Noble gases in Tagish Lake

Conference or Workshop Item

NOBLE GASES IN TAGISH LAKE. Monica M. Grady[1], A.B.Verchovsky[2], I.A.Franchi[2], I.P.Wright[2] and C.T.Pillinger[2], [1]Dept. of Mineralogy, The Natural History Museum, Cromwell Road, London SW7 5BD, UK (mmg@nhm.ac.uk), [2]PSSRI, The Open University, Walton Hall, Milton Keynes MK7 6AA, UK.

Introduction: Tagish Lake has been classified as a CI2 chondrite [1] with an interstellar grain abundance enhanced over that of CI1 and CM2 chondrites [2]. Noble gases have been used as markers for the presence of exotic, presolar grains in chondritic meteorites: Xe-HL (nanodiamonds) and Xe-s/Ne-E (SiC). We have measured ^{4}He, Ne, Ar and Xe in whole-rock Tagish Lake, and an orthophosphoric acid-resistant residue, in an effort to define more precisely the relative abundances of the different presolar components present, and to verify whether or not the meteorite has an enhanced complement of presolar diamonds. For comparison, whole-rock samples of Orgueil and Murchison have also been analysed using the same experimental procedure.

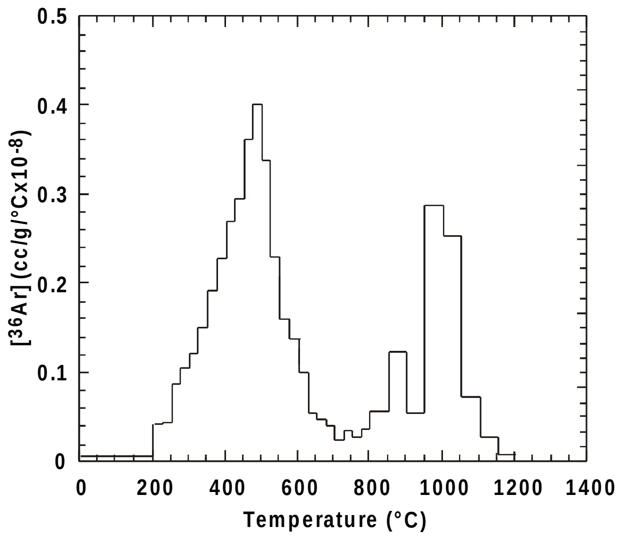
Experimental: a 4.400 mg chip of whole-rock Tagish Lake, and a 1.327 mg powder from the H_3PO_4-resistant residue (remaining from carbonate analysis) were separately combusted in narrow temperature increments from room temperature to 1200ºC. Gases were analysed on the Finesse multiple mass spectrometer system [3]. Nitrogen data acquired simultaneously have been reported earlier [2].

Results: *(i) whole-rock data*. The release of ^{36}Ar with temperature in whole-rock Tagish Lake is shown in the Figure. The [^{36}Ar] total is ~ 135 x 10^{-8} $cm^{-3}g^{-1}$ STP, an amount similar to that in CI and CM chondrites. There are clearly 2, and possibly 3, discrete argon components. The first, accounting for almost 60% of the total ^{36}Ar, has a broad release temperature, between 200 and 600ºC, with ^{38}Ar/^{36}Ar ~ 0.19. A small quantity of ^{4}He was released across this temperature range, but Ne yield was close to blank levels. Above 800ºC, just over 30% of the total ^{36}Ar was liberated, again with ^{38}Ar/^{36}Ar ~ 0.19. This component was accompanied by [^{20}Ne] ~ 250 x 10^{-8} $cm^{-3}g^{-1}$ STP and [^{4}He] ~ 4 x $10^{-5}cm^{-3}g^{-1}$ STP. Based on comparisons with other carbonaceous chondrites, it is likely that the lower temperature component is mainly from combustion of Q, the planetary noble gas-carrier, whilst the higher temperature release is a mixture of planetary, solar and exotic noble gases. The low amounts of gas released at the highest temperatures of the experiment preclude calculation of an exposure age from cosmogenic ^{21}Ne. However, from the low abundance of cosmogenic nuclides, it can be inferred that the exposure age is fairly low.

(ii) Acid residue data. Approximately 20% of the ^{36}Ar was lost from Tagish Lake during dissolution: [^{36}Ar] ~ 108 x 10^{-8} $cm^{-3}g^{-1}$ STP. The higher temperature component has disappeared, confirming probable identification as gas trapped or implanted into silicates. The remaining ^{36}Ar combusts across a narrow temperature interval, 300 - 400ºC. It has ^{38}Ar/^{36}Ar ~ 0.21, and is accompanied by Xe with ^{136}Xe/^{132}Xe between 0.3 and 0.5, and ^{134}Xe/^{132}Xe between 0.4 and 0.5. Total [^{132}Xe] ~ 0.39 x 10^{-8} $cm^{-3}g^{-1}$ STP (relative to whole-rock). This is a lower amount than was reported by Nakamura et al. [4]. It is likely that these are noble gas components associated with the presolar diamond, and are a mixture of Xe-P1 (Q-Xe), Xe-HL, Xe-P3, and possibly Xe-P6 [5].

Summary: the data acquired so far have not yet confirmed our findings that Tagish Lake is highly enriched in presolar components. Tagish Lake certainly contains planetary type noble gases, plus Ar-P3, Xe-P3 and Xe-HL.

Figure: Argon in whole-rock Tagish Lake



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