Chondritic models of 4 Vesta : Comparison of data from the Dawn mission with predicted internal structure and surface composition/mineralogy. M.J. Toplis[1], H. Mizzon[1], O. Forni[1], M. Monnereau[1], J-A. Barrat[2], T.H. Prettyman,[3] H.Y. McSween,[4] T.J. McCoy,[5] D.W. Mittlefehldt,[6] M.C. De Sanctis[7], C.A. Raymond,[8] C.T. Russell,[9]. [1]University of Toulouse (mtoplis@irap.omp.eu), [2]University of Brest, [3]Planetary Science Institute, [4]University of Tennessee, [5]Smithsonian Institution, [6]NASA Johnson Space Center, [7]IASP, Rome, [8]JPL, Caltech, Pasadena, [9]University of California, Los Angeles.

While the HEDs provide an extremely useful basis for interpreting data from the Dawn mission, there is no guarantee that they provide a complete vision of all possible crustal (and possibly mantle) lithologies that are exposed at the surface of Vesta. With this in mind, an alternative approach is to identify plausible bulk compositions and use mass-balance and geochemical modelling to predict possible internal structures and crust/mantle compositions and mineralogies. While such models must be consistent with known HED samples, this approach has the potential to extend predictions to thermodynamically plausible rock types that are not necessarily present in the HED collection.

Nine chondritic bulk compositions are considered (CI, CV, CO, CM, H, L, LL, EH, EL). For each, relative proportions and densities of the core, mantle, and crust are quantified. This calculation is complicated by the fact that iron may occur in metallic form (in the core) and/or in oxidized form (in the mantle and crust). However, considering that the basaltic crust has the composition of Juvinas and assuming that this crust is in thermodynamic equilibrium with the residual mantle, it is possible to calculate a single solution to this problem for a given bulk composition.

Of the nine bulk compositions tested, solutions corresponding to CI and LL groups predicted a negative metal fraction and were not considered further. Solutions for enstatite chondrites imply significant oxidation relative to the starting materials and these solutions too are considered unlikely. For the remaining bulk compositions, the relative proportion of crust to bulk silicate is typically in the range 15 to 20% corresponding to crustal thicknesses of 15 to 20 km for a porosity-free Vesta-sized body. The mantle is predicted to be largely dominated by olivine (>85%) for carbonaceous chondrites, but to be a roughly equal mixture of olivine and pyroxene for ordinary chondrite precursors. All bulk compositions have a significant core, but the relative proportions of metal and sulphide can be widely different. Using these data, total core size (metal+ sulphide) and average core densities can be calculated, providing a useful reference frame within which to consider geophysical/gravity data of the Dawn mission.

Further to these mass-balance calculations, the MELTS thermodynamic calculator has been used to assess to what extent chondritic bulk compositions can produce Juvinas-like liquids at relevant degrees of partial melting/crystallization. This work will refine acceptable bulk compositions and predict the mineralogy and composition of the associated solid and liquid products over wide ranges of partial melting and crystallization, providing a useful and self-consistent reference frame for interpretation of the data from the VIR and GRaND instruments onboard the Dawn spacecraft.