# Sublimation of amino acids as a possible response to the origin of homochirality on the Primitive Earth

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Since the enantiomeric excess (ee) of a partial sublimate of an enantioenriched compound is almost never the same as for the starting mixture, the sublimation has been regarded as a potential method for enantiomeric purification. To explain the solid-gas phase transition without any enantiomerization, the formation of a euatmotic composition of the gas phase has been proposed [1].

However, recent studies on low or high temperature sublimation of scalemic mixtures of natural amino acids (AAs) highlighted unexpected enhancements of enantiomeric excess (ee) [2-4]. Following both approaches, we investigated systematic studies on the sublimation of several mono-alkylated AAs with the aim of rationalizing their properties in this phase transition and to precise the potentialities of sublimation for enantioenrichment.

The first series of sublimation of scalemic mixtures of an AA were performed very slowly in the range of temperature around 90-140° C. Few percent were sublimed after 14 h. Starting from DL + L mixtures, a behavior corresponding to the formation of a euatmotic composition of the gas phase was observed for leucine, proline and phenylalanine but not for alanine and valine. Starting from mixtures of both enantiomers, a behavior of kinetic conglomerate [5] was evidenced showing that even in conditions defined to be as near as possible from a thermodynamic equilibrium, the ee of the partial sublimate is depending on the nature of the starting material [6].

In Viedma's conditions [5], subliming at very high temperature (500°C) mixtures of racemic AAs in the presence of an enantiopure or an enantioenriched AA, we observed the deracemization of all the previously racemic AAs. The ee's are dependent on the presence of a gaseous phase (air, CO2, N2, NO) and the temperature of sublimation. An unexpected synergistic effect was observed with complex mixtures [7].

Several mechanisms have been proposed to explain the enantioenrichment of building blocks of life on the prebiotic Earth. Although underinvestigated up to date, sublimation has the huge advantage of simplicity and to depend on only a few parameters. While our first approach at low temperature only leads to segregations of enantiomers, the second methodology changes the ratio between enantiomers, gives the same handedness for all AAs, and is effective for complex mixtures of AAs where any of them may act as an inductor. High temperature sublimations could have occurred on the warm surface of the Young Earth subjected to frequent meteorite bombardments and to lava flows.

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