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A Path to Homochirality on the Primitive Earth: High Temperature Sublimation of Enantioenriched α-Alkylated-α-Amino Acids

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Introduction: In 2011, Viedma et al. observed an increase of the enantiomeric excess (ee) for some α-alkylated-α-amino acids (AAs) quickly sublimed at a very high temperature (500°C).[1] We investigated the possible role played by this phase transition on the Primitive Earth as a path to homochirality.

Results: A racemic α-alkylated AA can be deracemized by co-sublimation with an enantioenriched AA under such harsh conditions. Both AAs have always the same handedness. An unexpected synergistic effect was observed when the complexity of the system was increased by the presence of several racemic AAs (Scheme 1).[2] Such enantioenrichments were also observed for alanine using serine or cysteine which lead after sublimation to alanine and many decomposition products.[3] An increase of enantiomeric excesses was observed using various gas phases (CO_2, N_2, NO,…) and in the 400-560 °C range.

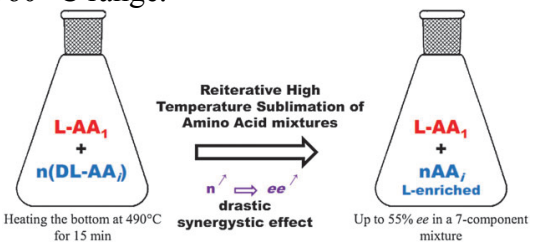

Figure 1. Synergistic effect in the enantioenrichment of high temperature sublimation of mixtures of amino acids

Discussion: In prebiotic chemistry, a relevant property of a compound should be maintained or enhanced when complex mixtures of compounds are involved. Few reactions satisfy this constraint, and many studies have been erroneously associated to the chemistry of the Primitive Earth.

The very simple high temperature sublimation of mixtures of compounds presents a huge potential interest in prebiotic chemistry since any mixture of α-alkylated AAs is thus enantioenriched. The dependence on the nature of the enantioenriched or racemic AAs, their number or the temperature of sublimation is only on the level of the enantioenrichments and the yields. Never a decrease of ees of the main handedness has been observed in such sublimations of more than one AA.

Extension to other initiators or racemates than AAs is currently under progress in our labs.

[1] Viedma, C.; Noorduin, W. L.; Ortiz, J. E.; de Torres, T.; Cintas, P. (2011) *Chem. Comm.* 47:671-673. [2] Tarasevych, A. V.; Sorochinsky, A. E.; Kukhar, V. P.; Guillemin, J.-C. (2015) *Chem. Comm.* 51:7054-7057. [3] Tarasevych, A. V; Vives, T.; Snytnikov, V. N.; Guillemin, J.-C. (2017) *Origins Life Evol. Biosphere*, DOI: 10.1007/s11084-017-9535-4.