CONTRASTING FORSTERITE COMPOSITIONS FOR C2, C3, AND UOC METEORITES: EVIDENCE FOR DIVERGENCE FROM COMMON PARENT; Ian M. Steele and J.V. Smith. The University of Chicago, 5734 S. Ellis Avenue, Chicago, IL 60637.

The composition and texture of refractory forsterite in the carbonaceous and unequilibrated ordinary chondrites (UOC) should provide important clues to early conditions in the solar nebula. We recognized that forsterite compositions differ in different meteorite classes (1) and that the forsterite compositions of Deep Sea Particles are similar to those of C2 forsterite (2). We now compare ~800 electron microprobe analyses of Al, Ca, Ti, V, Cr, Mn and Fe in forsterites from many textural occurrences in 12 meteorites listed in Fig. 1; Na, P and Ni were not detected. From multi-dimensional composition space, we select 2D plots relating Cr_2O_3, MnO and FeO in forsterites from 4 each of C2, C3 and UOC chondrites, and concentrate on overall features for each class.

Four conclusions are drawn. (a) The C2 data are tightly grouped in a linear trend in contrast to the wide scatter for C3 and UOC data. (b) The overall distribution for C3 closely matches that for UOC, and minor differences (e.g. MnO-FeO plot) are not significant at this stage of study. (c) All three classes show a high concentration centered at about FeO 0.7 wt.%, Cr_2O_3 1000 ppm and MnO 175 ppm. This common cluster corresponds to blue-luminescing olivine (1,3) which shows high Ca, Al, Ti and V. Such blue olivine invariably occurs as subhedral to euhedral cores of single grains or within chondrules, and is rimmed by red-luminescing or non-luminescing olivine with complex textural properties. (d) This cluster of analyses for the C3 and UOC classes shows a weak positive correlation between Cr_2O_3, FeO and MnO, which is approximately the same as that for the entire linear trend for the C2 class.

The conclusion that the forsterite compositions from the C3 and UOC classes are strongly similar, and distinctly different from those from the C2 class, is consistent with evidence from quantitative wavelength scans of cathodoluminescence (4). We now discuss possible causes of the compositional trends. First, the common clusters of blue-luminescing forsterites might represent a single population of forsterite, which was affected later by different processes, or they might represent three distinct populations which happen to have the same chemical properties. All the textural evidence (3) is consistent with vapor growth of the refractory-rich, blue-luminescing olivine, but such a simple, one-stage process should be accepted with caution. It must be recognized that vapor growth from a gas of cosmic composition must have occurred at many places in the universe, and that a similar minor-element signature is insufficient evidence for spatial communality. Second, the Fe-rich rims found only for the forsterite grains of the C3 and UOC meteorites typically contain numerous inclusions of Na,Al,Ca,Si-glass and metal, steep zoning profiles, and other features suggestive of crystallization from a liquid (1,3). The formation of abundant chondrules now present in C3 and UOC meteorites may correspond to this presumed liquid crystallization event. Typically there is a sharp luminescence boundary between the blue core and a red-to-dark luminescing Fe-rich rim. Questions arise about the mechanisms responsible for the melting event. Was the liquid formed by melting of a mixture of a portion of the blue olivine originally zoned to a high-Cr rim (Fig. 2 of ref. 2) and some external material richer in Fe and poorer in Cr? If so, the Fe-poor core could survive because of its greater refractory nature relative to the

the rim, and because of the time delay in heat transfer. Alternatively, the liquid might be totally or largely independent of the original blue olivine (e.g. derived from melting of a dust coat), and the original blue olivines of the C3 and UOC meteorites might not have been zoned to a Cr-rich rim. Current observations are inadequate to answer these questions. The role of olivine in E chondrites is currently under exploration to extend the sparse data in (1). NASA NAG9-47.

References. (1) Steele I.M., Smith J.V. and Skirius C. (1985) Nature 313, pp. 294-297. (2) Steele I.M., Smith J.V. and Brownlee D.E. (1985) Nature 313, pp. 297-299. (3) Steele I.M. (1985) Geochim. Cosmochim. Acta, submitted. (4) Steele I.M. (1986) Am. Mineral., in press.

