

## The case for asteroid sample return

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### Abstract

Most of the participants at the 1978 Chicago workshop on asteroid exploration concluded that asteroid sample return was not justified because we had representative samples of asteroids in our laboratories in the form of meteorites, there was too much uncertainty as to which asteroid to sample, and the mission was technically too challenging. None of these points are valid today and a reasonable exploration strategy for asteroids, analogous to that used by field geologists on Earth, calls for sample return as the next logical step. We do not have representative samples of asteroids on Earth because a number of severe selection effects bias the terrestrial meteorite collection to remarkably few asteroids. The cosmic ray exposure age distributions and, in the case of the L chondrites, their argon-argon ages, display peaks indicating that perhaps one-half to two-thirds of a class shared a common shock-heating event usually presumed to be fragmentation or ejection from their parent objects. (The spread around these peaks does not indicate these meteorites came from a variety of parent bodies fragmenting at different times but experimental uncertainties in isotopic abundance, inadequate corrections for shielding, gas-loss before or after the major event, and multiple fragmentation of the parent body and the fragments after ejection.) Similarly, the mismatch between asteroid classes and meteorite classes indicates major differences in the asteroid and meteorite populations. On the other hand, spectral classes provide an excellent method of meaningful target selection. Finally, the number of known near-Earth asteroids is very large and many are energetically more favorable to reach than Mars or even the Moon, yet they have the same class distribution as the main belt and offer easy opportunities to sample the same materials.