

TRAPPED NOBLE GASES IN 5 MORE UREILITES AND THE POSSIBLE ROLE OF Q.
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Ureilites are unique among the not-so-primitive, achondritic, meteorites in that they contain carbon (1) and trapped noble gases (2) in quantities even exceeding in some cases those found in the most primitive, carbonaceous, chondrites. Carbon has been found occurring in two forms, as graphite and diamond/lonsdaleite (1), and diamond has been identified as the major host phase of the trapped noble gases (2). Here we report noble gas data for bulk samples from five more ureilites and residues resistant to HF/HCl (Hajmah) and HF/HClO₄ (ALHA78019), resp..

Elemental abundance ratios. In Fig.1 the new data plot in the field defined by previous analyses (2). Various bulk fragments demonstrate variations within one meteorite on a cm scale, adding to the complexity observed in stepwise pyrolysis (3). Even stronger variations were observed in stepwise combustion of the Hajmah HF/HCl residue (Fig.2).

ALHA 78019. This ureilite is a special case, since it does not contain diamonds (4). Analyses by WACKER (5) and ourselves (6) demonstrate that it nevertheless does contain trapped gases (see also Table 1). X-ray analysis of the HF/HClO₄ resistant residue (0.25% of bulk) confirms the absence of diamonds. Combustion of this residue shows that it is essentially free of noble gases (Table 1). Since the lines of graphite were observed in x-ray diffraction, graphite is not the host of the noble gases in this meteorite. They rather must reside in a mineralic phase not releasing its gases by combustion up to 1000°C or in a phase destroyed by HF/HClO₄. The combustion analysis of bulk sample B2 (Table 1) argues for the second explanation to be correct. From comparison with the B1 data obtained using conventional pyrolysis at high temperature it appears that essentially all the trapped gases reside in combustible phases. Comparison of the release pattern upon combustion with that from the HF/HCl resistant residue from Hajmah (Fig.3) shows the major gas release to be at lower temperature (since this is a bulk sample, the

TABLE 1. Noble gases (10^{-8} cm³ STP/g) in bulk ureilite samples and acid-resistant residues from Hajmah (HF/HCl) and ALHA 78019 (HF/HClO₄). Data for bulk sample B2 of ALHA 78019 and residue BR11 were obtained by combustion. The B2 data are preliminary and do not include the Kr and Xe 640°C fractions, which were lost.

sample	³ He	⁴ He	²⁰ Ne	²¹ Ne	³⁶ Ar	⁸⁴ Kr	¹³² Xe
Y74123-F-II	14.9	178	8.69	2.06	924	4.30	2.92
Y74123-II-1	14.6	181	7.47	2.06	544	3.48	1.95
Y790981-I	25.4	191	5.35	4.90	249	1.85	1.64
Nilpena T2	11.2	72	3.56	3.27	56	0.29	0.17
Nilpena II-1	20.1	456	6.83	4.28	173	--	--
Hajmah F-I	2.63	69	3.82	0.315	1754	13.6	9.68
Hajmah F-II	2.54	--	4.91	0.309	503	2.84	1.57
Hajmah F-III	1.42	--	4.08	0.338	2943	14.3	13.7
Hajmah F-IV	1.86	--	3.35	0.280	3162	18.3	8.60
Hajmah II-1	2.22	54	2.33	0.282	1928	8.11	8.53
Hajmah II-2-R4 (res. combust.)	1.27	1421	65.6	0.167	51915	343	211
ALHA 78019-B1	0.086	12	1.20	0.026	118	0.53	0.31
78019-B2 (combusted)	--	--	--	--	194	0.72	0.44
78019-BR11 (res. combusted)	--	--	--	--	14	0.98	0.72

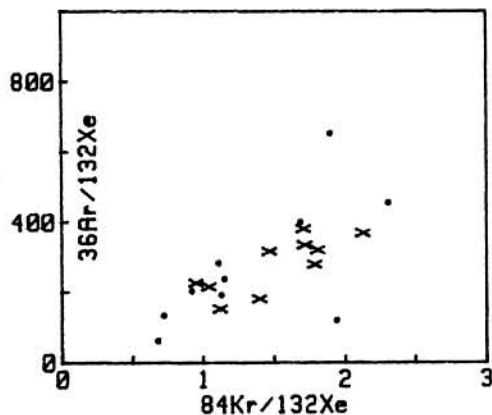


Fig. 1. Elemental abundance ratios in new analyses (X) compared with previous data (•). Bulk samples only.

