



# 1 Chirality and the origin of life: in-situ enantiomeric separation of amino acids in extraterrestrial environments

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The search of optical activity in extraterrestrial samples is of particular interest to better understand our solar system formation and evolution (i.e. endogenous or exogenous origin of enantiomeric excess on Earth) and especially the origin of life.

In this frame 3 different “one step” GC-MS methods of derivatization, have been used in order to allow in-situ enantiomeric separation of amino acids likely to be present in extraterrestrial environments such as Mars or comets. The first used *N*-methyl-*N*-(*tert*-butyldimethylsilyl)-trifluoroacetamide (MTBSTFA), as silylating agent, as it reacts quantitatively with a wide range of molecules (amines, acids, alcohols, amino acids, sugars, . . .) and gives a sensitive response in MS. Unfortunately, even if 20 silylated amino acids has been analyzed in one run, this method, has not yet allowed enantioseparation on chiral columns. In the second method the amino acids are converted in their N(O,S)-perfluoroacyl perfluoroalkyl esters in a single step procedure, using different combinations of the derivatization reagents: trifluoroacetic anhydride (TFAA)- 2,2,2-trifluoro-1-ethanol (TFE), TFAA-2,2,3,3,4,4,4-heptafluoro-1-butanol (HFB), heptafluorobutyric anhydride (HFBA)-HFB. The obtained derivatives are ana-

lyzed using 2 different chiral columns: a Chirasil-L-Val and a  $\gamma$ -cyclodextrin (Rt- $\gamma$ -DEXsa) stationary phases which show different and complementary enantiomeric selectivity. The third method used a mixture of alkylchloroformate-alcohol-pyridine, as reagents to obtain the N(O,S)-alkylalkoxycarbonyl esters of amino acids. By combining the resolution power of the Chirasil-L-Val column and the high selectivity of the SIM MS detection mode, this procedure makes it possible the enantiomeric separation and quantification 16 among the 20 pairs of amino acids studied. The performances of the 2 last derivatization reactions are investigated and optimized in order to develop a rapid, simple and reproducible, trace level quantitative enantioseparation method suitable for in situ space analysis.