

Occurrence of a heat shock protein in oceanic surface particulate organic matter

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The molecular characteristics of particulate proteins in Pacific surface waters were investigated by two-dimensional electrophoresis (2-DE). Most proteinaceous materials estimated by protein/peptide specific dye-binding methods was in the form of acidic molecules containing peptides and degradation products (peptides) of protein, indicating that almost all proteins in living organisms failed to survive in detrital particulate organic matter (POM). Nevertheless, 23 discrete proteins were distinguished by the 2-DE. Electrophoretic patterns of the discrete proteins indicated that they were not proteins in living organisms but were a component of detrital POM. Spatial variability of the discrete proteins suggested that they were not necessarily refractory but that their occurrence might be related to the source intensity.

Three discrete proteins were subjected to N-terminal amino acid sequence analysis. Two proteins out of 3 could not be determined due to the blocking of their N-termini, and one protein was determined from the N-terminus to the 9th amino acid residue. A homology search revealed that the N-terminal amino acid sequence of the protein agreed completely with that of 70 kDa heat shock protein (HSP70) derived from photosynthetic organisms. HSP70 is a major member of the molecular chaperones which protect or repair proteins from damage under conditions of environmental stress.

The occurrence of HSP70 in this study demonstrated that phytoplankton is able to induce the molecular chaperone(s). Questions arise as to what kind of phytoplankton induces HSP70 under what environmental conditions, and what molecular chaperones other than HSP70 are induced by marine organisms. Answering such questions will enable us to assess the actual environmental stress on phytoplankton at the biomolecular level.

Light hydrocarbons in volcanic and hydrothermal fluids

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Volcanic and hydrothermal gases from White Island volcano and geothermal systems in New Zealand, as well as many volcanoes and geothermal systems over the world were analysed for C₁-C₆ hydrocarbons (HC) including benzene. On the basis of the data set obtained for White Island volcano together with other available data, several general trends in the behaviour of CH₄, C₂-C₄ hydrocarbons and benzene are apparent, based on application of techniques developed by W. Giggenbach for the interpretation of crustal fluid composition in a high-temperature environment. The trends can be divided into two main types involving temperature-dependent equilibrium and mixing of carbon from magmatic and sedimentary sources.

The concentrations of methane in hydrothermal fluids are controlled mainly by the source output, comprising organic matter buried with sedimentary rocks. Thermal decomposition of this organic matter at upper crust levels produces CH₄ and light hydrocarbons as well as nitrogen accompanied by a very high N₂/Ar ratio. Therefore, the CH₄-rich endmember of hydrothermal fluids tends to have a high N₂/Ar ratio. By contrast, subduction-related magmatic fluids have almost no methane despite having a high N₂/Ar ratio due to degradation of subducted organic-rich oceanic sediments. Hence, volcanic gases and hydrothermal fluids are characterized by two different relationships between CH₄ concentration and N₂/Ar ratio.

Two systems show a good correlation with sampling temperature in volcanic gases: alkane-alkene pairs with the same number of carbon atoms and ethene-benzene. Their concentration ratios (C₂H₆/C₂H₄, C₃H₈/C₃H₆, ΣC₄H₁₀/ΣC₄H₈, C₂H₄/C₆H₆) in volcanic gases are strongly dependent on the temperature of the fumarole, and these ratios change with temperature along metastable equilibrium paths. Variations in alkane-alkane ratios in terms of the 2C_n=C_{n-1}+C_{n+1} equilibrium, either for volcanic gases or for hydrothermal fluids, show no systematic trends, and even at magmatic temperatures (>800°C).

Under conditions prevailing in the crust, the only process that results in equilibration within the CH₄-CO₂ system is the oxidation of methane. This can be facilitated by natural catalysts, which are usually oxides, but not native metals as in the case of the reduction of CO₂.