

VESICLES IN REMELTED CHONDRULES. *Susan V. Maharaj, Alex de la Cruz and Roger H. Hewins*, Dept. of Geological Sciences, Rutgers University, New Brunswick, NJ 08903, U.S.A.

Introduction

The original precursors of chondrules were probably anhydrous silicates, based on the abundance of vesicles in experiments doped with serpentine [1] as compared to natural chondrules which are essentially vesicle-free. Since chondrules may have formed in the protoplanetary disk by a flash-heating mechanism, however, many chondrules were most likely heated more than once. If more than one heating event eliminates all vesicles in chondrules then chondrule precursors could indeed have been hydrous. We have examined the occurrence of vesicles in remelted charges in order to test whether multiple heating events could have obliterated vesicles in chondrules made from hydrous precursors.

Experimental Methods

Experiments were performed on a TIIab/serpentine (50/50) composition [1] at 1500°C and IW-0.5 in a 1 atm Del-tech VT-31-OS vertical muffle-tube furnace. Samples were melted (a) 1, 2 and 3 times for 5 sec, cooled each time at 500°C/hr and quenched at 1000°C in water, (b) 1, 5 and 25 times for 5 sec, pulled and air quenched each time or (c) once for 1/2 hr and 1 hr, cooled at 500°C/hr and quenched at 1000°C in water. Each run was reproduced 2-4 times.

Results and Discussion

Experiments heated for 5 sec and cooled at 500°C/hr contain an average of 87%, 41% and 24% vesicles when heated 1, 2 and 3 times, respectively. Experiments heated for 5 sec and pulled and air quenched contain an average of 70%, 36% and 21% vesicles when heated 1, 5 and 25 times (Fig. 1a), respectively. Experiments heated for 1/2 hr and 1 hr contain an average of 16% and 15% vesicles (Fig. 1b), respectively.

The similar percentages of vesicles (though different number of heating events) between the first two groups of experiments probably reflects the different cooling conditions, as more vesicles would be expected to escape if cooled at 500°C/hr than radiatively to room temperature. The 16% and 15% vesicles after 1/2 hr and 1 hr, respectively, indicates that a significant amount of vesicles would be present even if samples were heated many more times than in this study, as does the marginal 1% decrease in the 1 hr case. It may be argued that the difference in pressure, rather than precursors, between our experiments (1 atm) and chondrules (10^{-3} to 10^{-5} atm) could account for the vesicles. But, vesicles are well known to exist in Ca-Al-rich inclusions [2-5], which were also melted in the solar nebula, and even in some chondrules [6].

Conclusions

High percentages of vesicles are retained in flash-heated, remelted chondrules (melted up to 25x) and chondrules melted for long durations (up to 1 hr) if they are assembled from hydrous silicates. Chondrules, therefore, whether melted once, multiple times, under flash-heating conditions or for an extended period, were made of anhydrous silicates.

References: [1] Maharaj S. V. and Hewins R. H. (1994) *GCA* **58**, 1335-1342. [2] MacPherson G. J. et al. (1985) *GCA* **49**, 2267-2279. [3] MacPherson G. J. et al. (1981) *Proc. LPSC* **12B**, 1079-1091. [4] Beckett J. R. and Grossman L. (1982) *LPS* **XIII**, 31-32. [5] Stolper E. and Paque J. M. (1986) *GCA* **50**, 1785-1806. [6] Zbik M. and Lang B. (1983) In *Chond. Origins* (ed. King E. A.), pp. 319-329, LPI.

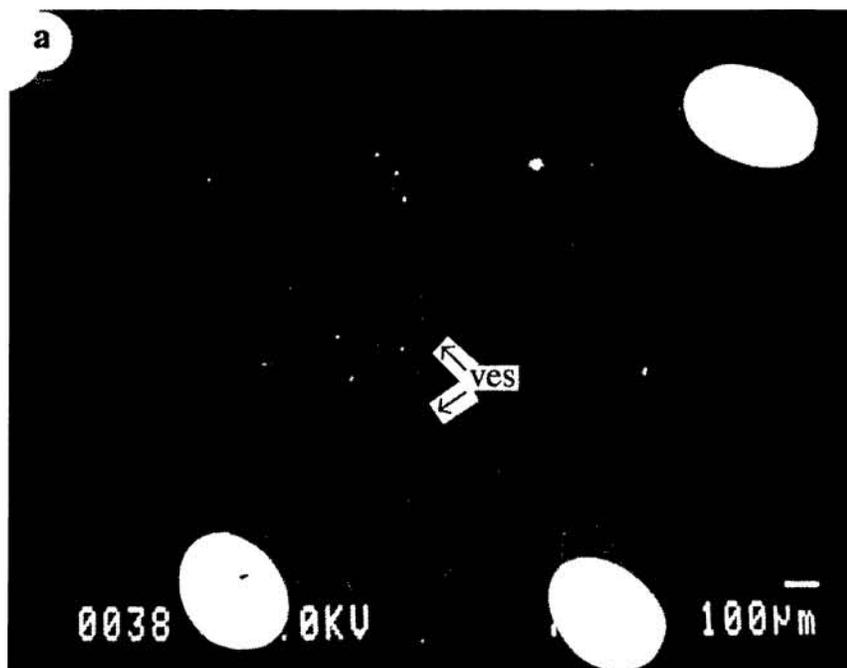
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Figure 1: High percentages of vesicles are retained in (a) flash-heated, remelted charges (melted 25x) and (b) charges melted for long durations (1 hr) if they are assembled from hydrous silicates.

