Multi-scale segmentation of global continental and coastal waters: typological analysis and application to the carbon budget

HANS H. DÜRR[1*], GOULVEN G. LARUELLE[2], RONNY LAUERWALD[3], JENS HARTMANN[3], PIERRE REGNIER[2], AND CAROLINE P. SLOMP[4]

[1]Ecohydrology Research Group, Earth and Environmental Sciences, University of Waterloo, Canada, hhduerr@gmail.com (* presenting author)

[2]Biogeochemical Modelling of the Earth System, Dept. of Earth & Environmental Scences, Université Libre de Bruxelles, Belgium Goulven.Gildas.Laruelle@ulb.ac.be, pregnier@ulb.ac.be

[3] Institute for Biogeochemistry and Marine Chemistry, KlimaCampus, Universität Hamburg, Germany, geo@hattes.de, ronny.lauerwald@zmaw.de

[4]Faculty of Geosciences, Utrecht University, The Netherlands, c.p.slomp@uu.nl

Abstract

The coastline of the Earth is over 400 000 km long and about 40% of the world's population lives within 100 km of the coast. Segmentations of the global coastline and their classification into various coastal settings can be derived from a continental perspective based on an analysis of river basin properties (COSCATS) [1], from an estuarine point of view (typology of estuarine systems) [2] or from an oceanic perspective, constructed around a regionalization of the near-shore and distal continental margins (LME) [3]. Here, we present an overview of recent efforts to characterize the whole aquatic continuum using comprehensive geographical units which retain the most important physical characteristics of the land/river, near-shore, and shelf areas.

Geographic and hydrologic parameters such as the surface area, volume and fresh water residence time are calculated for each coastal unit. Next, a multi-scale typological analysis is used to classify river basins, estuaries and continental shelf seas according to climatic, lithologic, morphologic and hydrodynamic criteria of both land and sea.

We combine the different approaches with global databases (GLORICH, GlobalNEWS, SOCAT) to extend the quantification of lateral carbon and nutrient fluxes and establish regional carbon budgets. Applications relate to coastal sciences at local, regional or global scales (e.g., budget calculations, model parameterisations, scaling of local estimates) such as i) GIS-based modeling of carbon routing showing e.g., that 2/3 of the organic carbon delivered by rivers transit through estuarine filters where further processing occurs while the remaining 1/3 directly reaches continental shelf seas, ii) regionalized estimates of the contribution of estuarine systems (small deltas, tidal systems, lagoons, fjords) and continental shelf seas to atmospheric CO_2 exchanges, iii) first steps towards a regionalization of the coastal CH_4 fluxes to the atmosphere.

[1] Meybeck *et al.* (2006) *GBC* **20**. [2] Dürr *et al.* (2011) *ESCO* **34**, 441-458. [3] Liu *et al.* (2010) *IGBP Series*, 515-527.

Using garnet to record mineralization in a BIF hosted orogenic Au deposit

JASON DUFF[1*], KEIKO HATTORI[1], DAVID A. SCHNEIDER[1], ÉLISE COSSETTE[1], SIMON JACKSON[2], AND JOHN BICZOK[3]

[1]Department of Earth Sciences, University of Ottawa, (jduff018@uottawa.ca (* presenting author), khattori@uottawa.ca, david.schneider@uottawa.ca, ecoss075@uottawa.ca)

[2]Geological Survey of Canada, Ottawa Simon. Jackson@NRCan-RNCan.gc.ca

[3]Goldcorp Inc., Musselwhite Mine John.Biczok@golcorp.com

The origin of Archean banded-iron formation (BIF) hosted Au deposits are enigmatic and remain highly controversial. Although they are classified as an orogenic Au deposits, the origin of the fluids (magmatic vs. metamorphic) is still in discussion. In an attempt resolve this debate, we present major and minor element compositions of garnet determined by LA-ICP MS and EPMA, from the Musselwhite deposit in the North Caribou greenstone belt, Western Superior Province. The deposit occurs within meta-(chemical) sedimentary rocks, which are enveloped by amphibolite grade mafic to ultramafic rocks. Samples were collected from auriferous garnet -grunerite schist, footwall and hanging wall schist in the mine, as well as auriferous schist from north of Opapimiskan Lake. A sample was also collected from the non-mineralized chemical sedimentary bed that is continuous 24 km from the deposit. Major elements of garnet from mineralized rock show Mn-rich cores (18-25 % Sps component) and Mg (8-15 % Pyp component) and CaO rich rims. The latter is atypical for normal growth zoning in garnet. Mineralized samples show high Eu/Eu* values ranging from 6.34-1.26 in the ore zone in the mine to ~1 to 2.98 from north of Opapimiskan Lake. Low Eu anomalies occur in the non-mineralized sample (Eu/Eu*= 0.706-2.19). The majority of garnet grains show high HREE concentrations with a mean $(Sm/Lu)_{CN}$ value of 1.6 and low LREE (ΣHREE/ΣLREE = 41). Rims of garnet from mineralized samples show large variation in Ni/MgO from ~ 0.14 to 15.5, and Y concentrations from ~ 0.89 to 198 ppm. The high Ni and low MgO are recorded in the core of these grains from the ore zone, whereas their rims show low Ni. Trace element zonation in garnet from the non-mineralized rocks is minor compared to the auriferous samples. The data suggest that garnet growth was contemporaneous with the precipitation of pyrrhotite and chalcopyrite; both sulfides are closely associated with the introduction of Au. Gold-bearing fluid was derived from rocks during metamorphism or extensive alteration of mafic rocks as reflected by variably high Eu/Eu* values and calcic rich rims in the garnet crystals in the mineralized rocks. Results presented here indicate that garnet effectively records the history of hydrothermal activity associated with Au deposits and the data are consistent metamorphic fluid as the principle transporter of Au at Musselwhite.