CONTAMINATION BY NICKEL AND VANADIUM OF SOME MOLLUSCS AND CRUSTACEANS ON SOUTHERN BRITTANY SHORELINE AS ACONSEQUENCE OF THE ERIKA OIL SPILL

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ABSTRACT

In consequence of the Erika oil spill on December 12th 1999, off the south coast of Finistère, about 20 000 tons of heavy fuel oil were spilled in the water column, to be settled in the following months on the coasts of the south of Brittany and Pays de la Loire. Among the chemical compounds of fuel oil, nickel and vanadium have respective concentrations of 40 and 90 mg/kg. Considering that 1 ton of nickel and 2 tons of vanadium were spilled in the north of the bay of Biscay, we studied the impact, in terms of spatio-temporal evolution, of the contamination of coastal mollusks, by these trace elements from the day of the spill to the end of year 2000. 33 sites, dispatched from Baie d'Audierne on the north to the coast of South-Vendée, were sampled every 2 months. Among these sites, there are 8 RNO (National observation network of the quality of the marine environment) stations for which a historical follow-up of the contaminations is possible thanks to the organism bank of this network. It preserves at a lyophilic state all the samples (mussels and oysters) sampled every 3 months since 1979. These collections were also used to bring to the fore the natural seasonal movements of the concentrations in nickel and in vanadium at other periods and/or in other places. In the other sites, examined animals are preferably mussels and oysters, but clams, cockles and goose barnacles were sometimes examined. The analytic technique, applied after an acid mineralization of the lyophilizate, is the atomic electrothermal absorption with Zeeman correction. The quality assurance is guaranteed by the automatic use of certified reference material (mussel or oyster flesh, lobster hepatopancreas) and by the regular participation in international exercises of comparison.

The results show the appearance of a very important peak in vanadium concentration during the spring (between 5 and 6 mg/kg of dry weight for mussels and 3 mg/kg for oysters whereas the average concentrations for these

organisms in this region are 1 and 0,5 mg/kg). This peak is much more important than the seasonal movements observed in this region for these animals, since the maximum concentrations for the previous 5 years, observed during the winter, reached only 2 and 1,5 mg/kg for mussels and oysters. In-phase with this peak of vanadium concentration, we observed a peak in nickel concentration, but however much smaller (in general, 3 and 1 mg/kg for mussels and oysters), that can be differentiated from the natural movements quoted above, excepted in some cases. For the other observed species, the concentration levels of vanadium are the same ones than those observed for mussels (cockles), or smaller (clams) or much smaller (donax clams, goose barnacles.

From a geographical point of view, the first peaks of vanadium concentration appeared at the east of Quiberon Peninsula and in Baie de Vilaine; next, they went to the west during the spring. On July 2000, the concentrations decreased in all the study area, to reach, at the end of the year 2000, comparable levels to those observed the previous year at the same period. The ubiquity of this peak of vanadium concentration in all the observed area suggests, of course, the Erika oil spill as origin, just as the few anomalies in the nickel distribution suggest a different origin (punctual contamination). Beside the geographical distribution of vanadium on the area, an interesting point is the date of appearance of this peak (from April to May 2000) very from that of PAH (Polycyclic Aromatic Hydrocarbons) that appeared at the end of the year 1999. This observation must to be compared with the rare available studies in literature that show a strong connection between vanadium and the porphyrin complex in oil, and their strong stability in the sea. This leads to several comments:

1. The appearance of a peak of vanadium, 4 to 5 months after the oil spill and the arrival of oil slicks on the coasts, shows a mobility of this element, but only after an important weathering of its support. Studies would be necessary to confirm this hypothesis.

2. Owing to the strong bond of vanadium in fuel oil for the first months of the oil spill, an important part was eliminated from the water column for the mopping-up sites. It would explain the reason why a few sites are less concerned than other ones. A comparison between the contamination variations by vanadium and the importance and the date of cleaning up of the sites would be instructive.

3. The use of vanadium in marine organisms, as a tracer of the contamination by fuel oil, must take into account the difference in phase between the arrival date of oil slicks and the appearance of the peak in vanadium concentration.

4. The use of the Ni/V ratio, commonly used to characterise a fuel oil, must not be made in this goal by taking the measured concentrations (or growth concentrations) in the marine organisms.

5. The period of return to initial state of the concentrations of PAH coincides with the appearance of peaks in vanadium concentration. The period of return to initial state of vanadium concentration is therefore much later.

This study only lasts 1 year. It does not show the potential new contaminations due to a new mobilization for the winter 2001-2002 of the oil slicks stuck to the rocks. So it is purposed to make a much lighter follow-up of the concentrations of nickel and of vanadium in the animals sampled in the impact area of the Erika every 3 months, in the scope of RNO. Moreover, it is suggested to compare the previous results with those of biomarkers (of exposure, of effect) obtained in the scope of another study on the same organisms and the same sites for the same year.