Critical zone and carbon cycle in the deep time

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The colonization of the continental surfaces by vascular plants occurred at the end of the Devonian period. This colonization coincide with the onset of a large scale critical zone on the continental surfaces and is thought to have boosted the global weathering of crustal rocks[1]. As a consequence, atmospheric CO_2 sharply decreased around the Devonian-Carboniferous boundary. The continental colonization event is considered as a major contributor to the Permo-Carboniferous glaciation[2].

Recently, a more physically-based modelling of the colonization event reconsidered its climatic consequences. The large scale spreading of vascular plants decreased the albedo of the continents, leading to a paradoxal climatic evolution in which an ample decrease in atmospheric CO_2 over the course of the Devonian period might have occurred at roughly constant continental temperatures[3]. This study also emphasized the key role played by land plants on the continental hydrologic cycle.

Land plants enhance weathering reactions. But this acceleration leads to a faster development of thick weathering profiles, especially in flat, warm and humid areas, eventually inhibiting weathering reactions. The long term dynamic response of the Earth system to perturbations is thus pending on the specific response of each climatic zone. In the present study, we aim at exploring the sensitivity of the Earth system to a global warming event, in the presence or absence of vascular plants, using a process-based modeling, in line with the Le Hir *et al*[3] method. A numerical model of the coupled climate/weathering/erosion processes[4] will be used to explore whether the presence of land plants truly enhances the weatherability at the global scale, and whether it increases or decreases the Earth system sensitivity to a global warming event in the geological past.

[1]Moulton *et al* 2000, *Am. J. Sci.*, **300**, 539-570. [2] Berner, 2004, The Phanerozoic Carbon cycle, OUP [3] Le Hir *et al* 2011, *Earth Planet. Sci. Lett.*, **310**, 203-212 [4] Carretier *et al* 2013, Geomorphology, in press.