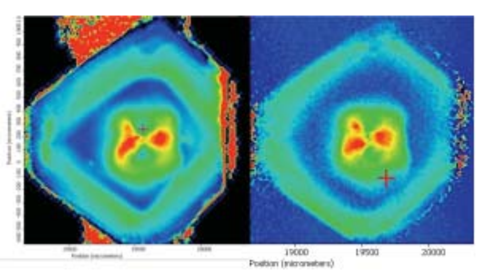

Figure 1: Contoured map of nitrogen concentration (left) and hydrogen concentration (right) in diamond Mur-79 . The diamond shows a transition from N and H rich cubic-growth core to octahedral-growth rim. Note also that the N-rich zone in the rim does not coincide with the H-rich zone at the very outer edge.

[1] Smith C.B. et al. (2004) *Lithos* **76** 219-232. [2] Smith C.B. et al. (2009) *Lithos* **112S**, 1120-1132. [3] Shirey (2004) *Lithos* **77**, 923-944.