NOBLE GAS STUDY OF THE UREILITES KENNA AND RAMLAT AS SAHMAH 247. R. Trappitsch[1], M. Cosarinsky[1], B. Hofmann[2], and I. Leya[1]. [1]Space Research & Planetary Sciences, University of Bern, CH3012 Bern, Switzerland. [2]Natural History Museum, Bern, Switzerland. mariana.cosarinsky@space.unibe.ch

Introduction: Ureilites are an interesting group of achondrites since they share features of both, fractionated igneous rocks and of primitive meteorites [1]. Particularly interesting is their record of primordial noble gases, which occur in elemental concentrations and isotopic compositions similar to those in carbonaceous chondrites. The main carriers of such gases are presumably carbonaceous materials (e.g., graphite, diamond, amorphous carbon), whose origin is not entirely understood in the context of ureilite petrogenesis. We have undertaken a study of the noble gas records in ureilites with the goals of constraining the origin of their primordial gases, the host phase(s), and the relationship of these gases to phase Q, the carrier of primitive gases in chondrites. Here we present preliminary results of Kenna and Ramlat as Sahmah 247 (RaS 247), a recent find from the Omani desert.

Samples: Kenna is a typical ureilite composed of olivine ($Fa_{20.8}$), commonly rimmed by forsterite (Fa_1), and pigeonite ($Fs_{18}Wo_9$), set in a matrix of three carbon polymorphs (graphite, lonsdaleite, and diamond) plus nickel-iron metal and troilite [2]. RaS 247 is a low-shocked (S2) ureilite composed of olivine ($Fa_{19.6}$), pyroxene ($Fs_{17.4}Wo_{11.2}$), and 16 vol.% of carbon plates, which are ~0.5 to 2 mm long and consist of graphite and diamond [3]. Reduced olivine grains near carbon plates reach compositions ~$Fa_{1.0}$. Metal and troilite are partially oxidized, and mostly occur along grain boundaries and surrounding the elongated carbon plates. Overall, this sample does not appear to be heavily weathered. (Fig. 1).

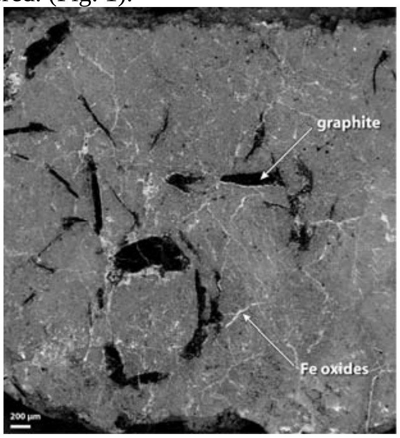

Fig. 1. Backscattered electron image of an unpolished and uncoated flat fragment of RaS 247. Graphite grains (black), easily distinguishable from the silicates (dark gray), are elongated and large (~2 mm long). Fe oxides occur around the graphite grains and along grain boundaries or filling cracks.

Results: Here we present the noble gas concentrations for bulk samples, which were obtained either by one-step pyrolysis at 1700˚C or by stepwise heating extractions (see below). *One-step pyrolysis*: Gas abundances are higher in Kenna than in RaS 247 roughly by a few percent for ^3He and Ne and by up to a factor of >2 for Ar. The most variable isotopes are ^4He and ^{40}Ar, which are higher in Kenna by ~70% and a factor of 4, respectively. These large variations in gas concentrations are common among ureilites, as already reported in the literature [e.g., 4,5].

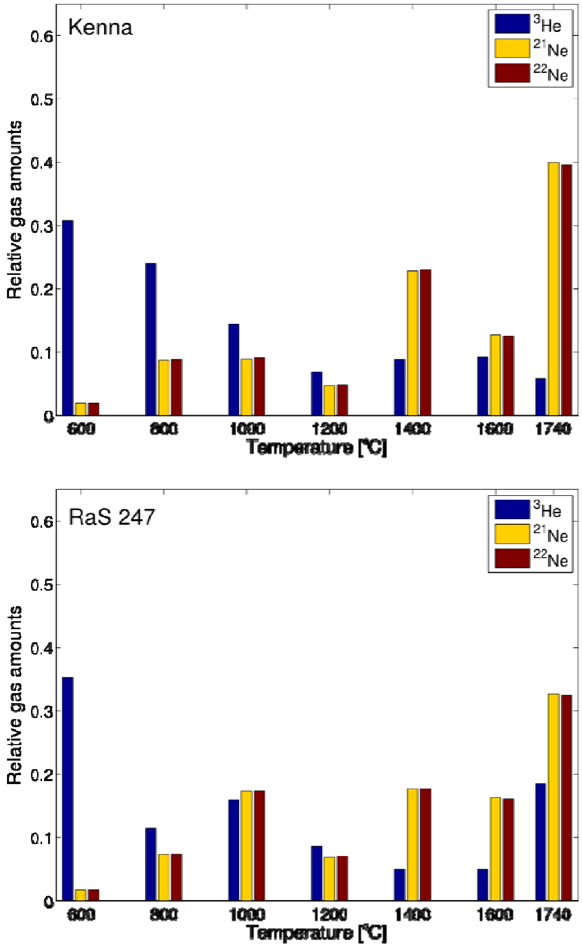

Fig. 2. He and Ne temperature release patterns for Kenna and RaS 247. The He an Ne release suggests their carrier is a phase that breaks up at low temperatures.

