Attempts to separate the Q-noble gas carrier in Yilmia

Conference or Workshop Item

ATTEMPS TO SEPARATE THE Q-NOBLE GAS CARRIER IN YILMIA. A. B. Verchovsky, M. A. Sephton, I. P. Wright and C. T. Pillinger, PSSRI, Open University, Walton Hall, Milton Keynes, MK7 6AA, UK

Introduction: Recently we have shown [1] that the planetary noble gas carrier (Q-phase [2]) is a distinct physical substance which can be separated from bulk meteoritic carbon. Due to its physical and chemical properties the carrier appears to have a distinctive response to parent body metamorphism. In particular, it is more resistant during reductive metamorphism in enstatite meteorite parent bodies than the major carbon components, e. g. macromolecular material. As a result, most of carbon in enstatite meteorites becomes graphitised while Q remains mostly unchanged. This leads to different combustion temperatures of the phases during laboratory stepped combustion experiments. The higher the temperature of the reductive metamorphism the greater the degree of separation between Q and graphite. The highest separation effect we have observed so far in Yilmia EL6 [1]. In attempt to isolate Q we separated Yilmia HF/HCl residue into several grain size fractions.

Experimental: For the separation we used hexane (0.7 g/cm^3). To separate the coarsest material we used a rapid separation technique collecting non-sedimented material (fraction Y2) in two minutes after sonication of the starting solution. The sediment (fraction Y1) was then separated into fine and coarse fractions (Y1a and Y1b respectively) by rapid precipitation in dichloromethane. Fraction Y2 was then separated into two further fractions (sediment Y2b and supernatant Y2a) by precipitation in hexane for two hours. Finally, Y2a was separated into fine and coarse fractions: Y2a1 and Y2a2. Certain samples were then analysed for Ar and carbon using static mass spectrometry (Finesse [3]) and stepped combustion.

Results: To compare the results for different fractions we normalised the ^{36}Ar contents to the amounts of carbon release. We found that ^{36}Ar from Q is more concentrated in fine grain material, an expected observation in view of previous result [4]. The difference in Ar concentration between the coarsest (Y1b) and the finest (Y2a1) fraction is more than an order of magnitude. However, in spite of apparent success at fractionating the Ar carrier, the expelled separation between the release of ^{36}Ar from Q and the release of carbon from combustion of graphite is limited (Figure). In part this can be explained by the fact that the combustion temperature of the fine-grained graphite is lower than the coarser one. Therefore the releases of ^{36}Ar and carbon in fine-grained fraction are closer to each other. More importantly, however, Q seems to be closely associated with graphite grains by some form of adsorption. Therefore, the size fractions actually represent only graphite grains and the variations in ^{36}Ar concentrations are likely to be due to differences in the number of Q-grains adhering to the surfaces of the graphite. The conclusions following from the results suggest that (i) Q phase consists of extremely small (perhaps nanometre-size) grains, and (ii) to isolate Q we need to physically cleave it from the graphite.

References: 1 A. B. Verchovsky et al. (2001), LPSC XXXII abstr. .#1706. 2. R. S. Lewis et al. (1975) Science 190, 1251. 3. A. B. Verchovsky et al. (1997) MAPS 32, A131. 4. U. Ott et al. (1984) GCA 48, 267.