FRACTIONATED MATRIX AND WHOLE-ROCK IN CV3 VIGARANO

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Wasson and Rubin [1] studied 50-μm-square grid areas in CR LAP 02343 and observed compositional variations interpreted to reflect variations preserved in fine-grained nebular carriers, possibly materials that experienced very low degrees of melting during the chondrule-forming process.

To explore the differences between chondrite groups we carried out a similar study on CV3 Vigarano, reputedly the most primitive reduced CV chondrite. A 3-μm focused electron microprobe beam was used to analyze ten elements in 49 spots in each grid area. We excluded data that deviated from the means by >3σ which eliminated large mineral grains as well as holes. About 10% of the points were discarded.

In agreement with earlier studies by Zolensky et al. [2], we found Vigarano matrix to be depleted in S. In chondrites that preserve the nebular record well S in the best elemental tracer of matrix in petrographic studies. In primitive chondrites such as CR2 LAP 02342 S contents in fine grained matrix are about ~4× whole-rock concentrations [1]. In contrast, S in Vigarano matrix is ~0.2× that of the whole rock and the S contents of [2] are a factor-2 lower still. We attribute this major S depletion to the movement of S from fine grained matrix sites to coarse sulfides in the interchondrule area during early thermal metamorphism [3].

The other two volatile elements that were enhanced in LAP are K (3-5× whole-rock) and Na (1.5-3× whole rock). Our Vigarano matrix-grid area show a small enhancement in K (1.1-1.3× whole rock) but a depletion in Na (0.6-0.8× whole rock). These are low despite the fact that we are using the whole rock INAA data of Kallemeyn et al. [4], who observed concentrations that were 30% lower than in other CV chondrites and large differences between replicate analyses. Curiously, our matrix Na contents are about 5× lower than those reported by [2], and ~4× lower than those of [5]. This lack of reproducibility observed in INAA and matrix studies implies that large composition variations are present in Vigarano. both in matrix and in whole rock.

We conclude that Vigarano is not primitive; it does not preserve the nebular record. The missing volatiles from the whole-rock were probably lost during impact processing. We suggest that Vigarano requires both a moderately high petrologic subtype number (e.g., 3.4, the upper end of the range suggested by [6], and a footnote to call attention to the large degree of matrix heterogeneity and the whole-rock volatile loss.

References: [1] Wasson J. and Rubin A 2009. GCA 73: 1436. [2] Zolensky M. et al. 1993 GCA 57: 3123. [3] Grossman J. and Brearley A.2005. GCA 40:, 87. [4] Kallemeyn G. et al. 1981. GCA 45: 1217. [5] McSween H. and Richardson S. 1977. GCA 41: 1145. [6] Bonal L. 2006. GCA 70:1849.