
The E-type asteroids have high albedos and featureless spectra which are interpreted as surface assemblages composed of an iron-free silicate mineral such as enstatite, forsterite, or feldspar [1-3]. It is believed that the E-class asteroids are analogous to (and perhaps even genetically related to) the enstatite achondrites (aubrites). These meteorites are the crust and/or mantle fragments of a highly reduced parent body (analogous to but apparently not genetically related to the enstatite chondrites) which underwent melting and efficient differentiation [4]. Because of the high melting temperature of enstatite, the E-asteroids and the aubrite parent bodies must have experienced extremely strong heating subsequent to planetesimal formation.

From its relatively neutral colors, the Apollo object (3103) 1982BB was originally classified as an X-type (E, M, or P) asteroid [5]. Determination of its high albedo (0.53-0.63), removed the ambiguity and identified it as taxonomic type E [6]. Reflectance spectra (0.8-2.5µm) of 1982BB were obtained using the NASA Infrared Telescope on Mauna Kea on July 18-20, 1991UT. The lightcurve amplitude (0.9 mag) is similar to that reported previously [5,7], and good spectra were obtained for both lightcurve maxima. The weak 0.89µm feature seen in the spectrum of the mainbelt E-asteroid (44) Nysa [2] is absent in this spectrum, and no other discrete mineral absorption features are seen. There are no detectable spectral differences between the opposite faces observed at the two lightcurve maxima. Apollo asteroid (3103) 1982BB is a high albedo E-type object with a reflectance spectrum consistent with the iron-free silicates, primarily enstatite, present in the enstatite achondrite meteorites. The correlated variation [8] of the visible [5] and thermal infrared lightcurves [6] indicate that it is an elongated object with no substantial surface albedo variations. Apollo asteroid (3103) 1982BB is presently in an orbital resonance (3:5) with the Earth, and appears to be a relatively long-lived member of the Earth-approaching population [9].

Since it is probable that a significant portion of the meteorite flux is derived from intermediate Earth-approaching parent bodies, we evaluated the possibility that (3103) is the sole or primary near-Earth parent body of the aubrites. Several lines of evidence which suggest that (3103) 1982BB is the actual near-Earth parent body of the aubrite meteorite class, and not merely a reasonable candidate among the known Earth-approaching asteroids:

(1) (3103) 1982BB is the only identified E-type object within the near-Earth population, and consideration of discovery biases suggests that there cannot be many kilometer-sized E-type objects within this population.

(2) The clustering of exposure ages and mineral compositions [4] suggests that most aubrites are derived from a single parent body.

(3) The time-of-day of aubrite falls indicates a limited range of source orbits, which are similar to that of asteroid (3103). Given the rarity of E-types in the near-Earth population, it is seems unlikely that many other comparable sized E-objects could be in similar orbits.

(4) The long aubrite cosmic ray exposure ages compared to other stony meteorites suggests that they were not small meteoroids but were probably stored on an intermediate parent body such as a near-Earth asteroid.

(5) The cosmic ray exposure ages of the aubrites would require that any near-Earth parent body be in a relatively long-lived orbit with a low regolith gardening rate similar to that of 1982BB.
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(6) A significant portion of the aubrite falls appear to derive from one or two meteoroid streams. A near-Earth source for any such stream is likely.

(7) Two of the nine aubrite falls occurred at the descending node of the orbit of (3103) suggesting a direct link.

It therefore seems probable that most of the aubrites are fragments of Apollo asteroid (3103) 1982BB. It also appears possible that (3103) was derived from the Hungaria region at the innermost edge of the asteroid belt. The orbital inclination (2°9) and aphelion distance (1.905AU) of (3103) 1982BB falls within the Hungaria zone (mean: a=1.90AU and i=28°; 80% limits: 1.79AU<a<1.98AU and 15°<i<40°). In considering whether (3103) was derived from the Hungaria zone, we focused on two issues: (a) whether effective mechanisms exist to convert a Hungaria-type orbit into a (3103)-type orbit, and (b) whether there is physical evidence linking (3103) to the Hungaria region of the asteroid belt.

The velocity change needed to convert a circular 1.905AU Hungaria orbit into that of (3103) is approximately 3.0km/sec. The lunar meteorites prove that some coherent material could be sufficiently accelerated by an impact event [10]. However, the size limit on coherent rocks impact accelerated to 3km/sec is 0.03-0.3 meters [10], so it does not seem probable that an object as large as 1982BB (1.5 km) could be accelerated by 3km/sec by a single impact. The Hungaria zone is bounded by the $\nu^{16}$ resonance which has a chaotic zone [11] that could serve to convert injected Hungaria fragments into Earth-approaching orbits similar to that of (3103). The impulse required to move an average Hungaria (a=1.90AU) into the $\nu^{16}$ resonance (a=2.08 at i=25°) is 1km/sec. It seems probable that a significant number of Hungaria collisional fragments are converted into planet-crossing orbits via the $\nu^{16}$ resonance, and that they constitute some component of the Earth-approaching population.

Orbital considerations suggest that (3103) could be derived from the Hungaria zone. However, the spectral type of (3103) makes such a source probable. The Hungaria zone is the only region of the asteroid belt where E-type asteroids are common [12]. E-type objects constitute about 55% of the classified Hungaria population. Although a more detailed investigation of the dynamical evolution of this object is needed, it appears highly probable that (3103) 1982BB was derived from the Hungaria region of the innermost asteroid belt, that it is a fragment of the collisional breakup of an E-object near 1.9AU, and escaped the mainbelt via the $\nu^{16}$ resonance. This represents the first reasonably direct genetic linkage between a meteorite type and a mainbelt source region.

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