A biogeochemical factor limiting the denitrification processes in hydromorphic area?
Mise en évidence d’un facteur biogéochimique limitant le processus de dénitrification dans les sols hydromorphes

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Mixed Fe(II)-Fe(III) oxides such as Green Rusts (Grs) has been recently found in hydromorphic soil (Trolard et al, 1997). The occurrence of these oxides in soils influences the sequence of oxido-reduction processes in soils. The reduction of Fe(III) into Fe(II) is possible under a large range of oxido-reduction potential depending on the nature of Fe-bearing mineral. Redox potential can be buffered by Grs, which can compete with other electron acceptors in soils. Whereas in the classical sequence, denitrification proceeds before the reduction of ferric oxides, in the sequence including mixed Fe(II)-Fe(III) oxide (Fe$_3$(OH)$_8$), the reduction of this compound proceeds before denitrification. To check this hypothesis, the temporal dynamic of nitrates and Fe(II) concentrations is carried out in groundwater of a Sg horizon. The hydromorphic area was located downhill a cultivated field which received mineral and organic amendments. Special collectors allow us to preserve the physico-chemical characteristics of the groundwaters. Eh, pH and temperature were measured in situ. Special attention was taken to preserve the anaerobial field conditions ; all the manipulation on the samples were carried out in a glove box under N$_2$ atmosphere. The sampling period started in november and ended in march.

The dynamic can be decomposed in three phases. First, one week after the saturation of the area by water, the concentration of nitrates started to decrease. When the concentration of nitrates reached zero, Fe(II) appeared and started to increase. During the second stage, precipitation of Fe$_3$(OH)$_8$ proceeded. Finally in the last stage, nitrates and Fe(II) co-existed in solution and groundwater was controled by the Fe$_3$(OH)$_8$ form.

During the first stage, no Grs were present in the system because during summer this mineral was completely oxidised in goethite. So, the classical sequence of reduction occured, first the nitrates then the ferric oxides. Whereas in the third stage, the occurrence of the Fe$_3$(OH)$_8$ compound buffered the system, and the denitrification can not proceed. The hypothesis of a biogeochemical factor limiting the denitrification is conforted. However, these process occured in special site and must not occured everywhere in the space. Since the soil is a complex and heterogen reactor, denitrification can proceed in a place and not in another. A spatial study of this phenomena is necessary.

References :

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