PROJECTILE DISSEMINATION AND FRACTIONATION AT WABAR CRATER, SAUDI ARABIA; T.H. See,* D.W. Mittlefehldt,* F. Hörz,** and J.T. Wasson;*** *Lockheed ESC, Houston, TX 77058; **NASA JSC, Houston, TX 77058; ***University of California, Los Angeles, CA 90024-1567

INTRODUCTION: We have previously reported on textural and compositional characteristics of distinct impact melt-types and target-rocks from the Wabar Crater, Saudi Arabia, in an effort to learn about the dissemination of impactor material. In increasing order of meteoritic contamination, we distinguished between "white" and "black" massive impact melts (~0.4% and 4% meteoritic contamination, respectively) thought to represent the crater's main melt volume,[1] and between "large" (>1mm) and "small" (<1mm) ballistically dispersed melt spray that contained, on average, some 7% and 11% projectile material, respectively. A single glass bead was found to be the most meteorite-rich sample, with some 17% meteoritic contamination.[2] We also expanded on the fractionation trends reported for opaque phases, which were found to be enriched in Ni,[3,4] by observing a corresponding Fe-enrichment in the melt matrix.[2] In light of our own melt analyses and published values for the Wabar IIIA meteorite, however, the overall enrichment/depletion factors for a series of siderophile elements seemed difficult to explain in terms of simple vapor-fractionation. We therefore reanalyzed (at UCLA) the "Wabar" and "Nejed" meteorites (both believed to be part of the Wabar impactor), verifying previous results and adding some new data on trace elements.

RESULTS: Figure 1 represents the concentrations of the major, minor, and trace elements for which we analyzed with electron-microprobe, XRF, or INAA methods; note that the entire suite of elements is not consistently available for all materials. The "target" composition was derived from mixing calculations of subtly different clasts that best match the "meteorite-free" composition of the white glass matrix.[1] The white and black glasses and the large and small glass-beads represent averages of many microprobe analyses (major elements) and variable numbers of aliquots or specimens analyzed via INAA.

INTERPRETATION: Note the systematic depletion of meteorite-derived species between the small ejecta spray and the white melts for all siderophiles, except Cr, which obviously is abundant in the target itself. Since meteoritic constituents can be substantial in the Wabar melts, complementary trends in most major target-components can also be readily observed. To first order, the absolute concentrations depicted in Figure 1 reflect some measure of dilution, indicating variable mixtures of the target and meteorite end-members. As emphasized in our previous reports, distinctly different target/meteorite ratios, (*i.e.*, variable dilution factors), demonstrate nonuniform dissemination of impactor material in the crater's melt volume. The average compositions depicted in Figure 1, however, do not adequately portray the transitional nature of the various glass types. Also, classification into "large" and "small" glass-beads is somewhat arbitrary, yet there are indeed size-dependent compositional trends in the melt-spray[2] as well as in the opaque Fe-Ni spherules that are scattered throughout the glass matrix.[4] While the absolute concentrations in Figure 1 represent primarily a measure of meteorite dilution, one also observes slightly variable slopes among different elements. Such variations in slope indicate non-uniform depletion or enrichment relative to pure mixing. Compared to Fe and Co, Ni is relatively depleted in the melts and Ir even more so. For clarity, these trends are illustrated in Figure 2 for individual analyses that also include As and Au which were not measured in all materials and therefore are not included in Fig. 1. These element ratios between the class IIIA meteorites and their residues in the impact melts are, however, not readily explained. Enrichments and depletions are not consistent with simple vapor-fractionation; *e.g.*, Ir and As represent low and high extrema, respectively, in the temperature of vaporization.[5] We also plotted element ratios versus ionic radii,[6] boiling point, heat of fusion, heat of vaporization, oxidation potential, and other thermodynamic parameters, yet no systematic correlation was obtained. We then explored the possibilty of an initially heterogeneous projectile by using diverse analyses of the massive Cape York iron[7] as an indicator of the homogeniety of IIIA's. Figure 3 illustrates the variation in Ir/Co and Ni/Co for Cape York and individual Wabar glass beads (normalized to CI). While there is surprising variation in Cape York, it is nevertheless substantially less than those of the Wabar melts. Variability of Cape York also indicates a magmatic partitioning trend, unlike the Wabar melts. While Figure 3 does not conclusively eliminate the hypothesis that initial heterogenieties in the impactor may at least partially be responsible for the Wabar trends, we consider this an unlikely scenario.

CONCLUSIONS: We conclude that siderophile elements may indeed be fractionated in the Wabar melts. The fractionation trends, however, are not readily explained by a single, simple process: a combination of processes may have been involved. Additionally, the relative, volumetric abundance of various glass-types remains unknown, making it difficult to perform meaningful mass-balance calculations that would demonstrate overall loss or enrichment of a specific element during the Wabar event. Nevertheless, these results serve to indicate that reconstruction of projectile type and mass, based on dilution ratios and relative abundance of some select siderophile elements, remains a difficult task even for relatively simple, initial impact-conditions.

REFERENCES: *[1]* F. Hörz *et al.* (1989) *PLPSC 19*, 697-709. *[2]* T.H. See *et al.* (1988) *LPS 29*, 980-981. *[3]* R. Brett (1967) *Am. Mineral. 52*, 721-733. *[4]* R.V. Gibbons *et al.* (1976) *PLPSC 7*, 863-880. *[5]* E.R.D. Scott (1972) *Geochim. Cosmochim. Acta, 36*, 1205-1236. *[6]* W.v. Engelhardt *et al.* (1987) *Geochim. Cosmochim. Acta, 51*, 1425-1443. *[7]* K.H. Esbensen *et al.* (1982) *Geochim. Cosmochim Acta, 46*, 1913-1920.