Long-term inorganic phosphorus dynamic: weathering, sorption and occlusion modelling on the 4100 kyrs chronosequence in Hawaii

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Ecosystem development relies on nutrients availability. Capturing their dynamic in ecosystem models is necessary to predict terrestrial carbon evolution. Amongst these nutrients, phosphorus (P) is often limiting. It is supplied by apatite weathering, which a common accessory mineral of silicate rocks. Once this mineral source is exhausted, only atmospheric deposition can compensate its loss by drainage or soil erosion. On the contrary of the major cations that are easily leached out of the soil, P shows a great affinity for soil particles. This increases its residence time in the soil, as it can be sorbed on clays and oxides surface. But it can also be trapped into the oxides (the occlusion process), reducing then its bioavailability. These processes are primarily controlled by the mineral sorption properties (variable charges surfaces) and soil pH. As a part of the Imbalance-P project (ERC Synergy Grant ERC-2013-SyG 610028-IMBALANCE-P), we introduced a simplified version of the Barrow's P sorption and diffusion model [1] into the WITCH weathering model [2]. We propose here to evaluate it on the Hawaiian chronosequence described by Crews et al. (1995) [3] and intensively studied since. Intermediate-aged andososols developed on basalt show the greatest ecosystem fertility. The weathering model cannot explain the nutrients dynamic in the youngest ecosystem. However, since the ecosystem reaches an equilibrium (20 kyr), the weathering model alone reproduces well the chemical composition of the soil solutions. We calibrate then the slow diffusion process. The long-term inorganic P dynamic is explored through its links with the soil mineralogy and ecosystem maturation.

[1] Barrow (1983) J. *Soil Sci* **34**, 733-750. [2] Goddéris et al. (2006) Geochim Cosmochim Ac **70** 1128-1147. [3] Crews et al. (1995) Ecology **76**(5) 1407-1424.