Major elements and nutrients transport in a small agricultural watershed: the Negron case (west centre of France)

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This study has been carried out in the framework of the G.D.R 'Agriculture-Environnement' C.N.R.S programme. Its aims are the understanding of the hydrochemical behaviour in the basin, the determination of the agricultural impact on the water quality and the quantification of material exported to the Vienne river in order to estimate the mechanical and chemical erosion in the basin. The last objective will only be exposed here.

Sampling and methods

The waterway studied, Negron, is the last left bank tributary of the Vienne river. Its 158 km^2 wide watershed is located in the west centre of France. It exhibits three major geological units (Alcayde *et al*, 1989): (1) two sets of Turonian chalk hills (28%) wich delimit the basin in the upper and in the lower parts (2) a large Jurassic limestone plateau (30%) and (3) a Cenomanian sandstone depression (29%). The most important activity in the watershed is agricultural poduction.

During the period 94-95-96 Negron waters have been monthly sampled in the outlet basin where was implanted an automatic gauge station wich continuously records the discharge. Three flood events have also been sampled. All samples were analysed for dissolved inorganic major element, nutrients and D.O.C.

Results and discussions

Fluxes exported by the Negron in 94/95 and 95/96 are presented in Table 1. In order to compare them with those of other watersheds, they are expressed also in $t.km^{-2}.year^{-1}$. The order of importance of exported fluxes reflect the abondance of each element in the water: $Ca^{2+} > Na^{+} > Mg^{2+} > K^{+}$ and $HCO_3^- > SO_4^{2-} > NO_3^- > Cl^-$. Bicarbonates and calcium with about 44 and 25%, constitue the essential of the total exportations, and sulphates, nitrates and chlorides represent non negligibles parts, with respectively 13, 8 and 7%. The quantities for all the exported elements are significantly greater in 94/95 than in 95/96 (1,5 time in average, 3 times for PO_4^{3-} and for C.O.D). This results from the important difference of pluviometry: 751 mm in 94/95 and only 517 mm in 95/96.

The total dissolved exportations are 11900t/year and 7500t/year respectively for 94/95 and 95/96, which correspond to a mean total dissolved solute (T.D.S) weighted discharge of 700 and 450 mg/l. Compared to the average world values and to other published data, those T.D.S are high When atmospheric and anthropogenic contributions are substracted, the calculated chemical erosion rates are 54 $t.km^{-2}.year^{-1}$ and 34 $t.km^{-2}.year^{-1}$; these rates are comparable with those of climatic temperate area: e.g Seine (44 $t.km^{-2}.year^{-1}$) (Roy, 1996), Girou (58

TABLE 1. Major elements, nutrients and D.O.C exportations by the Negron river in t/year corresponding specific fluxes in $t.km^{-2}$ $year^{-1}$

	Na+	K+	Ca++	Mg++	Cl-	(SO4)2-	(HCO3)-	H4SiO4	(NO3)-	(PO4)3-	D.O.C
94/95											
t/year	286	56	2737	114	755	1550	5106	307	828	1,73	162
t.km-2.year-1	1,81	0,35	17	0,72	4,78	9,81	32	1,95	5,24	0,011	1,03
95/96											
t/year	202	38	1910	76	485	942	3056	173	571	0,548	50
t.km-2.year-1	1,28	0,24	12	0,48	3,07	5,96	19	1,09	3,61	0,003	0,33

$t.km^{-2}.year^{-1}$) (Probst, 1986) Garonne amont (70 $t.km^{-2}.year^{-1}$ (Probst and Bazerbachi, 1986). The carbonate dissolution rate was calculated using the lithologic calcium exported amount. Its values are 40 $t.km^{-2}.year^{-1}$ in 94/95 and 28 $t.km^{-2}.year^{-1}$ in 95/96 and they represent respectively 74 and 82% of the chemical erosion in the basin.

Conclusion

As a result of the dominance of the calcareous bedrocks in the basin, the chemical erosion in the basin is determined essentially with the carbonate dissolution. Otherwise, the important amounts of sulphates, nitrates and chlorides in the exportations show the great impact of the agriculture in the watershed.

References

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