Stepwise heating experiments were carried out in seven steps from 600˚C up to 1740˚C with increments of 200˚C. Surprisingly, cosmogenic He and Ne are already released at temperatures around 600-800˚C (Fig. 2). This is in agreement with the He release results of [4]. Conversely, most Ar is released at >1400˚C in both meteorites. As with the bulk results, gas abundances are higher in Kenna than in Ras 247. However, one-step pyrolysis and stepwise heating results do not agree for each meteorite, with the former being higher in RaS 247 and the latter being higher in Kenna.

Discussion: He and Ne noble gases in Kenna and RaS are dominantly cosmogenic; using average values for the trapped and cosmogenic components in ureilites and stony meteorites [4,7,8], the cosmogenic component represents ca. 95% of the total Ne. Because of very low air contamination (Fig. 3), Ar component deconvolution results in most Ar being primordial in composition. Despite weathering effects on Kenna and RaS 247, the air component in these samples is negligible. For RaS this is a rather unusual result since hot-desert meteorites tend to have high ^{40}Ar abundances [6].

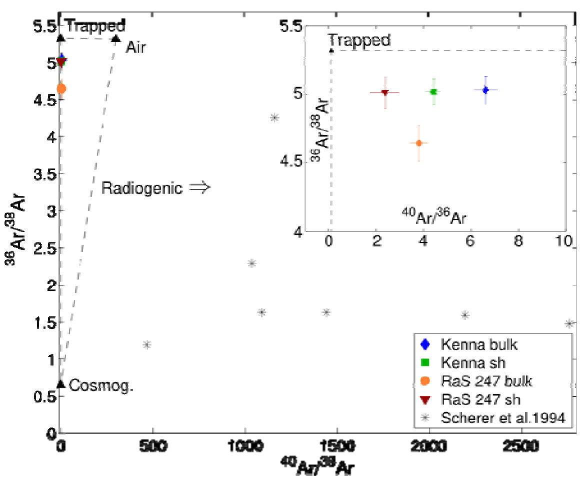

Fig. 3. Argon 3-isotope plot. The Ar in Kenna and Ras 247 is clearly dominated by the primordial component, whereas desert meteorites typically have a higher air component, e.g., [6]. The insert shows an enlargement of the graph where our data plots.

Our one-step pyrolysis and stepwise heating measured concentrations of total He and Ne in Kenna and RaS 247 disagree by 15% and up to a factor of 2, respectively. This variation is much larger than expected given our reproducibility and suggests a strong sample heterogeneity. Furthermore, there is a considerable scatter in published bulk pyrolysis and bulk stepwise heating measurements of Kenna [e.g., 5,9,10]. Given that our results as well as the literature data correspond mostly to cosmogenic gases, it seems likely that the scatter in all the data for Kenna is due to a heterogeneous distribution of the cosmogenic component. The origin of this heterogeneity is still not clear but could be related to variable degrees of weathering throughout this meteorite, resulting in variable losses of cosmogenic gases during, for example, oxidation of metal. However, we cannot completely rule out poor interlaboratory reproducibility as the reason for the scatter in the literature data.

The Ar abundances also show a discrepancy between one-step pyrolysis and stepwise heating results (25-50% variation). Since Ar is mostly primordial, this inhomogeneity is much easier to understand, considering that carbonaceous phases, which are not homogeneously distributed (see Fig. 1), are the dominant carrier phases for the primordial gases.

The large variation in the abundances of ^{40}Ar as well as ^{4}He between the two meteorites Kenna and Ras 247 could reflect loss of the radiogenic component during their time in the parent body, at the ejection from the parent body or afterwards.

The release of both cosmogenic He and Ne at the lowest temperature steps is intriguing. If these cosmogenic gases are hosted in the same phase, then this phase cannot be carbonaceous, as suggested by [4] for the case of He, because the production of cosmogenic Ne requires a target in the mass range of Mg, Al, and/or Si (or heavier). However, a proper identification of the host(s) requires further tests.

We plan on carrying out additional analyses to test the heterogeneity of Kenna on a cm scale by taking four different samples from a single slab, which has a total mass of 35 g. Additionally, we will measure light and heavy noble gases in C-rich acid residues of Kenna and Ras 247, which have been produced by off-line etching, using a step-wise extraction procedure. Doing so we hope to better understand the primordial trapped component. Further analyses will be carried out by stepwise online etching. This procedure should enable us to better constrain the distribution of the different noble gas components and further identify their likely hosts. For such analyses we will also include several other desert meteorites from Lybia and Oman, two of which are still unnamed ureilites.

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