Cr, P AND Si IN THE METAL OF RENAZZO. B. Zanda, M. Bourot-Denise, and C. Perron, Muséum National d'Histoire Naturelle and CNRS, 75005 Paris, France.

The presence of chromite, phosphate and silica/silicate inclusions has been reported in metal grains of H-chondrites (1) and of the CV3 chondrite Leoville (2). The differences in size and chemical composition of these inclusions between different meteorites appeared to be consistent with a common origin as precipitates from solid solutions of P, Cr and Si in Fe-Ni, followed by growth and chemical transformation during metamorphism in the parent bodies. The processes which led to the formation of the solid solutions are not clearly identified. A hint may be found in Leoville, in which P-, Cr- and Si-bearing metal grains were only observed inside chondrules.

We have extended this work to Renazzo, since it is one of the rare metal-rich carbonaceous chondrites of type 2. Our results confirm the general presence of inclusions in chondritic metals, but tend to show that the situation might be more complicated than the simple scheme presented above.

Metal in Renazzo occurs in two major settings: in (FeO-poor) chondrules, or as large isolated grains in the matrix, which can be considered as metallic chondrules. Inside chondrules, metal grains can be dispersed over the volume, or make either rims or cores (3). We have analysed metal from both settings by WDS. All metal grains studied contain measurable amounts of P and Cr, in agreement with (4), while Si is, in most cases, below the detection limit. A few typical analyses are reported in Table 1. Numbers in parentheses are the standard deviations of the concentration distributions in grains from a single chondrule. They reflect the strikingly small width of these distributions, compared to the variability from chondrule to chondrule.

Table 1:

Location	# of grains analysed	Cr (wt.%)	P (wt.%)	Si (wt.%)
in chondrule H2	8	0.36 (0.03)	0.31 (0.12)	<0.01
in chondrule I2	11	1.00 (0.11)	0.33 (0.03)	0.01-0.11
chondrule rim C1	5	0.19 (0.03)	0.18 (0.01)	<0.01
chondrule rim C2	4	0.33 (0.02)	0.46 (0.01)	<0.01
isolated D1		0.30	0.28	<0.01
isolated RM2		0.43	0.22	<0.01

Transparent and often rounded inclusions (5-20 µm), have apparently already been noted by Wood (3). EDS analyses show the presence of Si and O, with the addition, in some cases, of Mg, Al, Ca. The inclusions containing these last elements are usually located close to the metal surface, in regions containing cracks (generally corresponding to crystal boundaries). We believe they result from an alteration after formation as pure silica. Except in one case, no identifiable signal could be obtained with a Raman microprobe. This, together with the rounded shape, may indicate that these inclusions are made of glass. The exception is a 20 µm-inclusion, which yielded the Raman band of cristobalite. Smaller silica inclusions have been observed in one isolated grain (D1 in Table 1) and in all the grains of a chondrule (I2 in Table 1), with rather uniform sizes: 2-3µm in grain D1 (Fig. 1) and ≈0.5µm in chondrule I2 (Fig.2). This last chondrule , unique in our two polished sections, is particularly remarkable: its metal grains, sprinkled with silica inclusions, are reminiscent of what has been observed in OCs (1) and their Cr content is specially high. Note that the presence of SiO_2 inclusions might explain occasional high-Si analyses.

Two types of Cr-based minerals make less conspicuous inclusions. (i) A mineral containing Cr, S, Fe, and no or little Ni, tentatively identified as daubreelite, makes round (1-2µm) inclusions, observed in two isolated grains and all the grains of several chondrules. Apparently the same mineral has been detected in grain D1, where it has a square shape and is associated with the silica inclusions (see upper inclusion in Fig. 1). (ii) A few µm-sized chromites were also found in a large isolated grain, and in the metal grains of 2 chondrules. These inclusions can in no case account for the measured amounts of Cr, which is probably mainly in solution in Fe-Ni, although we cannot reject, at the present stage, the presence of <<1µm inclusions. This remark also applies to P, which we have not detected in any inclusion.

A striking feature of our results is the great homogeneity of the Fe-Ni within each chondrule, with respect to both its dissolved metal content and the nature and size of its inclusions. It has been widely held that P-, Cr-, or Si-rich Fe-Ni is a product of nebular condensation (5,6, in which, however, Renazzo was excluded from consideration). If this were the case for Renazzo, the data presented here would tend to demonstrate that there has been equilibration between the different metal grains inside each chondrule. Alternatively, they might indicate that P, Cr and Si have been integrated into the metal during chondrule formation. Their concentrations, and the type of the inclusions would then reflect the temperature and redox conditions experienced by each chondrule. Going one step further, one could even imagine that the Fe-Ni grains themselves formed by reduction of their silicate environment, during chondrule formation. In the last two hypotheses, the isolated metal grains pose a problem, unless they have been, some time, part of larger chondrules. One has also to explain the coexistence of Si in an oxidised state with Cr and P in apparently reduced states, a situation quite different from what has been observed in OCs and in Leoville (1,2).

References. (1) C. Perron et al., Meteoritics 25, in press. (2) B. Zanda et al., Meteoritics 25, in press. (3) J.A. Wood, Icarus 6, 1, 1967. (4) M.K. Weisberg et al., EPSL 91, 19, 1988. (5) L. Grossman et al., Science 206, 449, 1979. (6) L. Grossman and E. Olsen, GCA 38, 173, 1974.

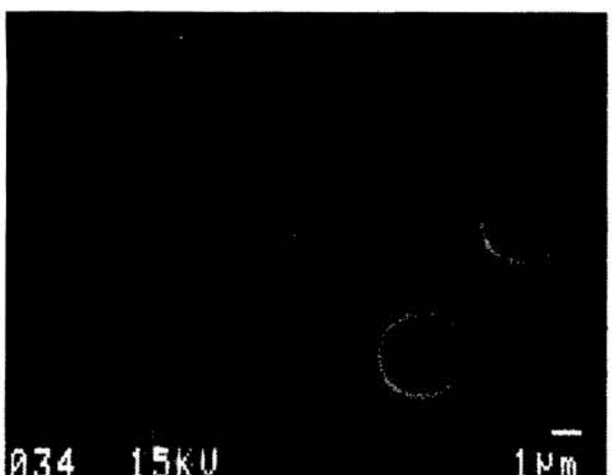

Fig. 1 Silica inclusions in metal grain D1. The arrow indicates a Cr-rich sulphide (daubreelite?).

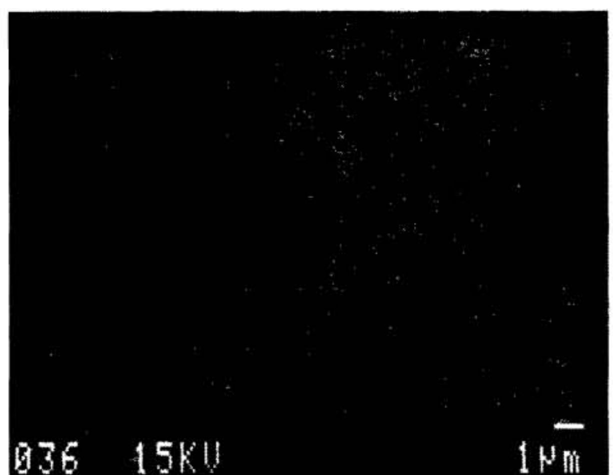

Fig.2 Silica inclusions in a metal grain of chondrule I2.