DYNAMICAL SIMULATIONS FOR THE ORIGIN OF CARBONACEOUS MICROXENOLITHS SUPPORT ASTEROIDS–COMETS CONTINUUM

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The existence of a radical distinction between asteroids and comets has been questioned in recent years [1]. No meteorite shows definitive evidence of a cometary origin, even if different studies proposed CI chondrites originate from comets [1-4]. A cometary origin has been proposed for IDPs [5] and micrometeorites [6].

Carbonaceous microxenoliths have been found in several classes of meteorites [7], and particularly in howardites [8, 9] and H chondrites [10]. They have affinities with known groups of carbonaceous chondrites, especially CM, CR and CI. To investigate which is the most efficient microxenolith source between asteroids and comets, we performed numerical simulations to compute the micrometeoroids mass influx on selected main belt asteroids.

Two groups of micrometeoroids, each composed by 1000 particles of diameter 100 µm and density 2 g/cm^3, have been considered. We assumed asteroidal micrometeoroids originate from C-, D- and P-type asteroids while cometary micrometeoroids originate from Jupiter-family comets. The steady state orbital distribution of cometary micrometeoroids has been obtained by the swift_rmvs3_pr code [11]. For asteroidal micrometeoroids the initial orbital distribution has been used. The micrometeoroid collision probability with Vesta (parent body of howardites [12]), Hebe, Flora, Eunomia, Koronis and Maria (proposed as parent bodies of H chondrites, see [13] for a discussion) have been calculated. We assumed 1.5 km/s as the maximum collision velocity that allows the production of unshocked carbonaceous xenoliths. Recent estimations [14] of the micrometeoroid mass between 2 and 4 AU have been used as calibration to calculate the mass influx on each selected targets.

Our results show that for each target (but Koronis) there is no significant difference between the asteroidal and cometary mass influx (within an uncertainty of a factor ~4). Assuming asteroids and comets are radically distinct, our results imply two radically distinct populations of microxenoliths should be observed in both howardites and H chondrites. However observed microxenoliths show limited differences, similar to those among different groups of carbonaceous chondrites. This supports the idea of a continuum between (primordial) asteroids and comets [1].

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