INTERPRETING ASTEROID SPECTRA – AVOIDING THE THREE "GREAT MISTAKES". M. J. Gaffey, Space Studies Department, John D. Odegard School of Aerospace Sciences, University of North Dakota, Box 9008, Grand Forks, ND 58202-9008, gaffey@space.edu.

Introduction: Asteroid spectra adequate for some degree of compositional interpretation have been obtained since the late 1960s [e.g., 1]. Spectral resolution and wavelength coverage has improved dramatically in the intervening decades. However, the inherent information present in many modern asteroid spectra is lost or degraded due to application of obsolete and/or incorrect models and methodologies. One can identify three common "great mistakes" that negatively impact asteroid spectral studies. Proper appreciation of these problems allows much greater sophistication in the analysis of asteroid spectra and greatly enhances the scientific return of asteroid investigations.

Mistake #1 – Curve Matching: Most asteroid spectra are analyzed by comparing them to laboratory spectra of meteorites and simulants. Techniques range from simple comparison of the asteroid spectrum plotted with a selection of meteorite spectra to routines that mathematically seek the sample spectrum that most closely matches the asteroid spectrum. While curve matching can provide general clues to the possible nature of the asteroid surface material, except in those cases where strong discrete mineralogical features are present, it is likely to mislead the investigator. Curve matching generally matches the entire spectral curve, with emphasis on the spectral slope and the depth of any absorption features. However, these parameters are strongly affected by space weathering. Without a solid understanding of asteroid space weathering (see #3, below), it is not possible to discriminate between slopes and band depths due to space weathering and those due to "composition". And even if the effects of space weathering can be identified and removed with confidence, spectral slope and band depth are not particularly diagnostic of mineralogy or composition. **Rule #1: Curve matching results should not be presented as compositional interpretations except where the asteroid spectrum has strong diagnostic mineral absorption features.**

Mistake #2 – Asking the wrong question / Ordinary chondrite parent bodies: Asteroid spectroscopy papers commonly frame their justification in terms of a search for ordinary chondrite parent bodies. Although identifying the specific parent body(ies) of a meteorite type is a significant scientific contribution, the focus on the ordinary chondrites is largely misplaced. It arose as a result of the assumption that meteorite fall frequency was related to relative abundance of materials in the asteroid belt. In that view, ordinary chondritic material was a major – if not the major - type of material in the early inner solar system. We now know that meteorite fall frequency – especially among the relatively weak and short-lived stony meteoroids - is primarily a function of parent body location relative to the major resonances (3:1, 5:2, ν_6, etc.) [e.g., 2,3]. There are only three ordinary chondrite parent bodies among the ~135 different meteorite parent bodies represented in the meteorite collections [4]. Even if we recognize that the relative weakness of chondrites limits their contribution to the meteoroid flux relative to iron meteorites, there are still more types of differentiated stony meteorites than chondrites, indicating that differentiated parent bodies are more common than chondritic parent bodies in the feeding zones of the resonances. The parent body of the H-chondrites (6 Hebe) has been identified with some confidence [5]. The search for the L-chondrite family and the LL-chondrite parent body are interesting efforts, but do not provide the justification often cited in papers. **Rule #2: The ordinary chondrites are not especially important chondrite types and there is no special priority for the search for their parent bodies.**

Mistake #3 – Space Weathering is not a panacea: Space weathering is commonly invoked to reconcile observational data with the incorrect expectation (see #2, above) that ordinary chondrite assemblages are common in the asteroid belt. The reality of asteroid space weathering has been well documented by spacecraft encounters. It is evident that the patterns of space weathering on asteroids are different than that seen on the lunar surface. Lunar-style space weathering produces correlated spectral slopes, feature intensities and albedos. On asteroid surfaces exhibiting space weathering the albedos, spectral slopes and band depths are not similarly correlated, and differ between objects. Thus, the nature of the various types of space weathering on asteroids is not understood and its effect on spectral curves for curve matching (see #1, above) cannot be reliably assessed at this time. **Rule #3: Something that is invoked to explain everything, explains nothing.**

Reference: [1] McCord T. B. et al. (1970) *Science, 168*, 1445-1447. [2] Morbidelli A. et al. (1994) *Astron. Astrophys., 282*, 955-979. [3] Vokrouhlický D. and Farinella P. (2000) *Nature, 407*, 606-608. [4] Keil K. (2000) *Planet. Space Sci., 48*, 887-903. [5] Gaffey M. J. and Gilbert S. L. (1998) *Meteoritics & Planet. Sci., 33*, 1281-1295.