Orogenic sources and sinks of CO_2: The Himalayan example

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The Himalayan orogeny has generated major changes in the Earth surface processes that affect the carbon cycle through various processes. Erosion triggered long term enhancement of silicate weathering and organic carbon burial that tend to consume atmospheric CO_2. Erosion also tend to return CO_2 by oxidation of fossil organic carbon. Finally, orogeny also generates metamorphism of carbonated formation that release massive fluxes of CO_2. While these processes have been active for at least 20 million years, their modern fluxes are still difficult to assess.

Geochemical signatures of modern river sediments allow quantifying fluxes of organic carbon and losses of mobile elements. Their compositions are governed primarily by mineral sorting processes occurring during transport. However these are well correlated to simple parameters such as Al/Si ratios and allow very accurate inter-comparison of sediments. Differences between river sediments and source rocks allow to quantify losses and gain of elements resulting of weathering, soil, and transport processes.

Following this approach, silicate weathering is mostly linked to alkaline silicate weathering. This strongly limits the efficiency in term of long-term CO_2 uptake as alkaline cations further undergo reverse weathering which returns all the linked alkalinity to the atmosphere. On the reverse, the overall budget of organic carbon oxidation, fixation and burial is highly efficient. This efficiency is not due to exceptional organic carbon concentration in sediment which does not exceeds 0.4 wt.% on the average. Rather, its importance is due to the intensity of physical erosion that generates intense particulate flux. This favours rapid burial in the Bengal fan preventing oxidation of organic carbon and induce major flux.

The Himalayan orogenesis also acts as a source of CO_2 to the atmosphere through metamorphic decarbonation. Direct evidences of these fluxes have been measured through dissolved and gas CO_2 discharge associated to thermal spring along the MCT in Himalaya [1&2]. While inaccurately determined, these fluxes are significant and certainly counter balance those linked to silicate weathering.

[1] Evans *et al*. (2008) *G*^{3} **9**, Q04021, [2] Perrier *et al*. (2008) *EPSL* **278**, 198-207.

Channel processes and sedimentation in the Kupa River (Croatia)

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Introduction

Channel processes and sedimentation of the 300 km long Kupa River have been studied first time, after some previous research describing sediment pollution [1, 2, 3]. This river basin is of supraregional interest: besides its central position in Croatia, it is shared by two neighboring countries (Slovenia and Bosnia and Herzegovina) and is of strategic importance due to its rich water resources. Also, some of its parts in karstic areas are protected as national parks.

Results, Discussion and Conclusions

The generally meandering course starts from a karstic spring and flows to the plains with braided channels. The river basin material varies in size from bulders to fine sand. The bouldery and gravelly marginal bars and channel bars are quite conspicuous in the upper part and sandy point bars characterize some locations of the meander bends. Grain size data were used to predict sediment transport paths compared with literature [4]. Cumulative curves of fluvial deposits attain more and more lognormality with distance of transport, show two inflections, indicating breaks for rolling to saltation and saltation to suspension mode of transport. There is general fining of grain size downstream, Mz (φ) increases. Majority of samples show moderate to poor sorting. The negative skewness in the upper stretch reflects addition of pebble sizes to the main sand fraction. Lower portion of river is getting moribund due its localized and arrested geomorphic setting and severe eutrophication with macroalgal blooms and marsh vegetation. Human interference caused modification to morphodynamics of the river channel. Systematic monitoring of its geomorphological and pollution status is suggested.

[1] Frančišković-Bilinski (2007) *Fres. Env. Bullet.* **16**, 561-575. [2] Frančišković-Bilinski (2007) *J. Geochem. Explor.* **88**, 106-109. [3] Frančišković-Bilinski *et al*. (2005) *Fres. Env. Bullet.* **14**, 282-290. [4] Mc Laren and Bowles (1985) *J. Sed. Petrol.* **55**, 457-470.