

*Asteroid 1986 DA: Radar Evidence for a Metallic
Composition*

S. J. Ostro

S. J. Ostro, Jet Propulsion Laboratory
 D. B. Campbell, Cornell University
 J. F. Chandler, Center for Astrophysics
 A. A. Hine, Arecibo Observatory
 R. S. Hudson, Washington, State University
 K. D. Rosema, Jet Propulsion Laboratory
 I. I. Shapiro, Center for Astrophysics

Radar observations of this near-Earth asteroid were carried out at the Arecibo Observatory in April 1986, two months after its discovery. Resolution of the echoes in frequency (radial velocity) and, on one date, in time delay (distance) show this object to be about 2 km in size and to have an extremely irregular, nonconvex, and possibly bifurcated shape. However, the echo polarization implies that the asteroid's surface is very smooth at cm-to-m scales. The measured radar cross section, when combined with all available constraints on the object's dimensions, yields a radar reflectivity at least twice as large as that estimated for any of the several dozen other radar-detected asteroids and about ten times the lunar value. The most plausible interpretation of this radar signature is that 1986 DA's composition is very rich in metal, and that there is little coverage of the surface by a porous regolith thicker than a few centimeters. The radar results are consistent with the hypothesis that 1986 DA is a piece of NiFe metal derived from the interior of a much larger object that melted, differentiated, cooled and subsequently was disrupted in a catastrophic collision.

This 2-km asteroid might be (or have been a part of) the parent body of some iron meteorites. Or, 1986 DA might share the parentage and/or part of the dynamical history of some meteorites without ever having contributed any of its own ejecta to our meteorite sample. Analysis of samples returned from 1986 DA's surface via spacecraft would elucidate this asteroid's history and its meteoritic kinship.

Motivations leading to spacecraft missions to 1986 DA might ultimately involve economic considerations. Meteoritic metal is mostly iron with about 8% nickel, but also contains substantial concentrations of precious and strategic metals, including ~1 ppm of gold and ~10 ppm of platinum-group elements. If these abundances apply to 1986 DA, it contains some 10^{16} g of iron, 10^{15} g of nickel, 10^{11} g of platinum-group metals, and 10^{10} g of gold.