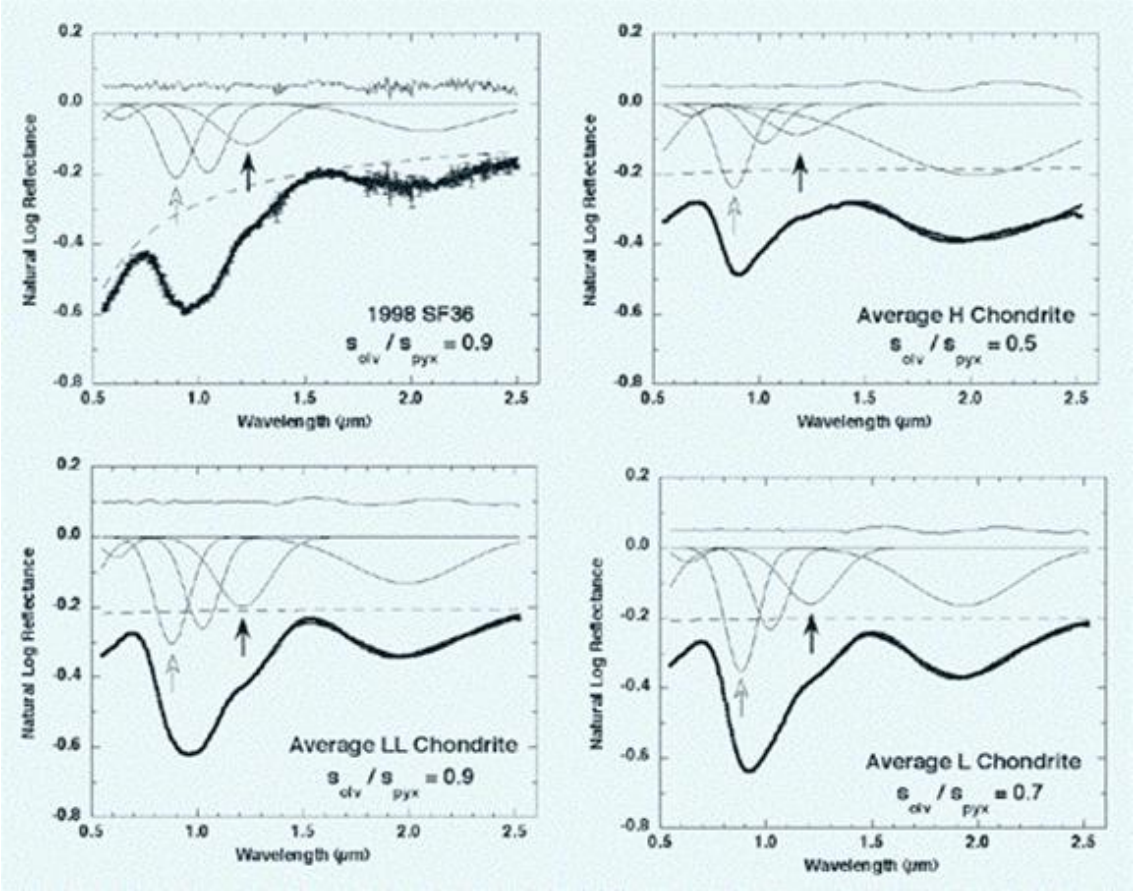
Spectrum of the MUSES-C target asteroid 1998 SF36

The near-Earth asteroid (25143) 1998 SF36 is the planned target for the Japanese MUSES-C sample-return mission that is scheduled for launch in 2002. A favorable apparition of (25143) in March and April 2001, during which it passed within 4 million miles of the Earth, provided an excellent opportunity for ground-based physical studies of this object. A visible/near-infrared reflectance spectrum of (25143) 1998 SF36 obtained by Binzel et al. (2001, Meteoritics Plan. Sci., 36, 1167-1172) gives strong evidence that this asteroid has a surface composition corresponding to that of ordinary chondrite meteorites.

The reflectance spectrum of (25143) 1998 SF36 is plotted in the upper left panel of the figure below. This spectrum is the result of combining visible-wavelength data obtained with a CCD spectrograph on the 4-m reflector at Kitt Peak (covering the wavelength interval from 0.53 to 0.92 microns) and near-infrared spectra obtained with SpeX, the new low- to medium-resolution near-IR spectrograph at the NASA Infrared Telescope Facility (IRTF). This spectrum contains two very broad absorption features, centered near 1 and 2 microns, which are diagnostic of the silicate minerals olivine and pyroxene.

This high signal-to-noise spectrum of (25143) 1998 SF36 allows for a quantitative comparison with average spectra representing different classes of ordinary chondrite meteorites. In the figure, panels have been included to show the average spectra for the H-, L-, and LL-classes of ordinary chondrites. The depths and shapes of the 1- and 2-micron bands have been modeled using the Modified Gaussian Model (MGM, Sunshine et al. 1990, J. Geophys. Res. 95, 6955-6966) where complex absorption features are resolved into individual absorption bands, which can then be assigned to specific mineral phases. Plotted in each of the four panels, from top to bottom, are: the residual error between the actual and modeled spectrum (offset by 10% for clarity), the individual modified Gaussian distributions that represent absorption bands, the continuum or baseline onto which these distributions are added (dashed line), and the modeled spectrum overlying the measured spectrum. In each plot, the MGM band marked by an open arrow is unambiguously due to pyroxene, while the band marked by the solid arrow is due to olivine. By comparing the ratio of olivine to pyroxene band depths, the spectrum of (25143) 1998 SF36 is found to most closely match that of an average LL-chondrite meteorite.

This finding, along with others about the physical nature of (25143) 1998 SF36, is crucial to the detailed planning of the MUSES-C mission. This work also highlights the power of the IRTF and SpeX to obtain high signal-to-noise near-infrared spectra of asteroids. These spectra, along with advanced analysis techniques such as MGM, provide enormous potential for advancing our understanding of asteroid mineralogy.


Natural Log Reflectance
Wavelength (μm)
1998 SF36
$s_{oiv} / s_{pyx} = 0.9$
Average H Chondrite
$s_{oiv} / s_{pyx} = 0.5$
Average LL Chondrite
$s_{oiv} / s_{pyx} = 0.9$
Average L Chondrite
$s_{oiv} / s_{pyx} = 0.7$