Solar wind Ar, Kr, and Xe abundances deduced from Genesis targets

N. VOGEL[1], V.S. HEBER[2], H. BAUR[1], D.S. BURNETT[3] AND R. WIELER[1]

[1]IGMR, ETH Zurich, Switzerland (nadia.vogel@erdw.ethz.ch)
[2]EPS, UCLA, Los Angeles, USA (heber@ess.ucla.edu)
[3]CalTech, JPL, Pasadena, USA (burnett@gps.caltech.edu)

Introduction

The Sun's composition is a proxy for that of the solar nebula, which serves as a reference baseline in earth and planetary science. The Sun's composition can be inferred by analyzing its outflowing particle stream, the solar wind (SW). The Genesis mission returned targets irradiated with SW for ~2 years [1], which allow to directly constrain modern SW Ar, Kr, and Xe compositions. Such analyses could so far only be made indirectly on SW irradiated regolith samples [2-4].

Results

We analyzed Si targets exposed to the bulk SW. Noble gases were extracted by UV laser ablation. Ar, Kr, and Xe were analyzed together after gas purification. Average isotopic and elemental ratios are $^{86}Kr/^{84}Kr$ ~0.3037, $^{129}Xe/^{132}Xe$ ~1.037, $^{36}Ar/^{84}Kr$ ~2484, $^{84}Kr/^{132}Xe$ ~9.5 [5,6]. A larger dataset will be presented at the conference.

Discussion

Genesis SW $^{86}Kr/^{84}Kr$ and $^{129}Xe/^{132}Xe$ ratios agree well with those from "young" lunar regoliths [3]. This supports the claim [3] that such regoliths carry unfractionated SW. Also the Genesis $^{84}Kr/^{132}Xe$ of ~9.5 agrees with that deduced from lunar data [4]. However, the solar photospheric $^{84}Kr/^{132}Xe$ ratio is ~22 [7], thus, the SW is enriched in Xe relative to Kr [4,8]. The Genesis $^{36}Ar/^{84}Kr$ of ~2480 is identical to the solar photospheric [7,9], but different from the lunar value [4]. This discrepancy might be due to the selection of etch steps used to deduce the lunar SW ratio. Genesis $^{84}Kr/^{132}Xe$ data support elemental fractionation between the Sun and the SW according to the first ionization potential (FIP) [4,8]. However, with respect to $^{36}Ar/^{84}Kr$, Genesis data now indicate unfactionated SW. Thus, to finally rule on the solar composition using SW data, fractionation between the Sun and SW needs to be carefully reinvestigated.

[1] Burnett *et al*. (2003) *SSR*, *105,* 509-534. [2] Heber *et al.* (2001), in *Solar and Galactic Composition*, 423 p. [3] Wieler & Baur (1994) *Meteoritics*, *29,* 570-580. [4] Wieler & Baur (1995) *ApJ*, *453,* 987-997. [5] Heber *et al.* (2008) *AGU, 89,* P42A-08. [6] Vogel *et al.* (2009) *LPSC*, *40,* A# 1964. [7] Lodders (2003) *ApJ*, *591,* 1220-1247. [8] Wieler *et al.* (1996) *Nature*, *384,* 46-49. [9] Lodders (2008) *ApJ*, *674,* 607-611.

Selective analysis of petroleum from single fluid inclusions using femtosecond laser pulses

H. VOLK[1]*, D. FUENTES[1], C. MIESE[2], A. FUERBACH[2], W. KOEHLER[3], N. BÄRSCH[4] AND S. BARCIKOWSKI[4]

[1]CSIRO Petroleum, North Ryde, Sydney, NSW 2113, Australia (*correspondence: Herbert.Volk@csiro.au)
[2]MQPhotonics Research Centre, Macquarie University, Sydney, NSW 2109, Australia
[3]Femtolasers Produktions GmbH, Fernkornagasse 10, 1100 Wien, Austria
[4]Laser Zentrum Hannover e.V., Hollerithallee 8, 30419 Hannover, Germany

Petroleum trapped in fluid inclusions is common in petroliferous basins and its composition provides a unique snap-shot of the fluid composition in the geological past. To date, the chemical composition of individual petroleum inclusions can only be assessed by inference from a combination of spectroscopic and microthermometric methods. However, detailed molecular and isotopic data, which provides information on source and maturity of the trapped oil, can only be obtained by mechanical crushing or thermal decrepitation, followed by solvent or thermal extraction - GC-MS. Using the latter approaches, samples are extracted in bulk and distinguishing the geochemical signature of different fluid inclusion generations in the same mineral is not possible.

In the present study, we demonstrate that high repetition rate femtosecond laser pulses can be used to ablate mineral samples and thus to liberate and analyse petroleum from single inclusions. The Nd:YAG laser of CSIRO's existing laser micropyrolysis – GC-MS system was replaced by a long-cavity, femtosecond oscillator system. Test samples were well-characterised idiomorphic quartz crystals from the Barrandian Basin (Czech Republic) that have been previously analysed by bulk crushing [1]. Micron sized holes were drilled into the quartz to open individually selected inclusions. GC-MS chromatograms show branched, cyclic, aromatic and straight-chained hydrocarbons with carbon numbers ranging from 4 (iso-butane) to 19 (pristane). The distribution of these compounds is similar to that observed by on-line bulk crushing [1], and pyrolysis artefacts such as alkenes and ketones were not detected. Hydrocarbons with higher carbon numbers appear to have remained in the extraction chamber, a limitation that may be overcome by improvements to the inlet system.

[1] Volk *et al.* (2002). *Organic Geochemistry* **33**, 1319-1341.