Reports

Pristane in Zooplankton

Abstract. *The hydrocarbon pristane (2,6,10,14-tetramethylpentadecane) occurs in unusually high concentrations (1 to 3 percent of the body fat) in the three copepods* Calanus finmarchicus, C. glacialis, *and* C. hyperboreus. *These planktonic crustaceans appear to be the primary source of the pristane in liver oils of sharks and whales.*

In a search for the biogenic sources of hydrocarbons in sea water we have analyzed some bulk extracts of zooplankton from the Gulf of Maine and the western North Atlantic. A very large part of the saturated hydrocarbon fraction consists of a single hydrocarbon, which cochromatographs with normal heptadecane on nonpolar gas-chromatographic substrates.

Samples for further analysis were prepared by trapping the hydrocarbon as it was eluted from the chromatographic column or by distilling the saturated fraction of the extract in a micromolecular still (*1*). A molecular weight of 268 was determined by mass spectrometry and, together with the near infrared spectrum and the chromatographic behavior, it suggested a highly branched isomer of nonadecane $C_{19}H_{40}$. The extremely low melting point —there was no crystallization even at dry-ice temperature—suggested that the hydrocarbon was pristane (2,6,10,14-tetramethylpentadecane). This was confirmed by the agreement of the mass- and infrared-spectra with published data (*2, 3*) and with spectra obtained on commercial pristane.

Table 1. Pristane in *Calanus* species. Collecting locations: 42°14′N, 64°30′W, and 41° 39′N, 65°07′W. Collecting date: Atlantis II, cruise 2, 9 to 17 April 1963.

Pristane per individual (μg)	Percentage pristane	
	Dry wt.	Total lipids
Calanus finmarchicus V		
2.0	0.77	1.5
C. finmarchicus, female		
1.2	0.46	1.7
C. glacialis V		
2.3	0.47	0.86
C. hyperboreus V		
5.9	0.84	1.6
C. hyperboreus, female		
12.2	0.90	2.9

In our zooplankton samples pristane occurs mainly in three cogeneric species of copepods, *Calanus finmarchicus, C. glacialis*, and *C. hyperboreus* (Table 1), in which it constitutes an appreciable fraction of the total body fat. Other species in the same zooplankton samples (for example, *Metridia lucens, Rhincalanus nasutus, Euchirella rostrata, Pleuromamma robusta, Paraeuchaeta norvegica, Nematoscelis megalops*, and *Meganyctiphanes norvegica*) contain, relative to their dry weight, much less pristane, or none at all.

Pristane is a minor constituent of the liver oil of both plankton- and nekton-feeding sharks and whales (*4*) from which it is commercially isolated (*5*). Recently it has been found at concentrations up to 0.5 percent in various crude oils (*2, 6*).

The pristane of sharks and whales has been thought to be already formed in zooplankton or intermediate food animals (*7*). Our findings confirm this and suggest that the copepods of the genus *Calanus* are among the major producers of pristane. The structural similarity between pristane and phytol suggests that the hydrocarbon may be derived in *Calanus* from the chlorophyll of its phytoplankton diet. The pristane of crude petroleum may also be directly derived from zooplankton, though the possible conversion of phytol to pristane in sediments by biotic or abiotic processes should not be ruled out.

A fraction of the pristane formed by the copepods may find its way into the sea water. During the spring bloom, *Calanus finmarchicus* in Cape Cod Bay (*8*) reaches a density of up to 2000 individuals per cubic meter. A small part of their total pristane, when dissolved in the water, could be detected by sensitive analytical techniques. As a relatively refractory compound, the pristane might thus tag the water mass in which the copepods live (*9*).

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References and Notes

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Krypton Fluoride: Preparation by the Matrix Isolation Technique

Attempts to prepare compounds of krypton and fluorine through pyrolysis (*1*) and photolysis (*2*) have been unsuccessful. Grosse *et al.* were able to prepare KrF_4 in a high-voltage discharge through a krypton-fluorine gas mixture at −78°C. We now report the preparation of KrF_2 by the photolysis of fluorine suspended in a solid mixture of argon and krypton at 20°K. This experimental method is called the matrix isolation technique (*3*).

In a typical experiment, a gaseous mixture of fluorine, krypton, and argon at mole ratios $F_2:Kr:Ar$ of 1:70:220 was deposited slowly upon a CsI window held at 20°K. After an infrared spectrum had been recorded (with a