HOW MANY ORDINARY CHONDRITE PARENT BODIES: WHAT'S IN THE BUCKET?

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Introduction: One of the most intriguing and enduring puzzles in asteroid and meteorite science is the location of the parent bodies of the ordinary chondrites. The search for the sources of these most common types of meteorites falling to Earth has been a goal of asteroid spectral and dynamical studies for a third of a century. Although numerous possible parent bodies have been singled out – especially among the S-type asteroids - subsequent investigations have eliminated most of those candidates. Only one main belt asteroid (the probable H-chondrite parent body 6 Hebe [1]) has survived this elimination process so far.

Space weathering has often been invoked to alter the spectra of OC-type assemblages so that they resemble the spectra of S-type asteroids. Although this works superficially, it fails in most cases when examined critically. In most cases, detailed mineralogical analysis eliminates proposed S-type OC parent bodies. Additionally the lunar-style space weathering – which is commonly invoked to produce S-type spectra from OC-substrates - does not appear to dominate the spectra of most main belt asteroid surfaces [2]

The meteorites in our collections sample more than a hundred parent bodies [135 parent bodies according to 3]. It is difficult to envision a nebular model where large portions of the early asteroid belt are dominated by two or three OC compositions while simultaneously having the belt region divided into more than a hundred chemically and isotopically distinct regions.

One fundamental question is the minimum number of OC parent bodies sampled by the meteorites. Current literature suggests that the collections include material from five OC parent bodies (one each for the common H-, L- & LL-types and one each for the rare H/L- & L/LL-types). From the parent body perspective, are there additional OC-types hidden within the large sample of OC meteorites? [A colleague once described how OC samples were handled, saying that a basic classification is done on a sample to identify the subtype, and then – because these meteorites are so common - the sample is "tossed into the bucket" (i.e., generally put away without further examination).]

If there really are a significant number of OC-type parent bodies in the asteroid belt, (e.g., approaching the estimated upper limit of ~10% among the S-asteroids [4]) there should be a number of additional OC-types present – albeit rare – within the large collections of OC samples. These additional types need not be abundant since the cosmic ray ages of stony meteorites suggest that unless the parent body is relatively close to an escape hatch (e.g., the 3:1 proper motion resonance or the nu_6 secular resonance), it will not be commonly delivered to the Earth. The absence of such samples of additional OC-type parent bodies would reinforce the conclusions of the near-IR spectral studies.

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