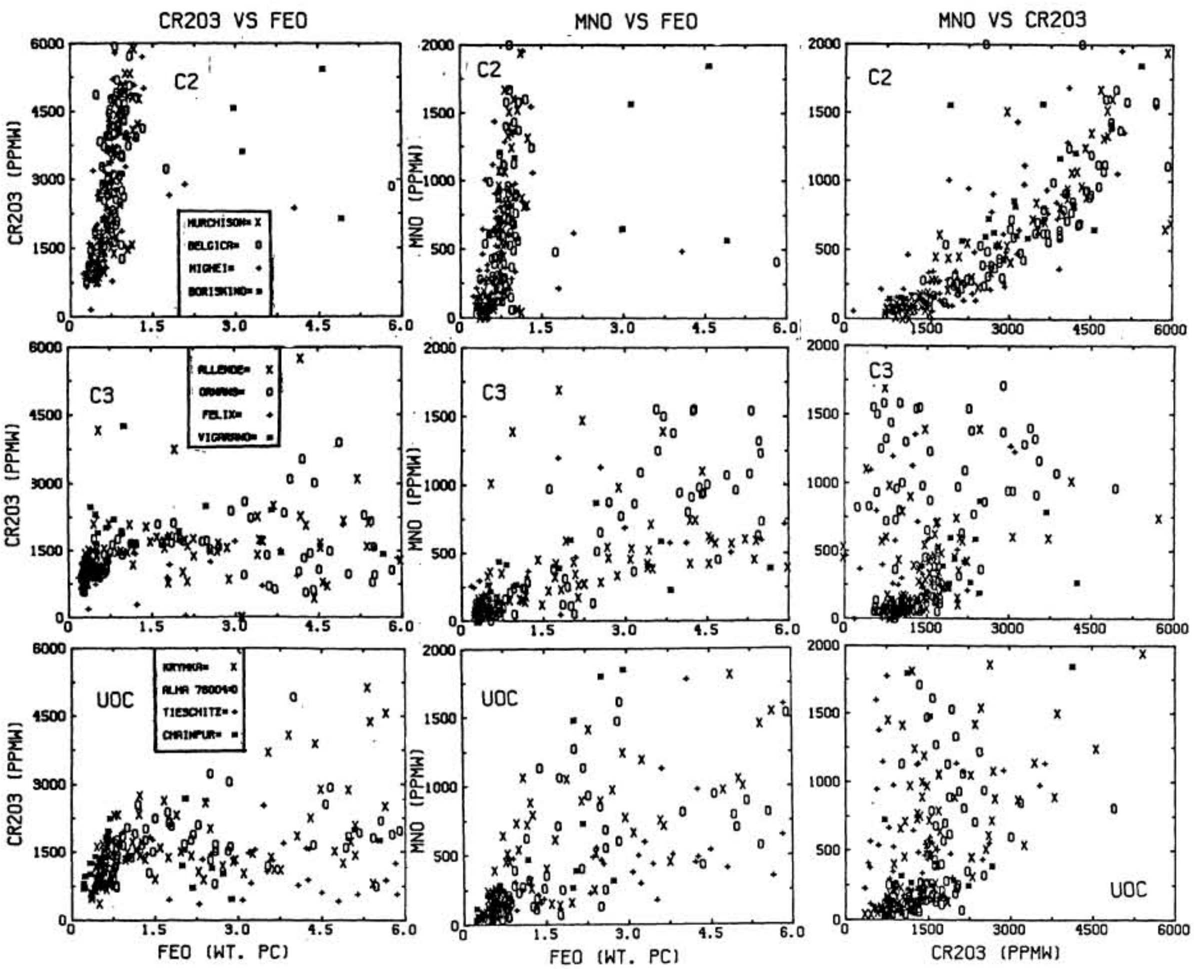

Fig. 1. Variation of Cr_2O_3, MnO and FeO in Mg-rich olivine of C2, C3 and UOC meteorites. Symbol key given in plots of column 1; meteorite type given on each plot. Note: oxidation state not measured.