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STUDIES ON THE ADSORPTION AND BINDING OF NUCLEIC ACIDS ON CLAY MINERALS

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Bernal's hypothesis on the origin of life as a result of the adsorption of organic molecules on clay has paved the way for a series of experiments on the adsorption of nucleic bases and the polymerization of mononucleotides on the surface of clay minerals, in order to explain the possible prebiotic formation of the macromolecules of life (Lailach *et al.*, 1968; Ferris *et al.*, 1989).

Very little, however, is known at present about the adsorption process and the physical-chemical properties of the clay-nucleic acid (NA) complexes.

The study of the adsorption and binding of NA on clay minerals could shed new light on the peculiar characteristics of DNA bound on clay that have been recently observed, the enhancement of its resistance to nucleolytic degradation and the maintenance of its ability to transform competent bacterial cells (Gallori *et al.*, 1994).

These observations suggest that the formation of clay-NA complexes could have played a key role in the persistence of genetic information in the primeval habitats and, therefore, in the evolution of life on earth.

The equilibrium adsorption of different NA (chromosomal DNA, covalently closed circular and linear monomers of plasmid pHV14 DNA, and RNAs from bacterial and yeast cells) on the clay minerals montmorillonite and kaolinite was determined. The results indicated that maximum adsorption was NA type and clay dependent. To elucidate the physical-chemical nature of the bonding between the NA and the clays, the complexes were studied by X-ray diffraction and Fourier Transform Infrared (FT-IR) spectroscopy.

X-ray diffraction results indicated that NA were mainly adsorbed on the edges of the clay minerals, as previously suggested by electron-microscopic observations (Paget and Simonet, 1994).
FT-IR spectra of the complexes showed characteristic, reproducible absorption bands in the 1600-1220 cm^{-1} region. These bands, due to base ring modes and to furanose C-C modes, are characteristic of minus hydrated forms (A and Z forms) (Ghomi *et al.*, 1990) and could suggest a variation of nucleic acid conformation as a consequence of their adsorption on clay minerals.

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