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The degree of aqueous alteration of carbonaceous chondrites and its influence on the soluble organic content

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Introduction: The soluble organic content of carbonaceous meteorites reflects the chemical reactions that occurred on their parent bodies, solar nebula or interstellar medium [1,2]. Indeed, the degree of aqueous alteration on the parent body of CM chondrites appears to have influenced the distribution and relative abundance of their soluble organic compounds [3-7]. The higher relative abundances of alkylated aromatic hydrocarbons as well as the relative abundances of β-alanine/glycine are related with a higher degree of aqueous alteration on the meteorite parent body of CM chondrites [6]. Furthermore, the more aqueously altered CM chondrites have higher L-enantiomer excess (Lee) values of isovaline [6,8,9]. The Paris meteorite, one of the least aqueously altered CM chondrites analyzed to date could be considered like a point zero in terms of the degree of aqueous alteration [10-15]. The isovaline detected in this meteorite is racemic (corrected D/L = 1.03), indicating that aqueous alteration may be responsible for extending any initial Lee of isovaline [6]. However, aqueous alteration is not responsible for creating an isovaline asymmetry, which may be attributed to other mechanisms. These include e.g. ultraviolet circularly polarized light (UV-CPL) photo-processing of interstellar/circumstellar ices [16-21], equilibrium solid-liquid phase behavior of amino acids in solution [22], or solid-solution phase behavior leading to the formation of conglomerate enantiopure solids during crystallization on the meteorite parent body [23]. While aqueous alteration on the parent body(ies) of carbonaceous chondrites does not explain all their soluble organic content, it is an important player. The analysis of the soluble organic content of carbonaceous meteorites, in particular the very primitive ones helps to build a link between the different contributions from interstellar precursors, solar nebula, and the subsequent incorporation in asteroids.

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