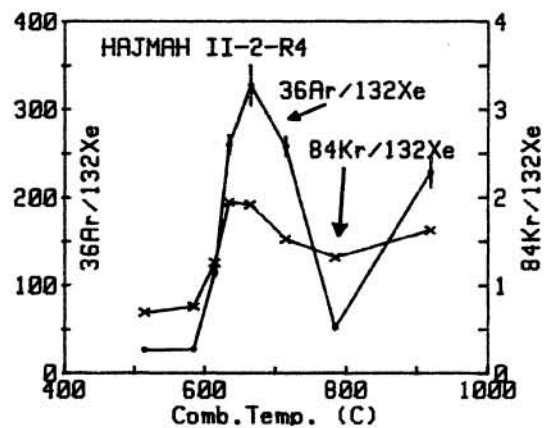


Fig. 2. $^{36}\text{Ar}/^{132}\text{Xe}$ and $^{84}\text{Kr}/^{132}\text{Xe}$ in stepwise combustion of Hajmah HF/HCl residue.

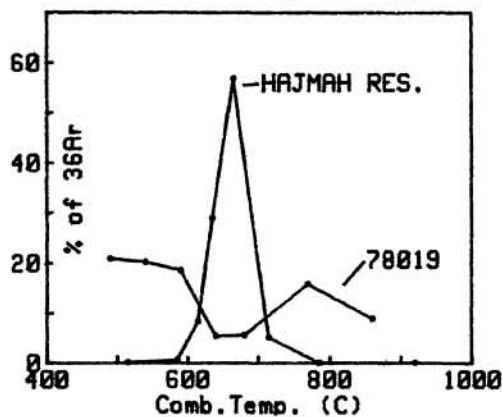


Fig. 3 (left). Release of ^{36}Ar in combustion of Hajmah residue and bulk ALHA78019. From the latter 4.5% were released in a 820°C preheating step without oxygen.

second peak at higher temperature may be due to phases protected from direct attack by oxygen). While in the Hajmah residue release of trapped gases essentially parallels production of CO_2 from combustion of graphite and diamond (these cannot be distinguished; see also (7)), the ALHA 78019 carrier releases its gases in combustion at $T \lesssim 600^\circ\text{C}$ (except for the app-

arently protected phases).

Is Q the host phase? We have repeatedly pointed out the similarity of the noble gases contained in Q and in ureilites. Ne-U (6,8) differs from all other known components of trapped Ne except possibly Q-Ne, which has a similar, but ill-defined ratio $^{20}\text{Ne}/^{22}\text{Ne}$ (9). Other similarities lie in the elemental abundance pattern and the isotopic composition of trapped Xe and possibly carbon (10). Release of noble gases by combustion at $T \lesssim 600^\circ\text{C}$ and solubility in HF/ HClO_4 is observed for Q as well (11), and hence Q may be the host phase of the trapped gases in ALHA78019. On the other hand, if Q is a surface phenomenon rather than a specific phase (12), this similarity may merely indicate that the same process was responsible for noble gas trapping in chondrites and ureilites. Whether a Q phase has acted as a precursor host in the case of the other ureilites, or whether it is actually present (being protected by diamond from chemical attack) is not clear from these data.

References: (1) Vdovykin G.P. (1970) *Space Sci. Rev.* **10**, 483. (2) Göbel R. et al. (1978) *JGR* **83**, 855. (3) Göbel R. et al. (1977) *Meteoritics* **12**, 238. (4) Berkley J.L. and Jones J.H. (1982) *PLPSC* **13**, *JGR* **87**, A353. (5) Wacker J.F. (1984) *Meteoritics* **19**, in press. (6) Ott U. et al. (1984) *Meteoritics* **19**, in press. (7) Grady M.M. et al. (1982) *LPS XIII*, 279. (8) Ott U. et al. (1984) *Proc. 'Isotopic Ratios in the Solar System'*, Paris, in press. (9) Alaerts L. et al. (1979) *GCA* **43**, 1421. (10) Ott U. et al. (1984) *GCA* **48**, 267. (11) Frick U. and Pepin R.O. (1981) *EPSL* **56**, 45. (12) Zadnik M.G. et al. (1984) *subm. to GCA*.